Oil Price Uncertainty, Sectoral Stock Returns and Output Growth in Nigeria

By

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Declaration of Originality

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Dedication

To God Almighty

who gave me life, strength and opportunity to undertake this programme

To my wife

Ann-Mary "Great Grace" Magnus, for your love, support and sacrifices

To my children

Enangha, Ekhaana, Okhaan and Odaam

who shared in the pains and joys of the many years of this work

To my parents

who sowed in me the seed for greatness and godly aspirations in life

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Abstract

This thesis examines the influence of oil price uncertainty shocks on sector stock return uncertainties and real output and provides new insights on how oil price uncertainty impulses are transmitted to the Nigerian macroeconomy. Five industry sectors namely banking, oil and gas, insurance, food beverages and tobacco, and consumer goods are investigated.

The major contributions of this thesis include the decomposition of the effect of oil price change into sector stocks, application of second moment analysis, utilisation of high frequency micro-data and adoption of more than one econometric methodology. This deviates markedly from previous studies and unveils critical decision making information that was hitherto subsumed under the conventional macro-analysis approach.

Three themes are examined for Nigeria using the multifactor model and the structural vector autoregressive framework. The first focuses on estimating sector stock returns sensitivity to oil price changes; the second analyses the effect of oil price uncertainty shocks on sector stock returns uncertainty, while the third assesses the effect of oil price uncertainty shocks on output growth. Significant policy issues include the overwhelming consequence of the oil price factor, the industry-wide negative effect of exchange rate and the near neutrality of interest rate effect. Evidence of price and exchange rate puzzles are clearly demonstrated. Though this poses a serious threat to the effective conduct of monetary policy in achieving the price and monetary stability mandate, they however, serve as potent tools for economic agents' portfolio selection and management of investment risks.

Suggested policy direction includes monitoring oil price movements, ensuring a stable foreign exchange market, and the removal of structural rigidities such as infrastructural bottlenecks and fuel subsidy programme. This would eliminate the perceived impediments to the effective conduct and implementation of monetary policy as well as enhance the seamless transmission of policy impulses to the economy.

CHAPTER ONE

INTRODUCTION

1.1 Background

The concept of oil price uncertainty has variously been used in the macroeconomic literature to examine several economic phenomena such as the behaviour of investment decisions (Bernanke, 1983 and Pindyck, 1991); monetary policy (Bernanke, Gertler and Watson, 1997; Kilian and Lewis, 2011 and Bodenstein, *et al.* 2012); unemployment (Edelstein and Kilian, 2009, and Davis and Haltiwanger, 2001); demand for real balances (Madj and Pindyck, 1987 and Hanson, *et al*. 1993), and stock market returns (Jones and Kaul, 1996; Agren, 2006; Kilian and Park, 2009; Elder and Serletis; 2010; and Lee, *et al.* 2011).

Of these literature, a considerable proportion is devoted to the oil price and stock market returns nexus owing largely to i) the increasing role of the stock market as a virile source of low-cost long-term investment capital for promoting and accelerating economic growth (Filis, *et al.* 2011 and Park and Ratti, 2008), and ii) the critical role of oil resource in the consumption and production processes of household and firms, especially in the advanced and industrialised economies. Other early theoretical investigations by Hamilton (1985), Olsen and Mysen (1994), Jones and Kaul (1996), Levine and Zervos (1998) Basher and Sadorsky (2006) had focused at examining the behaviour of output growth as stock market returns adjust to oil price evolutions.

Overwhelming evidence from these studies associated changes in oil price with slow output growth, weak financial markets performance, exacerbating inflationary pressures, rising interest rate, depreciating exchange rate and worsening unemployment rate at the macro level (Jones and Kaul, 1996; Agren, 2006; Kilian and Park, 2009; Elder and Serletis, 2010; and Lee *et al.* 2011). From the micro perspective, Bouri (2015) and Jones *et al.* (2004) link future cash flows, company returns and stock dividends directly and indirectly to oil price innovation.

In the literature, oil price change has also been connected with economic recessions (real business cycles), changes in monetary policy, demand for real balances and transfer of income between oil producers and consumers (Madj and Pindyck, 1987; Kim and Loungani, 1993; Mork, 1994 and Kilian, 2014). Bernanke (1983), Pyndick (1991), Elder and Serletis (2010) and Baskaya *et al.* (2013) further opined that unexpected change in real oil price uncertainty, apart from accentuating riskier capital, also stymied economic agents' consumption and investment decisions. According to them, to the extent that real oil price uncertainty is measured by the expected volatility, depending on the structure and degree of openness of the economy, an unexpected change could trigger instability and taper economic growth.

Although, the vicissitudes in global oil price has been traced to several factors, Hamilton (2009), Kilian (2010) and Degiannakis *et al.* (2013) summed them all into three broad structural components. These include the supply-side shocks, representing unexpected changes in global supply (Hamilton, 2003); the demand-side shocks, reflecting the cycles in global oil demand as witnessed in the unexpected growth of the emerging economies of Asia (Kilian, 2008a, b; Kilian, 2009; Filis *et al.*, 2011 and Basher *et al.*, 2012) and the precautionary or speculative demand shock, measuring the unanticipated oil demand, as evidenced in the 2007-2008 oil price surge (Kilian, 2010). Though debates about this dichotomy are rife, Fukunaga *et al*. (2010) noted that oil price shocks are fundamentally triggered by the underlying uncertainty factor surrounding the future availability of the oil resource and that the associated consequences on business cycle and stock market returns are diverse and far-reaching. According to Kilian (2009), oil price shocks are simply symptoms of deeper demand, supply and precautionary shocks, each of which affects oil importers and producers differently.

A cursory examination of extant literature indicate that i) a large proportion focused more on the developed economies than the developing and emerging counterparts, ii) the few existing studies for emerging economies (Adeniyi, 2009 and Olemola, 2006 for Nigeria) generally adopted the macro analyses approach, and iii) the measurement of the sensitivity or exposure of individual sector stock returns to oil price shocks is yet to receive adequate research interest owing to the paucity of data, especially for developing and emerging economies. Highlighting the relevance of sector level studies, Elyasiani, *et al.* (2011:1) opined that such studies "have better risk-return trade-offs; ascertain whether oil price constitutes a systemic asset price risk; are essential for appropriate investment and corporate management decisions; avail individual investors and arbitrageurs the knowledge of the relative sensitivities of industry stock returns to fluctuating oil price; determine the dependence of the sectors on oil industry, that is, reveal the effect of oil price shocks masked by the aggregate stock market effect, and enable investors to fully account for sectoral oil sensitivities when implementing sector-based investment strategies".

These assertions underscore the imperatives for a proper understanding of the dynamics of industry activities for a better reward to investors for holding riskier assets. According to Huang, *et al.* (1996), to the extent that oil price change affects firm's financial or cash flow performance, it invariably affects the individual firm's dividend payment, retained earnings and equity prices. Given the weight of the energy component in the expenditure baskets of firms in Nigeria, the impact of oil price across five industry sectors namely: banking, insurance, oil and gas, consumer goods and food and beverages is investigated. The choice of the sectors is guided primarily by the availability of data, especially after the reclassification of the stock market in 2009, which truncated most of the industry data series[1].

1.2 Justification of the study

The recent oil price instability, traced largely to supply disruptions, surging demands and financial speculations, renders investigation on their relationship and their contribution to economic growth in Nigeria imperative. This is in addition to the growing sophistication and increasing role of the Nigerian stock market and the inceasing integration of the economy to the global market. The improved availability of stock market data for emerging and developing economies is another compelling reason for such a study, especially given its relevance and usefulness for the effective and efficient decision making processes of portfolio managers.

Consequently, the motivation for this research is, thus, four-pronged. First, Nigeria is one of the few oil-exporting countries that are also a massive importer of refined petroleum products. The implication is that the expected benefits from oil price increase are very often neutralised by the recycling of the oil receipt to finance refined petroleum products and other imports. This dependence on oil income to finance imports unduly exposes the economy to oil price shocks and a study that would offer the prognosis of such shocks on the economy would be considered apt and germane. Second, the hitherto traditional macro aggregate and market-wide returns approach adopted by previous studies in analysing the effects of oil price shocks on the stock market inherently subdue information on sector stock sensitivities to oil price changes. This renders the disaggregation or micro approach superior, as according to Arouri, *et al.* (2012:2) "the use of equity sector indices is, in our

[1] The stock market reforms of 2009 reclassified and reduced the number of industry sectors from thirty-three to twelve at the stock exchange in conformity with international industry standards. See appendix 2A for the current market-wide sectors

opinions, advantageous because market aggregation may mask the characteristics of the various sectors". The micro approach, as espoused in this thesis, follows Gogineni (2010:2) arguments that "industry level analysis warrants special attention as each industry differs in its usage of oil and its sensitivity to oil price with respect to the demand for its products and services". The approach has the advantage of highlighting the degree of individual industry level exposure to oil price shocks, reduce investors' risk to the minimum and maximise yields during periods of oil price uncertainty.

The third motivating factor is the use of monthly frequency stock returns data for Nigeria, which addresses the shortcomings associated with previous studies as estimates now reflect the true risk positions of firms and households. These dynamics are concealed and smoothened in low frequency data of previous studies. The fourth factor is the significant contribution the thesis would make to the body of literature on stock market volatility, especially for Nigeria, where though few studies have been devoted to examining stock market reaction to oil price shocks, there are yet studies committed to considering the impact of oil price uncertainty on the sector stock returns uncertainties.

These are critical issues for both regulators and practitioners alike and constitute the fulcrum of this thesis. It is expected that measuring the relative contributions of oil price uncertainty shocks on the returns of the various sectors would provide additional insights to the source of market returns trepidations in Nigeria. This study would not only serve as the springboard for more rigorous research for Nigeria but also contribute to knowledge and fill the existing gap in the literature.

1.3 Objectives of Study

The broad objective of this thesis is to use monthly data to provide hindsight on how oil price uncertainty affect industry stock returns uncertainty and output in Nigeria. Pursuant to this broad theme, the study attempts to specifically:

- Measure the effect of oil price returns on industry stock returns in the Nigeria stock market, determine the presence of oil price asymmetric effect of stock returns and confirm stock returns lagged dependencies to oil price innovations.
- Assess the influence of oil price uncertainty shock on sector stock returns uncertainty at the micro level and evaluate the magnitude and direction of such impact, and
- Determine the contribution of oil price uncertainty shock on stock market returns and output growth in the economy of Nigeria.

Findings are expected to validate anecdotal evidence of stock market volatility sensitivity to oil price shock in Nigeria given the relative weight of oil resource in the economy's revenue basket. Inferences would further serve as useful input for economic agents' (especially investors, risk managers) decision making process on financial assets pricing, portfolio construction and diversification, measurement and management of investment risk in the market. In addition, policymakers and market regulators would find the outcomes of the study helpful in the formulation and conduct of monetary policy as it relates to oil price shocks for improved economic management and regulation.

1.4 Problem Statement

Against the backdrop of the arguments of Lee, *et al.* (1995) and Davis and Haltinwanger (2001) that the effect of oil price across sectors in the stock market is not homogenous, this study pries deeper into the heterogeneous feature of the sectors and measures the degree of exposure of the individual sectors to the vicissitudes of international oil price. The objective is to investigate the possible implications of oil price uncertainty on sector cash flows, dividend and sector returns or yields. It is also intended to highlight how the sector stock returns are indirectly affected by slow output, increased inflationary pressures, rising interest rate and depreciating exchange rate induced by oil price uncertainty shocks as demonstrated in the literature (Jones and Kaul, 1996 and Elder and Serletis, 2010).

The body of literature for Nigeria on these issues is still growing. However, the existing studies[2] are limited in several ways, specifically in the use of low frequency data (quarterly and annual) and the adoption of aggregate analytical approaches. While the first limitation reflected the inability of the studies to capture the inherent dynamics, characteristic of the capital market and oil price movements, the second weakness arguably apportion equal degree of exposure, or oil price risks, to the different sectors of the market. The aggregate approach undermines the heterogeneous and industry-specific features of the individual sectors and their oil resource consumption levels.

Though the prevailing body of research on the contributions of these studies to the conduct of monetary policy and investment decision making processes is substantial, an important facet concerning the measurement of oil price uncertainty and the uncertainties of sectoral stock returns has remained largely outstanding. Indications are that this observation is not peculiar with Nigeria (Aye, 2015) but cuts across emerging market and African economies ostensibly due to the dearth of high frequency sector level data. This thesis, therefore, sets out to address the identified limitations by adopting a disaggregated method to estimate monthly data with a view to contributing to the literature and extending the frontiers of knowledge of the Nigerian economy.

2 Ayadi, *et al.* (2000), Ogiri, *et al.* (2013), Omisakan, *et al*. (2009), Iwayemi and Fowowe, (2010), Adebiyi, *et al.* (2010), Riman, *et al.* (2014), Asaolu and Ilo (2012), ThankGod and Maxwell (2013) and Adaramola (2012) This is elaborated in the literature review in chapter three.

1.5 Methodology

In the literature, a plethora of methods, techniques and approaches to measuring the speed, direction and magnitude of the relative effect of oil price shocks on the macroeconomy have been adopted. Prime among them are the traditional univariate capital asset pricing model (CAPM) introduced by Treynor (1961, 1962) and the three-factor Fama and French (1996) multifactor framework. These models were basically used to assess portfolio exposure or sensitivity to market risk, such as oil price effect on the expected stock returns. Later, Burbidge and Harrison (1984), Mork (1989) and Hooker (1996) used unrestricted VAR to demonstrate the asymmetric relationship for the US economy. Engle (1982), Bollerslev (1986), Bollerslev, *et al.* (1988), Lee, *et al.* (1995), Elder and Serletis (2010) and Bredin, *et al.* (2010) introduced and popularised the GARCH approach to computing the unexpected component and conditional variance of real oil price. According to them, the size and variability of the forecast error variance decomposition explained output growth better than real oil price change or regular forecast error.

King, *et al.* (1994) estimated a multivariate factor model to identify the causes for stock volatility, while Sadorsky (2006) utilised international multi-factor model that allows for conditional and unconditional risk factors for 21 emerging stock markets. Agren (2006) used the popular asymmetric BEKK (1990) model for stock prices for Japan, Norway, Sweden, the UK and the US, while Chang, *et al*. (2009) adopted a multivariate GARCH compared with Lin, *et al.* (2014), which applied VAR-GARCH technique for Ghana. Schwert (1989) and Riman, *et al.* (2014) used the unrestricted vector autoregression (VAR) technique and found weak evidence supporting macroeconomic volatility predicting stock market volatility. Adebiyi, *et al.* (2010) and Tajudeen and Abraham (2010) used structural vector autoregression (SVAR) and autoregressive distributed lag (ARDL), respectively, to analyse the volatility of oil price shocks for Nigeria. For South Africa, Aye (2015) also employed structural VAR framework that accommodate GARCH-in-mean in considering oil price uncertainty in the case of South Africa. Each technique has been found to demonstrate relative strengths and weaknesses, depending on the purpose of the research.

In this thesis, two methods of analyses are adopted namely the multifactor regression framework in the spirit of Khoo (1994), Faff and Brailsford (1999) and McSweeney and Worthington (2008) for Chapter 5 and the structural vector autoregression (SVAR) model introduced by Sims (1980) for Chapters 6 and 7. While the choice for the multifactor model is informed by the ability of the technique to measure sector level sensitivity to oil price movement, the preference for SVAR is based on its ability to meaningfully evaluate and assign economic interpretation to structural parameter estimates for purposes of policy analysis and inference. In addition, the SVAR approach, which is regarded in the literature as the workhorse of empirical macroeconomic and financial analyses, is also a potent technique for measuring the responses of variables to structural shocks; quantify the contribution of structural shocks through forecast error variance decomposition; provide historical decomposition that measure the cumulative contribution of structural shocks to the evolution of each variable over time; and the construction of forecast scenarios (Kilian, 2011).

Oil price uncertainty shock[3] in all cases was modelled as a stochastic volatility process using the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) residuals. This involves the inclusion of the time-varying volatility in the mean equations of the GARCH model to capture the direct effect of uncertainty on the stock market returns. The process allows for the inclusion of the innovation term, in addition to that of the first moment. The conditional

[3] Bloom *et al.* (2011) and Jo (2012) defined oil price uncertainty shock as an unexpected change in the conditional second moment of a productivity innovation process, which result in a sharp and rapid economic decline even though the first moment remains unchanged. In other words, it is the time varying standard deviation of the one period ahead oil forecasting error, which controls the size of unanticipated oil price change. It is also defined as the second moment of a shock process.

variance permits the splitting-up of the sources of uncertainty into anticipated and unanticipated changes, which was evaluated. The impact of changes in oil prices uncertainty or volatility on the industry stock returns was investigated to ascertain the direction, magnitude, timing and duration of response. In Chapters 6 and 7, the impulse response function, forecast error variance decomposition and historical decomposition analyses are used to extract the major contribution of oil price shocks to variations in sector stocks returns uncertainty. This approach introduced some elements of dynamism where the uncertainty indicators in the model are allowed to depend on each other and capture the behaviour of variables within the system upon the introduction of an exogenous shock.

1.6 Scope of the study

The choice of the study period from January 1997 to March 2016 is primarily constrained by the availability of data. The nascent nature of the market, prior to financial reforms of the 2000s, limited the duration and the frequency of data as well as the sample size used in the estimation process. However, this period witnessed four major episodes of oil price change as well as significant developments in the stock market activities that informed its choice. For instance, the period 1997 to 2003 coincided with low but stable international crude oil price (US$22.7 per barrel). The second episode (2004 – 2007) witnessed oil price increase that averaged US$77.4 per barrel (BP, 2012). The third episode (2008 – 2009), reflected the period of the Global financial crises, which recorded a considerable decline in the price of crude oil (US$34.0 per barrel), coupled with a crash in the stock prices across the globe.

The fourth regime was the post-global financial crisis (2010 to 2016) that witnessed sluggish recovery in the global economy, particularly stock and oil prices[4]. The choice of oil price and stock returns is guided by the theoretical

[4] This will be discussed in detail in later Chapter

argument that stock prices, which equal the discounted expectation of future cash flows, are affected by macroeconomic movements that are in turn influenced by oil price shocks. According to Agren (2006), to the extent that increases in oil price reduces economic agents' disposable income, it serves as inflation tax on consumers, thereby reducing aggregate demand and lower company income and dividends.

1.7 Structure of the study

This thesis is structured into eight chapters. Following the introduction is Chapter two, which highlights the stylised facts on the developments in the oil price and stock market as well as their interlinkages. In Chapter three, related theoretical and empirical literature are reviewed with emphasis on the oil price relationship at the macro and sector levels and the oil price transmission mechanism. Chapter four focused on the review of methodological approaches in the literature, including the assessment of data properties, preliminary tests, including unit root and stability tests. Data transformation processes as well as the models representation are also components of this chapter.

In Chapter five, three regression models are estimated to investigate the effect of oil price returns on sector stock returns. Chapter six analyses oil price uncertainty shock on stock returns uncertainty using impulse response function and historical decomposition. Chapter seven evaluates oil price uncertainty from the aggregate economy perspective with the inclusion of key macroeconomic variables, particularly credit to the private sector and output. The final chapter highlights major findings of the study, contributions and recommendations for regulators and investors. The identification of areas for further studies and the conclusion of the study are also issues considered in this chapter.

CHAPTER TWO

SYNOPSIS OF STOCK MARKET AND OIL PRICE DEVELOPMENTS IN NIGERIA

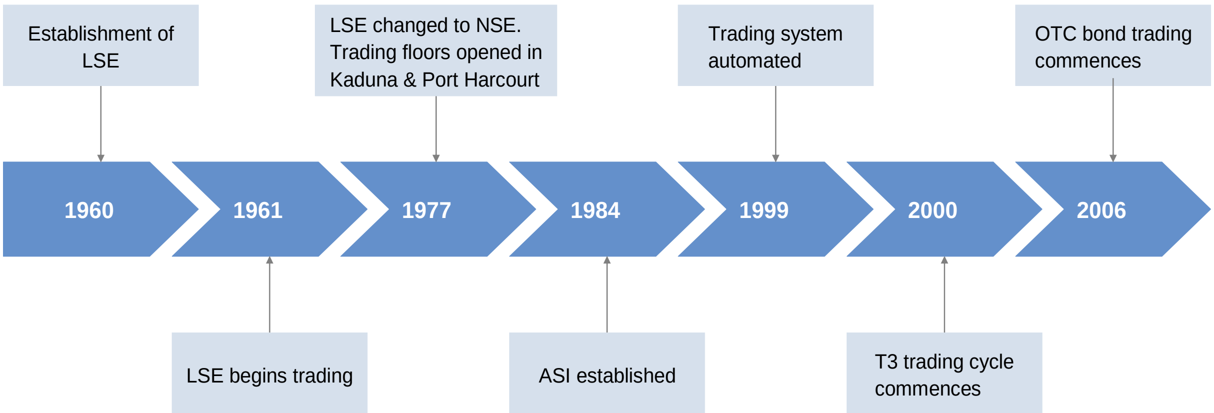
2.1 Overview of the Nigerian Stock Market

The Nigerian Stock Exchange (NSE), hitherto referred to as the Lagos Stock Exchange, was conceived with the primary objective of harnessing and channelling latent domestic savings for high-yielding investable projects in the economy (Osaze, 2007). Prior to its establishment, this developmental function was solely undertaken by the British colonial government, which mobilised and channelled domestic savings to the financing of local government administration, provision of economic and social infrastructure and the investment of the surplus on the London Stock Exchange. To domesticate this function with a view to engendering growth, several ordinances, including the Government and Other Securities – Local Trustees Powers Act, 1957; the General Loans and Stock Act, 1957; the Local Loans – Registered Stock and Securities Act, 1957; and the Central Bank of Nigeria Act, 1958 were promulgated. These provided the requisite legal and institutional architecture needed for the establishment of a virile and growth-engendering capital market in Nigeria, as a precursor for economic independence.

With the legal infrastructure in place, the Lagos Stock Exchange was established and commenced operations in 1961 with 19 listed securities made up of 3 equities, 6 Federal Government Bonds and 10 industrial loans. The fewness in number of listed companies at inception was largely due to the exclusion of foreign participation. This is in addition to the extant repressive market policies such as the placement of caps on share price, weak infrastructure, low volume and value of transactions, and the incessant market illiquidity (SEC, 2009). These factors constrained the market's capacity to support the needed economic growth.

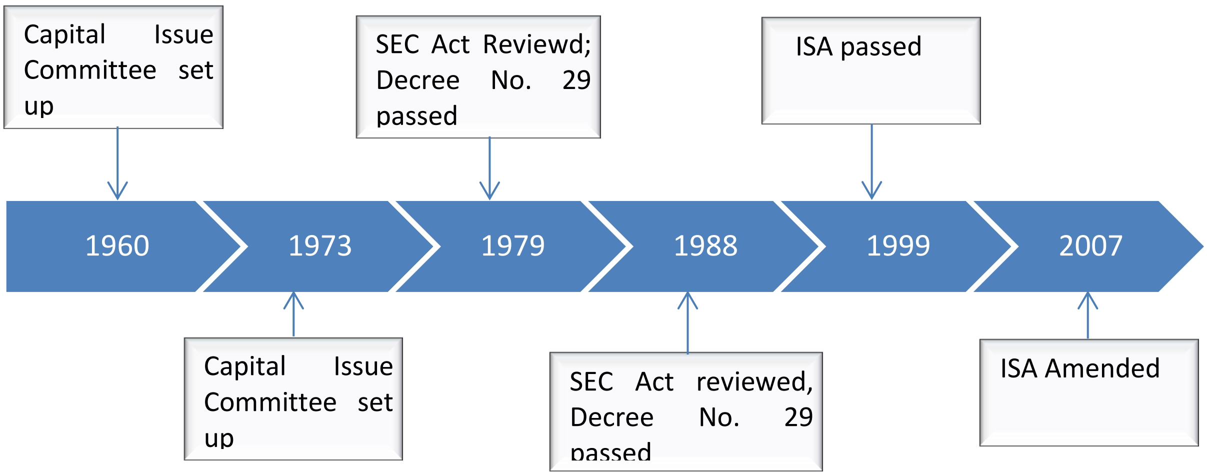
In order to circumvent these limitations, and in line with the Indigenisation Act of 1977, the Lagos Stock Exchange nomenclature was changed to the Nigerian Stock Exchange (NSE) and subsequently licensed under the Investment and Securities Act (ISA). It later became a registered company limited by guarantee in 1990. With only 2 trading floors in 1980, the NSE grew steadily to become one of the largest financial centres in the sub-Saharan Africa with 14 trading floors opened at major commercial cities in the country as at 2015 (NSE, 2016). Listed companies on the Exchange represent a cross-section of the economy, ranging from agriculture through manufacturing and services, some of which have foreign and multilateral affiliations. The NSE was further empowered by Decree to establish exchange commission in order to deepen the operations of the Nigerian capital market (SEC, 2009). Figure 2.1 and 2.2 highlights some of the milestone reforms of the NSE since inception and the evolution of the Nigerian capital market.

Figure 2.1: Landmark Development of the Nigerian Stock Exchange



Source: SEC (2009)

Figure 2.2: Evolution of the Nigerian Capital Market



Source: SEC, 2009

With a view to fostering growth through the market, the non-statutory Capital Issue Committee, established in 1962, was transformed into the Securities Exchange Commission and then to the Securities and Exchange Commission (SEC) in 1979 to regulate capital market operations. The SEC, which is the apex regulatory body of the NSE, was vested with the regulatory oversight functions to forestall infractions of market rules; and detect as well as deter unfair manipulations and unethical trading practices in the market in consonance with the provisions of the Investment and Securities Act (ISA) of 1999. It was the responsibility of SEC to also provide institutional support to facilitate the issuance process, pricing and timing of securities offered; protect investors' and stakeholders' interest; and promote sustainable development of the market. To ensure and reinforce international best practices, the NSE is not only a founding member of the African Stock Exchanges Association (ASEA), but also an affiliate member of the World Federation of Exchanges (WFE).

The Nigerian stock exchange (hereafter referred to as the 'Exchange') operates automated trading system (ATS) where electronic clearing, settlement and delivery (CSD) services are provided through the central securities clearing system (CSCS) platform. The CSCS was incorporated in 1999 to ensure market efficiency and an investment-friendly business environment. Following the deregulation of the financial services sector in 1993, the Nigerian capital market was also deregulated in the same year with the prices of new and secondary shares jointly determined by the issuing houses and stockbrokers.

Though the Nigerian stock exchange currently has about 14 electronic trading floors, spread across the geopolitical zones of the country, the Lagos floor remains the most dominant and enterprising, accounting for about 98 per cent of trading activities, while the Abuja trading floor accounted for the balance. The near zero participation at the equity market by a large number of the trading floors suggest the extent to which a significantly huge proportion of the population is excluded from active participation at the market. This confirms Yartey (2008) assertions that stock market capitalisation has very little to do with the size of the country. The near - zero participation compares abysmally with the 1.4 per cent for India, 9.4 per cent for China and 7.4 per cent for South Korea (Ghosh and Kanjilal, 2014). The low retail investor participation connotes the minimal contribution of financial inclusion to economic growth, in spite of the special trading window created to encourage SMEs participation, aggressive market penetration and the harnessing of latent resources in this segment of the market.

The Nigerian Exchange is broadly categorised into equities and Bond market segments. While the bond market consists of industrial or corporate (debentures/ reference), Federal, State Government securities and municipal, and Supranational bonds, the equities segment is classified into the Main Board, Alternative Securities Market (ASeM) and Exchange Traded Products segments. The Main Board is further segmented into three tiers, namely the large, medium and small scale companies, differentiated essentially in their listing conditions. Though the three tiers officially list securities, the third-tier is a special window designed to cater for the peculiar needs of the small and medium scale enterprises for ease of access to long-term funds (SEC, 2010). It was also established in line with the vision to broaden and deepen the participation base at the second tier securities market through the relaxation of the stringent listing conditions and cost to facilitate SMEs' access to the market. Without prejudice, this study focused on equities, which according to SEC (2009), accounted for 68 per cent of the listed companies cutting across all sectors of the market.

A stock market is typically a reflection or embodiment of the structure and nature of the economy. For instance, for technology-based economies such as the USA, the most capitalised firms on the Exchange are usually the technology-related firms, while on the London and South African Exchanges, the most capitalised firms are those from the financial and mining sectors, respectively. For Nigeria, the most capitalised firms in the last decade, especially after the banking sector consolidation of 2005, are the financial firms comprising mainly of commercial banks. Accounting for approximately 56 per cent of the total market capitalisation, prior to the global financial crisis, the sector significantly dictate the amplitude of activities and fortunes on the Exchange. Also, 15 out of the 20 most capitalised companies on the Exchange were banks, while 10 banks out of 89 accounted for 52 per cent of total assets, 54.4 per cent of total deposit liabilities and 43 per cent of total credit, prior to the banking sector consolidation exercise (CBN, 2015).

This market structure was not only lopsided and oligopolistic in nature but also one that unduly exposed the market to the vagaries of the financial sector activities. These made the pursuit for stock exchange market reforms compelling given that the market was also characterised by incessant boardroom squabbles, unethical and insider dealings, shallow depth/breadth, high transaction cost, financing of margin loans for the oil and gas sector, cumbersome market process and relatively low market liquidity relative to other developing economies (SEC, 2009). Reform measures, thus, focused at realigning the financial system with the principal tenets and pillars (liberalisation and deregulation policies) of the Structural Adjustment Programme (SAP) for the effective transformation and resuscitation of the ailing economy.

Consequently, three (3) Discount Houses (DHs) were established in 1992 to promote and develop the primary and secondary market for government securities; the Foreign Exchange (Monitoring and Miscellaneous Provision) liberalisation policy, was introduced to provide for free capital mobility; and the Debt Management Office (DMO) was established in 2000 to centrally coordinate the country's debt profile and transform it into assets for the growth and development of the economy. These functions were hitherto carried out by several government agencies without proper coordination.

At the NSE, the market-wide reforms of 2009 focused at repositioning the market; structurally re-aligning it with the fundamental realities of the economy; entrench transparency and efficiency as its operational hallmarks; and to make it internationally competitive, particularly in the African sub-region. A principal component of the reforms was the industry/sector reclassification exercise envisioned to bring the market in conformity with international industry standards; reflect the peculiarities and structure of the domestic economy and the stocks listed on the Exchange. Based on a sectoral survey analysis report on the Nigerian stock market that showed 21 out of the 33 industry sectors contributing approximately zero per cent to the total market capitalisation (NSE 2011), the 33 activity sectors were, thus, streamlined to 12 industry sectors only[5].

This new structure, however, failed to whittle the dominance of the financial services industry, as the sector still accounted for a huge 40 per cent of market

[5] See Table 2A in the appendix for the reclassified industry sectors

capitalisation, followed by consumer goods (29 per cent), industrial goods (20 per cent) and oil and gas (5 per cent) (NSE 2011). The Nigerian bourse reviewed the number and composition of the NSE Indices, which currently stand at 10[6], out of which 5 sectoral indices are used in this thesis. The sectoral indices comprise of the most capitalised and liquid companies in the sector developed with a base value of 1,000 points and designed to provide investible benchmarks to capture the performance of specific sectors.

Market responses to the reform measures were immediate and phenomenal. The SEC Committee Report on the Nigerian Capital Market, noted that the "value and volume traded at the market grew at an average annual compounded rates of 176 per cent and 153 per cent, respectively" (SEC 2009:22). The Report attributed the unprecedented development to several factors, including market deregulation, which assumed market-determined pricing; socio-political stability following the emergence of democratic governance in 1999; and the financial sector reform that led to the consolidation of the banking and insurance sectors (2004 – 2007). Other complementary factors such as market efficiency, increased savings/ investment culture and the existence of an investment-friendly economic environment were also identified as stimulants that further reinforced market growth trend.

The Exchange also witnessed significant growth in the number of listed companies, rising from 19 at inception to 240 and comprising 99 equities and 141 debt securities (SEC, 2009). This further grew to 260 and 264 in 2000 and 2010 made up of 195 and 217 equities and 65 and 47 debt securities, respectively. With strengthened investor confidence, total capital inflows rose from US$6 billion in 2010 to US$20 billion in 2014 even as the country's FGN bonds got listed in the JP Morgan Government Bond Index for Emerging

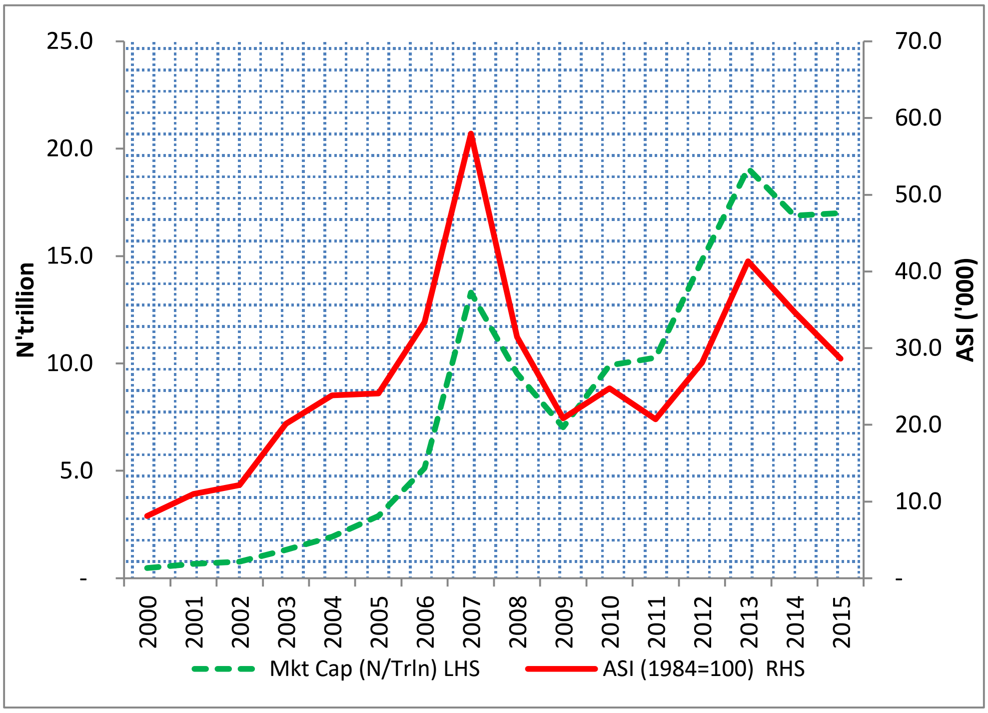
[6] NSE All Share Index (ASI), NSE 30 Index, Banking, Consumer Goods, Industrial Goods, Insurance, Oil and Gas, Pension, Lotus Islamic and ASeM Indices.

Markets in 2012. Hence, the period between 2012 and 2014, witnessed the largest equity portfolio investment, representing over 70 per cent of total capital inflows, and surpassing foreign direct investment (Kale, 2016). Tangentially, the number of active dealing members rose to 234, while issuing houses and listed equity companies increased to 28 and 199, respectively, categorised into 12 industry sectors and served approximately 5 million investors. In 2011, foreign investors accounted for 81 per cent of total capital inflows, same as total external financing to developing nations during 1999 – 2003 (Onyema, 2012), while the ratio of foreign transaction had consistently outperformed the domestic transactions since 2011 (NSE, 2016).

By the same token, market capitalisation increased considerably by approximately 300 per cent, rising from ₦472.5 billion or 7.0 per cent of GDP in 2000 to ₦1.3 trillion or 13.4 per cent of GDP in 2003 and further to ₦13.3 trillion or 64.4 per cent of GDP in 2007 (sees Figure 2.3). Though the Exchange was reckoned as the 2nd largest financial centre in the sub-Saharan Africa and the 3rd largest in Africa by capitalisation (US$75.8 billion) in 2012, its ratio to GDP was, however, diminutive compared with the ratio of 190 per cent for South Africa, 914 per cent for Hong Kong, 224 per cent for Singapore, 160 per cent for Malaysia and 126 per cent for Taiwan (Hassan, 2013). This underscores the virile role of the stock market as a major channel for foreign capital inflow, as well as the mobilisation of domestic savings for economic growth and sustainable development.

Similarly, the All-Share Index (ASI), which measures the movement in the composite value of all common stocks listed in the stock exchange, improved significantly, from 8,111 points in 2000 to peak at 57,990 points in 2007. However, activities at the floor of the Exchange weakened considerably following the divestment by foreign portfolio investors, panic dumping of shares, asset switching in favour of real estate and money market instruments and speculative activities occasioned by the global financial crisis of 2007.

Figure 2.3: Market Capitalisation (N'trln) and All Share Index (2000 – 2015)



Source: CBN Annual Report and Statement of Accounts (Several Editions)

The effect was the immediate and severe decline in market capitalisation that crashed to a decade low of ₦7.03 trillion in 2009 (28.4 per cent of GDP), compared with 64.4 per cent of GDP recorded in 2007. Concomitantly, the ASI fell by 45.8 per cent to close at a trough of 31,451 points in 2008 and declined further to an average of 22,109 points between 2009 and 2011 (SEC 2010). These developments were offshoot of the recession that beset the global capital market in the face of declining share prices, driven by waning investors' confidence in the market.

However, the relative stability that prevailed in the aftermath of the global financial crisis, gradually rebounded the market, buoyed by the economic and political stability that engendered sustained steady recovery and growth. Other ancillary government initiatives in the area of pension fund reforms and the continued banking and insurance sector reforms contributed in no small measure to the sharp recovery. With the pension reforms providing a new pool of long-term investible funds of up to ₦125 billion annually, and the banking and insurance reforms raising the capital structure of the banks by 1,150 per cent from ₦2 billion to ₦25 billion to create additional credit space for more meaningful contribution to the growth of the capital market, finance project and infrastructure as well as asset securitisation, growth indicators once again resume upward trends (SEC, 2009). Through mergers and acquisitions, the number of banks and insurance companies reduced markedly from 89 and 104 to 24 and 49, respectively, (NAICOM, 2008). These served as supports and, to a large extent, contributed to the Partial immunity of the economy from the initial effect of the global financial crisis and the quantitative interventions by the government to keep the economy afloat.

A cursory review of the performance of the NSE vis-a-vis selected markets in the sub-Saharan region reckoned the Nigerian stock market as the fastest growing and the fourth largest, in terms of market capitalisation, only after South Africa, Egypt and Morocco (CBN 2010). This was premised on the Exchange's recording of over a 100 per cent increase in turnover ratio between 2006 and 2008, the highest in the African region, and the growth in volume and value of shares from 36.8 and 78.9 per cent in 2006 to 278.4 and 346.5 per cent in 2007. Table 2.1 depicts market capitalisation (in US dollars) and the number of listed companies of some selected stock exchanges in Africa.

Table 2.1 shows mixed outcome in the number of listed stocks in the selected Exchanges before and after the global financial recession. For instance, while the two leading Exchanges of South Africa and Egypt had the number of listed companies pruned from 403 to 352 and 792 to 227 in 2004 and 2010, respectively, Nigeria and Morocco, on the other hand, recorded additions from 207 and 52 to 215 and 73, respectively, during the same period. By 2016, while Egypt witnessed a rise to 251 listed companies, Nigeria and South Africa had declined to 169 and 303, respectively. Total number of listed companies decline by 37.0 per cent, falling from 1,524 in 2004 to 960 in 2010 and further to 872 in 2016, respectively.

Table 2.1: Market Capitalisation and Listed Companies of Selected Stock Exchanges in Africa (2004 - 2016)

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Egypt	Mkt Cap (US$bn)	38.52	79.67	93.48	139.27	85.98	91.21	84.28	48.85	59.18	61.63	70.08	55.19	33.32
	Listed Companies	792	744	603	435	373	312	227	231	234	235	246	250	251
	Mkt Cap/GDP (%)	49.00	89.00	87.00	106.70	52.80	48.30	38.50	20.70	21.40	21.50	23.20	16.7	16.7
Ghana	Mkt Cap (US$bn)	2.64	1.66	3.23	2.40	2.84	2.43	2.95	3.09	3.46	na	na	na	na
	Listed Companies	29	30	32	29	31	31	31	29.00	29.00	na	na	na	na
	Mkt Cap/GDP (%)	30.00	15.00	16.00	9.70	10.00	9.30	9.20	7.80	8.00	na	na	na	na
Nigeria	Mkt Cap (US$bn)	14.46	19.36	32.82	84.89	48.06	32.22	50.56	39.03	56.21	80.61	62.77	49.97	29.79
	Listed Companies	207	214	202	211	212	214	215	196	189	188	188	183	169
	Mkt Cap/GDP (%)	16.00	17.00	23.00	51.00	23.10	19.00	13.80	9.50	12.30	15.80	11.50	10.8	na
Morocco	Mkt Cap (US$bn)	25.06	27.22	49.36	75.49	65.75	62.91	69.15	60.09	52.48	53.83	52.75	45.93	57.58
	Listed Companies	52	56	65	73	77	76	73	75	76	75	74	74	74
	Mkt Cap/GDP (%)	44.00	46.00	75.00	100.00	74.00	69.00	74.20	59.30	53.40	50.40	48.00	45	na
South Africa	Mkt Cap (US$bn)	455.54	565.41	715.03	828.19	482.70	799.02	925.01	789.04	907.72	942.81	933.93	739.95	951.32
	Listed Companies	403	388	401	374	367	353	352	347	338	322	322	316	303
	Mkt Cap/GDP (%)	208.00	229.00	274.00	276.60	168.30	270.00	246.40	189.50	229.00	256.50	265.80	234	234
Mauritius	Mkt Cap (US$bn)	2.38	2.62	3.59	7.92	4.66	6.58	7.75	7.85	7.18	8.94	8.75	7.24	7.57
	Listed Companies	41	42	41	67	65	64	62	63	60	63	66	71	75
	Mkt Cap/GDP (%)	37.00	42.00	53.00	92.20	46.70	72.10	77.50	68.10	61.50	73.70	68.30	62	na
Total	Mkt Cap (US$bn)	538.60	695.94	897.51	1138.16	689.99	994.37	1139.70	947.95	1086.23	1147.82	1128.28	898.28	1079.58
	Listed Companies	1524	1474	1344	1189	1125	1050	960	941	926	883	896	894	872
	Avg.Mkt Cap/GDP (%)	64.00	73.00	88.00	106.03	62.48	81.28	76.60	59.15	64.27	69.65	69.47	61.42	41.78

Source: The World Bank, World Development Indicators: Stock Market (2017)

Total market capitalisation, witnessed significant rise from US$538.6 billion in 2004 to US$1,139.7 billion and US$1,147.8 billion in 2010 and 2013, respectively, but moderated downward to US$898.3 billion in 2015 and closed at US$1,079.6 billion in 2016. Interestingly, market capitalisation for all Exchanges recorded relative growth albeit at slower rate for some. The average ratio of market capitalisation to GDP for all Exchanges steeped steadily from 64.0 per cent in 2004 to 106.03 per cent in 2007 but consistently receded thereafter to 41.8 per cent in 2016. Generally, all markets showed signs of recovery from 2012, except for Morocco. Total market capitalisation and the number of listed companies for the selected Exchanges, during the sample period, witnessed deep plunge in 2008, reflecting the effect of the recession occasioned by the global financial and economic crises. Comparatively, Nigerian indices were salutary and displayed signs of appreciable improvements, replicating the general recovery of the economy after the financial and global crisis of 2007.

2.2 Oil Price and the Nigerian economy

Nigeria is ranked by the US Energy Information Administration (EIA, 2015) as the highest crude oil producer in Africa with an estimated proven crude oil reserve of 37.2 billion barrels as at 2013, the second largest in Africa, after Libya. Nigeria is also reckoned as the continent's largest holder of natural gas, the ninth largest holder in the world and the fourth leading global exporter of liquefied natural gas (LNG) in 2015. According to the IMF, as cited by EIA (2013) the oil and gas sector contributes about 25 per cent of Nigeria's GDP, 75 per cent of general government fiscal revenue, and accounted for over 90 per cent of total exports.

Prior to the commercial exploration of crude oil, the Nigerian economy was predominantly agrarian with the agricultural sector accounting for 64.1 and 47.6 per cent of GDP in 1960 and 1970, respectively, (CBN, 2015). However, the structure of the economy was significantly altered following the inflow of petrodollars from crude oil exports in the mid-1970s. This reduced the share of agriculture in GDP to about 33.6 per cent in 1981 paving way for the oil sector dominance of foreign trade (accounting for about 75.7 and 60.5 per cent), total export receipts (98.2 and 92.5 per cent) in 2006 and 2015, respectively, and as the major source of foreign exchange earnings (CBN, 2015).

The consequence is the undue exposure of the economy to external shocks propagated by oil price movements as demonstrated during the global financial crisis and the recent trends in the foreign exchange market in Nigeria. The generally downward trend in the contribution of oil to trade and the economy, is a reflection of the declining crude oil production (upstream) and refining (downstream), which has persistently suffered serious disruptions over the decades. Some of the daunting challenges confronting the oil sector in Nigeria include, but not limited to significant decline in global demand, especially from the US, persistent attacks and vandalism of oil infrastructure, massive oil theft, aging infrastructure, poor maintenance, natural gas flaring, incessant fire outbreaks, surging security challenges, and militancy and youth restiveness in the Niger Delta region. Consequently, domestic crude oil production, which peaked at a decade high of 2.44 million barrels per day (mbl/d) in 2005, consistently declined to about 1.8 mbpd in 2009, while the refineries' operating capacity similarly dwindled (EIA, 2014).

Though the combined installed refining capacity of the four existing refineries at 445,000 barrels per day (bbl/d) far exceeded the domestic consumption requirements, the EIA report noted that the four refineries jointly operated at capacity utilisation rate of 22 per cent in 2013. With domestic consumption estimated at 270,000 barrels per day (bbl/d) as at 2012, the OPEC (2013) Statistical Bulletin reports that, Nigeria imported more than 31.1 per cent (84,000 bbl/d) of refined petroleum products to bridge the yawning supply gap in 2012. In 2013 and 2014, the 164,000 and 305,000 bbl/d petroleum products consumed, respectively, were, as in many other years, imported.

This constitute a significant fiscal shock to the economy as the government had in 1978 instituted the fuel subsidy policy where petroleum products (locally produced or imported) are dispensed at below market prices as safety nets for the poor as well as the protection of the emerging industrial sector from the vagaries of international oil prices. Unfortunately, the laudable fuel subsidy programme turned out to be a source of huge revenue leakage as a result of corruption and mismanagement. In 2011, for instance, the cost of subsidies was estimated at US$11 billion, representing 30 per cent of government expenditure, 4 per cent of GDP, and 118 per cent of the capital budget, while revenue losses associated with oil theft and mismanagement from 2009 -2011 was estimated at US$10.9 billion (EIA, 2015). This constitute a colossal weight on government expenditure profile, distort the market mechanism, fuel fiscal deficits, imbued corruption in the system and led to enormous manpower loss productivity loss arising from incessant fuel scarcity.

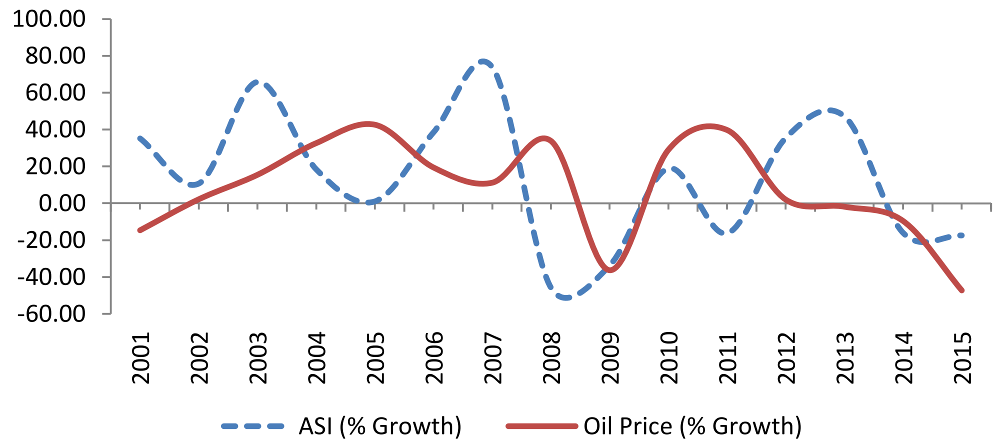
Given the huge cost implication of petroleum products subsidy on the economy, coupled with the fact that programme has failed to improve the welfare of the targeted segments, several attempts have been made by governments to completely remove the subsidy policy as well as privatise the refineries. These attempts have always been met with stiff resistance from the organised labour and the general public who consider petroleum subsidy as a "natural benefit" or 'safety net' for the poor majority living in the oil producing country. To address these anomalies, the petroleum industry bill (PIB) is being considered by the National Assembly. It is expected that the bill, when passed into law, will change the organisational structure and fiscal terms governing the oil and gas sector, boost investment, stem the crowding out of investible funds, privatise the refinery sub-sector and liberalise the domestic fuel price by scraping the fuel subsidy programme. This is expected to break the government fuel subsidy policy jinx, provide the needed funds that had truncated plans to construct new refineries, and reinvigorate the interest of the over 20 private refinery license owners to invest in the sector. It is also expected that the plan by Dangote Group to construct Africa's largest refinery with 500,000 bbl/d capacity, by 2018 would offer succour to this thorny and endemic challenge facing the economy.

2.3 Stock Market and Oil Price Nexus

The relationship between the stock market and oil price in Nigeria is critical especially with the assumption of the market as the safe haven for energy investors. This relationship is depicted in Figure 2.4, which shows the growth rates in oil price and all share index (ASI). Inference from the figure suggests a generally mixed relationship with incidence of oil price rise being inversely associated with ASI decline (between 2004 and 2007), while at other instances, the two indicators trended in the same direction (between 2008 and 2010).

For instance, the steep increase in oil price from US$24.9 per barrel in 2002 to US$28.6 per barrel in 2003 (representing 15.5 per cent growth) was accompanied by a corresponding rise in the all share index from 764.9 points in 2002 to 1,324.0 points in 2003, representing 65.8 per cent growth.

Figure 2.4: Growth in All Share Market Index and Oil Price Movements (2001 - 2015)



Source: CBN Annual Report and Statement of Accounts (Several Editions)

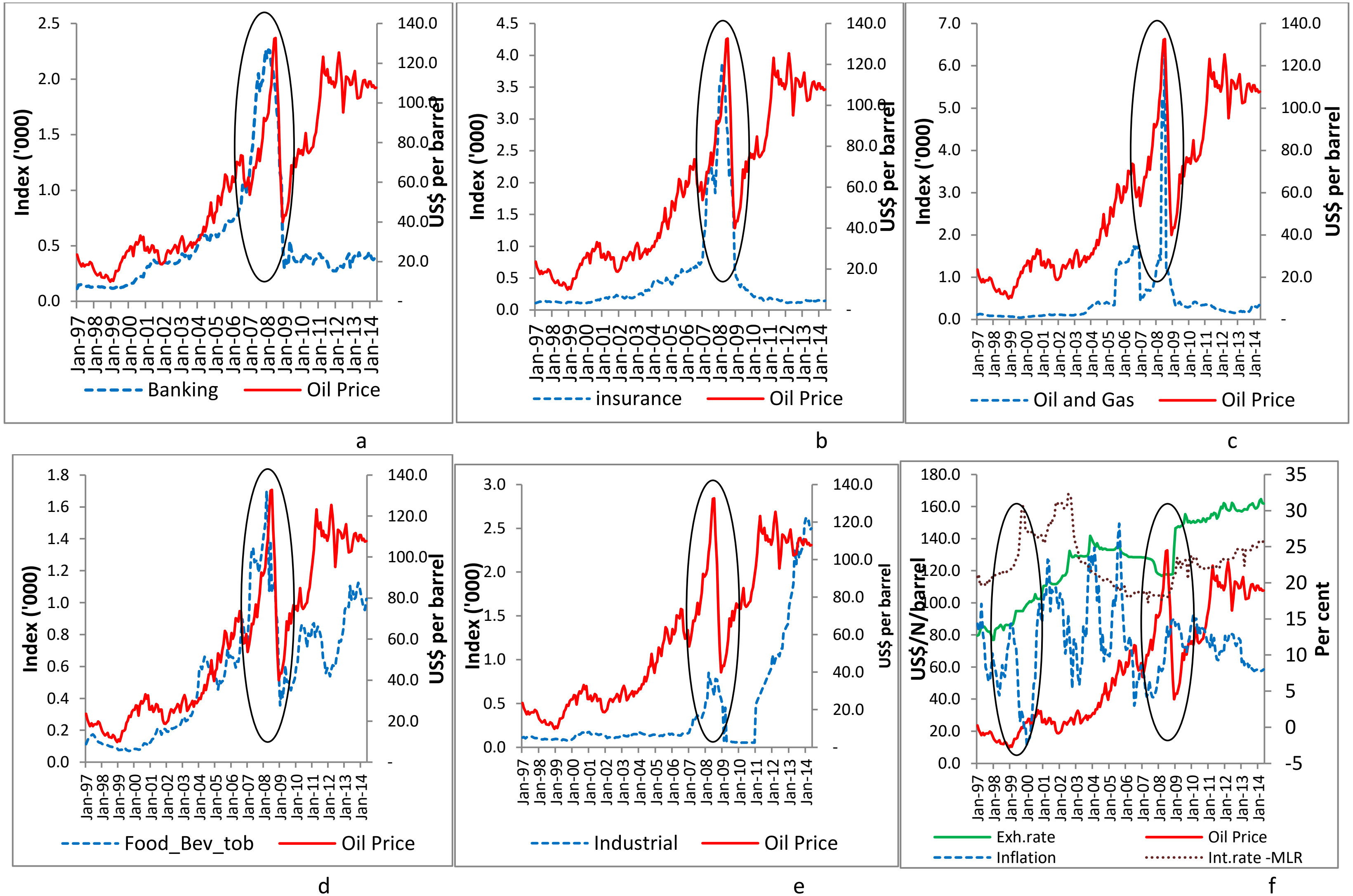
Similarly, the plunge in ASI from the 2007 growth of 73.8 per cent to negative 45.8 per cent in 2008 corresponded with the oil price tumbling from the 2008 height to US$62.1 per barrel or 33.8 per cent to a negative growth of 36.3 percent. Interestingly, with the wind of recovery, both indicators simultaneously rebounded gradually to US$113.5 per barrel and 41,329.2 points in 2013, respectively, demonstrating the inter-linkages between them.

The developments at the sectoral levels equally mimicked the oil price change relationship with the macroeconomy, which is not unconnected with the integration of the stock market to the global economy. According to Huang, *et al*. (1996), to the extent that this link had been established severally in the literature, implies that stock market returns, a major driver of the economy, naturally respond to fluctuations in economic fundamentals. Premised on the assumption that economic agents are rational and profit maximising, it follows that an increase in oil price is expected to drive cost and constrain production.

This is clearly demonstrated in panels a - e of Figure 2.4, which evidence strong correlation and perfect tracking of the turning points in the relationship. The graphical representation shows steep decline in oil price from about US$110 per barrel to about US$40 per barrel during the financial crisis, explaining the massive erosion of sector market capitalisation index during the period. However, while the index of food beverage and tobacco and consumer goods recovered in line with oil price recovery in the post global financial crisis era, the banking, insurance and oil and gas indices maintained their downward trends in spite of improved international oil price. The intuition behind these contrasting relationships is the possible loss of investor confidence in these sectors as the improved oil price could have been considered transitory.

The representation in panel f of Figure 2.4 suggests the satisfaction of the *apriori* expectations in the movement between oil price and exchange rate, inflation rate and interest rate. The counterintuitive response of exchange rate to oil price could be explained by the intermittent intervention in the market by the monetary authority to keep the rate stable and sustainable, consistent with the development objectives of government. The two troughs in 1999 and 2009 represent responses to policy changes and global financial crisis, respectively.

Figure 2.5: Monthly Sector Stock Returns Indices with WTI Oil Price (January 1997 – March 2016)



Source: Authors computation

In contrast, interest rate satisfied the theoretical relationship prior to the 2008 financial crisis as rising oil prices dampened interest rate in the economy. A rise in oil price implies liquidity increase in the economy via the monetisation of oil proceeds, which leaves the government and its agencies with excess funds. This dampens government appetite for credit, claims from the market or private sector, cascading to a decline in rates. Meanwhile, no direct link was established between inflation and oil price, suggesting that oil price change only affect inflation indirectly through exchange rate or interest rate channels.

2.4 Cyclical Correlations between Oil Price and Sector Stock Returns

To the extent that macroeconomic variables exhibit co-movements with oil price, as shown in the preceding section, it becomes imperative to determine the cyclical correlations in the relationship at different lags and leads. According to Arouri and Nguyen (2010) determining the cyclical correlations provide insights about the existing linkages between oil price and stock market over the business cycle as well as elicit information about the strengths and synchronisation of the short-run component co-movement. The cyclical cross-correlations between oil price and sectors indices is computed using stationary cyclical deviations based on the Hodrick and Prescott (1980) filters and the degree of co-movement measured by the magnitude of the correlation coefficients.

The HP filter decomposes the series into long-run and business cycle components. Following Arouri and Nguyen (2010) and Ewing and Thompson (2007) in applying the methodology introduced by Serletis and Shahmoradi (2005), the cross correlation between the cyclical component of oil price (opr_t) and individual sector returns at lag and lead is determined as

$$\rho_{xyi}(k) = \frac{\operatorname{cov}(x_t, y_{i,t-k})}{\sqrt{\operatorname{var}(x_t)\operatorname{var}(y_{i,t})}} \text{ for } i = 1, 2, ..., N; \text{ and } k = -6, -5, ..., +6 \qquad (2.1)$$

The contemporaneous correlation coefficient $\rho(k)$, which shows the degree of co-movement between the oil price series and the cycles of other variables are computed for $k = 0, \pm 1, \pm 2, ..., \pm 6$ and $\rho(k)$ is defined as procyclical, acyclical and countercyclical if it is positive, zero or negative. Relying on Pearson's correlation coefficient values, it is assumed that the cyclical components are strongly, weakly and zero correlated contemporaneously, for a shift in period, based on $0.23 \leq |\rho(k)| < 1$; $0.15 \leq |\rho(k)| < 0.23$ and $0 \leq |\rho(k)| < 0.15$, respectively. If $\rho(k)$ is maximum for a positive, the cycle of oil price is said to lead the cycle of stock returns by k periods, while zero or negative values of k connotes immediate occurrence (synchronous), and lagging behind the cycle of stock returns by k periods, respectively, (Arouri and Nguyen, 2010).

Table 2.2: Cyclical Correlations of Oil Price, Sector Stock Returns and Selected Key Macroeconomic Indicators in Nigeria

	k												
	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Market Index	0.316	0.407	0.496	0.565	0.608	0.630	0.613	0.548	0.447	0.323	0.184	0.057	-0.054
Banking	0.322	0.402	0.484	0.546	0.597	0.625	0.623	0.570	0.478	0.344	0.201	0.061	-0.060
Insurance	0.235	0.378	0.504	0.578	0.624	0.624	0.614	0.566	0.506	0.405	0.298	0.171	0.061
Food Bevg Tobacco	0.384	0.439	0.481	0.515	0.521	0.525	0.519	0.482	0.405	0.300	0.172	0.031	-0.094
Oil and Gas	-0.372	-0.245	-0.024	0.182	0.399	0.517	0.590	0.553	0.481	0.389	0.321	0.240	0.200
Con.Goods	-0.024	0.073	0.172	0.293	0.403	0.469	0.534	0.549	0.554	0.517	0.466	0.395	0.323
Inflation	-0.295	-0.334	-0.310	-0.243	-0.158	-0.076	-0.027	0.009	0.024	0.006	-0.024	-0.068	-0.094
Exchange Rate	-0.015	-0.069	-0.133	-0.212	-0.316	-0.443	-0.570	-0.668	-0.706	-0.671	-0.581	-0.432	-0.278
Treasury Bill rate	-0.032	0.016	0.041	0.071	0.118	0.164	0.184	0.175	0.188	0.173	0.125	0.089	0.049

Source: Author's computation.

Table 2.2 reports the contemporaneous correlations over a 6-lead-lag time horizon between the cyclical components of oil price, the reference series, and each of the industry returns including all share index, exchange rate and consumer price index. The contemporaneous correlation coefficient $\rho(k)$ is strongly positive and generally procyclical for all the series, except at lag 4- 6 of oil and gas and the lag of inflation and exchange rate. The all share index

(ASI) exhibit strong cyclical correlation with oil price for positive values of k, implying the pro-cyclicality and lagging of the stock market by oil prices.

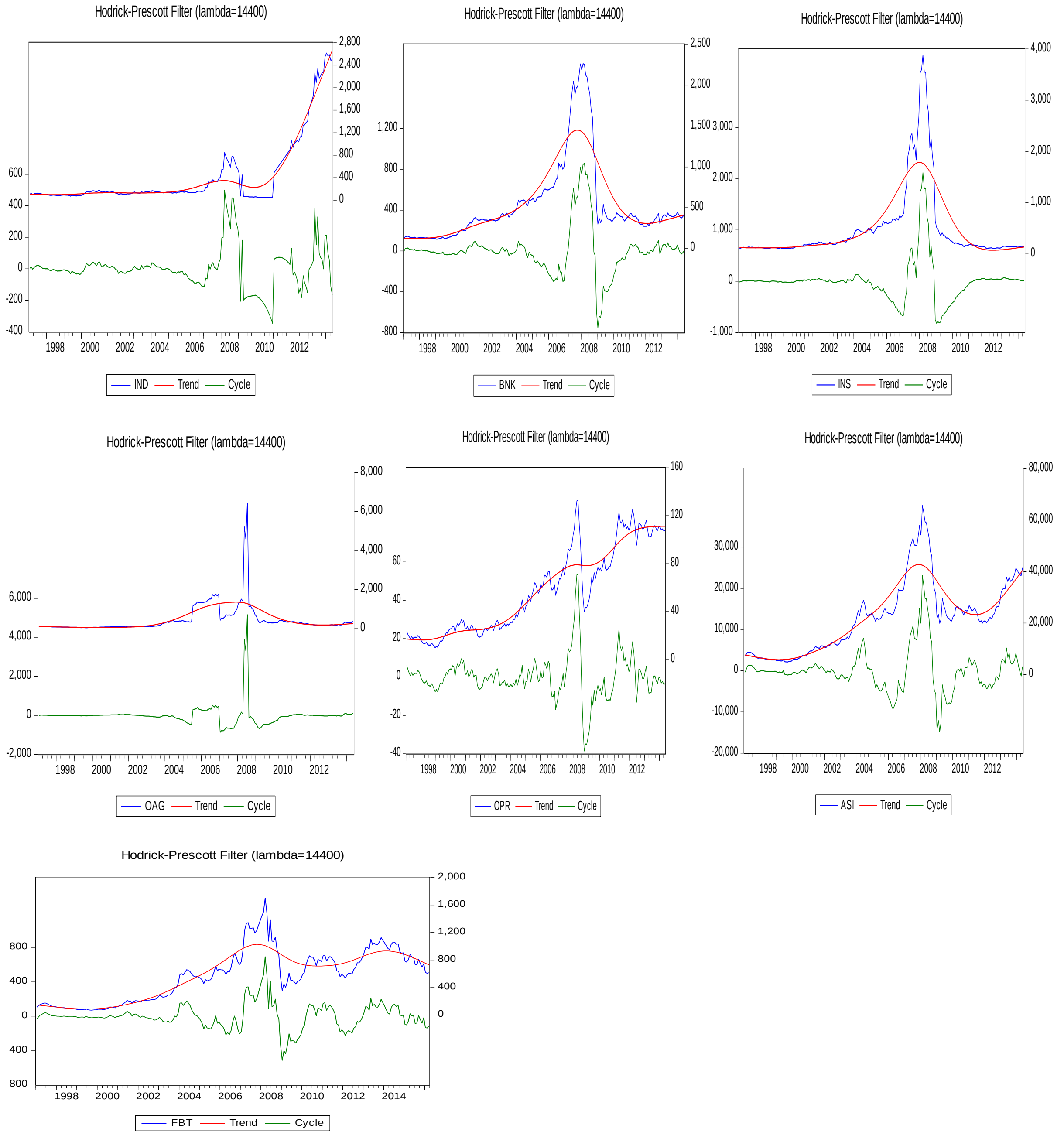
The procyclicality is confirmed by the equally contemporaneous positive and strong correlation of the coefficients of most of the variables for the lags and leads of oil prices. This suggests that for values of k, oil prices are pro-cyclical and generally lagging and leading the sectors. Expectedly, given the dependence of the economy on crude oil exports for foreign exchange, highly negative cyclical correlation are noted for exchange rate for positive values of k, suggesting that oil prices are counter-cyclical and lead the exchange rate generally by a few months ahead.

Oil price lags the cycle as it is negatively and contemporaneously correlated with domestic prices, suggesting that dependable forecast could not be derived from changes in oil price. The cyclical correlation between interest rate and oil prices is positive and strong contemporaneously, indicating a lag and lead of 4 and 5 months, respectively.

Finally the contemporaneous correlation of oil price is strong for all the sectors indicating the sensitivity of the markets' common drivers. Oil price lead all the series except inflation while all series except exchange rate were lagged by oil price. Similarly, symmetric reaction to oil price shock is noted for all series except inflation and exchange rate. The value and sign of stock returns of the sensitivities of stock returns to oil price changes vary significantly across sectors.

It had been shown in this chapter that both the oil sector and capital market play critical roles in the growth and developmental aspirations of Nigeria through resource mobilisation. Similarly, the evolutionary path of both sectors has much in common as they rose from playing ancillary development roles prior to independence to the assumption of prime roles in harnessing latent resources in the economy.

Figure 2.6: Hodrick Prescott Filter Residuals for Sectoral Indices



Source: Author's computation

Note: CG=Consumer Goods; BNK=Banking; INS=Insurance; OAG=Oil and Gas, OPR=Oil Price and ASI=Market Index; and FBT=Food beverages and tobacco.

It had been shown in this chapter that both the oil sector and capital market play critical roles in the growth and developmental aspirations of Nigeria through resource mobilisation. Similarly, the evolutionary path of both sectors has much in common as they rose from playing ancillary development roles prior to independence to the assumption of prime roles in harnessing latent resources in the economy. It was, therefore, not surprising that the two sectors demonstrated evidence of strong relationship with the fortunes of one dictating the trajectory for the other. This was more evident during the global financial crises, where market capitalisation, all share index and oil price rose and fell in unison. These co-movements were equally observed at sector levels, suggesting that an analysis of oil price shock at the sector level would reveal enormous information relevant for decision making by economic agents.

The contemporaneous correlation coefficient show the All share index (ASI) exhibiting strong cyclical correlation with oil price, implying the pro-cyclicality and lagging of the stock market by oil prices. The obvious question at this point is: are these observations peculiar to Nigeria or do they cut across economies; and are they consistent with existing economic theory and empirical literature? These questions would form the basis for the next chapter, which reviews the empirical and theoretical literature on stock market and oil price developments to elicit insights that could serve as benchmark for assessing the economy of Nigeria.

Appendix 2

Table 2A: NSE Industry Sector Reclassification

Indices Index	Constituents	Adjustments
NSE-All-share Index (NSE ASI)	The NSE ASI is a market capitalisation weighted index. It includes all the companies listed in the first-tier market segment. Formulated in January 3, 1984 with base value of 100 points	Calculated on a daily basis. Adjusted for corporate actions, new listings, right issue and placing.
NSE 30 Index	Started on 29/12/2006 with a base value of 1000 points. It includes the top 30 companies in terms of market capitalisation and liquidity	The NSE 30 index is weighted by adjusted market capitalisation. It is reviewed half-yearly.
NSE Banking Index	Started on 1st July 2008 with a base value of 1000 points. It comprises of the top 10 most capitalised and liquid banks.	It is weighted by adjusted market capitalisation. It is reviewed half-yearly.
NSE Insurance Index	Started on 1st July 2008 with a base value of 1000 points. It comprises of the top 10 most capitalised and liquid Insurance companies.	It is weighted by adjusted market capitalisation. It is reviewed half-yearly.
NSE Consumer Good Index	Started on 1st July 2008 with a base value of 1000 points. It comprises of the top 10 most capitalised and liquid companies in the Food/Beverages and Tobacco sector.	It is weighted by adjusted market capitalisation. It is reviewed half-yearly.
NSE Oil & Gas Index	Started on 1st July 2008 with a base value of 1000 points. It comprises of the top 10 most capitalised and liquid companies	It is weighted by adjusted market capitalisation. It is reviewed half-yearly.
NSE Industrial Index	Started on April 9, 2013, it comprises the top 10 companies in the Industrial Sector in terms of market capitalisation and liquidity. The base date and value are December 30, 2011 and 1000, respectively.	It is a price index and is weighted by adjusted market capitalisation. It is reviewed half- yearly.
ASEM Index	Started on April 23, 2013, the ASEM Index is a market capitalisation weighted index. It includes all the companies listed in the Alternative Securities Market. The base date and value are December 31, 2010 and 1000, respectively.	Calculated on a daily basis. Adjusted for corporate actions, new listings, right issue and placing.
NSE-Lotus Islamic Index	Started on 31st December 2008 with a base value of 1000 points, comprising of ethical stocks that have certified by an International Sharia Advisory Board selected by Lotus Capital	It is weighted by adjusted market capitalisation. It is reviewed half-yearly.

Source: NSE (2016)

CHAPTER THREE

REVIEW OF THEORETICAL, EMPIRICAL AND METHODOLOGICAL LITERATURE

3.0 Introduction

Based on the synopsis of the stock market and oil price developments in Nigeria examined in the previous chapter, this chapter sets out to review existing theoretical, empirical and methodological literature on the relationship. The first sub-section concentrates on theoretical exposition of the relationship as well as the transmission mechanism of oil price to the economy. The second specifically focuses on the review of the empirical links between oil price and economic activities, stock market and sector stock returns. These reviews are critical for the proper identification of the gaps in the literature and the comparison of estimation results in chapters five, six and seven with existing researches. The study on the individual behaviour of the sector stock returns is necessitated by the intrinsic heterogeneous nature and the policy and investment implications of their exposure to oil price innovations. The third sub-section reviews the methodologies and techniques adopted in the literature in establishing the relationship between oil price and the economy. The review forms the basis for the choice of appropriate estimation techniques of analyses and the variables of interest, consistent with study objectives.

3.1 Theoretical Literature Review

Existing theories on the effect of oil price uncertainty on stock market returns are generally derived from the irreversible theory of investment postulated by Black and Scholes (1973) and Henry (1974) and popularised in the 1980s by Bernanke (1983), Brennan and Schwartz (1985) and Majd and Pindyck (1987), among others. The basic tenets of the theory is the assumption that uncertainty shocks do not only inherently truncate investment decisions but also constrain firms' ability to re-deploy capital since capital, once installed, becomes largely irrecoverable (Bernanke, 1983).

The concept is, thus, used to describe economic agents' postponement of taking immediate investment decisions, pending when additional information or more auspicious or efficient production technology is made available. Bloom, *et al* (2011) describes it as the "variability in the potential values of forthcoming but indeterminate economic outcomes, such as prospective stock prices or GDP growth". It follows by implication that uncertainty is countercyclical to business cycles such that it rises during business downturns and declines during booms. Uncertainty is essentially forward looking and is represented by several proxies in the literature including the dispersion in aggregate stock market since it cannot be measure directly and is generally assumed to be higher for developing economies.

An early evaluation of the theory was made by Bernanke (1983) in his investigation of the effect of energy prices volatility on irreversibility, uncertainty and cyclical investment. The study observed delayed current investment and production decisions by agents pending when the uncertainty about the future trajectory of oil prices is fully determined. The underlying intuition is to uncover the influence of relative increase in oil price uncertainty influences on the future cost and sales of firms' products with the associated consequence of reduced aggregate economic activities. The findings by Pindyck (1991) and Leahy and Whited (1996) show elements of consistency with Bernanke's as they also observed consumers' postponement of irreversible purchase of consumer durables during periods of high uncertainty in oil price. Bloom's (2009) evidence further show uncertainty shocks as typically worsening and dampening firms' economic outlook, restraining irreversible investment decisions, and making firms' response to oil price shock to be dependent on the perceived degree of uncertainty.

Oil Price uncertainty in the literature, has been severally linked with intersectoral capital and labour allocative disturbances arising from energy price evolution. Davis (1987), Hamilton (1988, 2008), and Bresnahan and Ramey (1993) argue that where capital and labour are sector or product-specific, intersectoral and intrasectoral reallocations usually cause structural unemployment as capital and labour adjusts between energy-intensive and less capital-intensive sectors. Other theoretical models associated with oil price uncertainty are the equilibrium model of exhaustive resource market developed by Carlson, *et al.* (2007); the equilibrium model of oil production with irreversible investments and capacity constraints by Kogan, *et al.* (2009) and the general equilibrium production model constructed by Casassus, *et al.* (2009). All these models generate stochastic volatilities relative to adjustment cost and irreversibility of investment with the degree of the measure of uncertainty varying across firms and depending on the share of real oil price in investment making decisions process.

Theoretical literature has also revealed various transmission channels of energy price effect on investment and production decisions. Some of the identified channels include the real balance and monetary policy channel, the income transfer channel and the labour and capital channels (Elder and Serletis, 2010). The real balance channel centres on how increased oil price uncertainty exacerbates domestic prices, reduce household and firms' disposable incomes and eventually stifle aggregate output. The income transfer channel is premised on the argument that oil price increase reallocates income or wealth from oil-importing to oil-exporting economies. Darby (1982) and Sill (2007) enthused, however, that where oil proceeds are not recycled back through trade, oil price increase implies resource outflow and contraction in aggregate demand in the oil-importing country. The third channel assumes energy price effect as being mainly transmitted to the economy through the influence of productivity of labour and capital as demonstrated by Kim and Loungani (1992) and Rotemberg and Woodford (1996).

Bodenstein, *et al.* (2008), in addition, acknowledged the valuation or financial channel, where differentials in total asset return, in response to oil demand and supply shocks, are captured in the income flows or valuation changes. This, according to them, depends on the country's initial net foreign asset and composition of international financial instruments. Additional channels in the literature included the inflation effect channel that examine the links between inflation and oil price; the sector adjustment effect channel that focused on the adjustment cost of industrial structure; and the unexpected effect channel that focus on the uncertainty about future oil price and its impact (Brown and Yucel, 2002).

Debate on the effect of oil price shocks on economic growth through a reduction in consumer spending is on-going in the literature. Edelstein and Kilian (2009) and Kilian (2010) identified four conventional effects namely: the discretionary income effect (where higher energy prices are said to reduce the income of economic agents given the increased weight of energy bills in the firm and household expenditure baskets); the uncertainty effect (where current changes in energy prices do not only create uncertainty about future energy prices but also cause consumers to postpone the purchase of mostly energy-using consumer durables); the precautionary effect (which associates decreases in consumption to energy price shocks as economic agents increase their precautionary savings component in order to smoothen future consumption and hedge against possible loss of employment and income in the future); and the operating cost effect (which involves the consumption of specific complimentary durables, especially energy-using durables such as automobiles). Kilian (2010) noted that though these concepts were originally used in the context of consumer expenditure, the arguments equally suffice for investment expenditure. The insight gained from the consumption and expenditure effect is the fact that oil price increase generally dampens aggregate demand, which has implications on the performance of other key economic parameters.

In order to explain the theoretical constructs or underlying fundamentals behind oil price shock effect on the economy, especially output, several macroeconomic models have been built. Prominent among such models were those of Rotemberg and Woodford (1996), which for instance, used large and time-varying mark-ups to determine oil price shock on GDP. Others include the Atkeson and Kehoe (1999) putty-clay model, which focused on capital energy complementarities in production and the Finn (2000) model, which found large effect of oil price shocks on real output in perfectly competitive regime[7]. Though conclusions from these models were mixed, as they failed to agree on which of the transmission channels had the most widely acceptable empirical validity, understanding oil price uncertainty is, however, crucial in the realisation of economic agents' optimal profit-maximisation objective. Given that uncertainty could either improve or worsen stock returns (market risk), reasonably predicting its dynamic behaviour becomes relevant for effective portfolio management and contribution to timely and appropriate policy formulation and implementation.

Among the several econometric approaches used in measuring the interactions between oil price and economic output, the Dividend Discount Model introduced by Miller and Modigliani (1961) has been noted in the literature as one of the earliest. The model suggests that expected cash flow and the rate of returns to investors are the major determinants of stock prices and that the change in the macroeconomy influence stock prices given the sensitivity of these two factors to the trends in macroeconomic indicators.

Equally used generally in the literature to determine the relationship between macroeconomy and stock prices is the Arbitrage Pricing Theory (APT) model introduced by Ross (1976). The theory postulate that the return of an asset is influenced primarily by two major risks namely the systemic and unsystemic risk factors. While the unsystemic risk factors are classified as asset-specific and could be shared through portfolio diversification, the systemic risk factors,

[7] Details of these models are not discussed as they fall outside the ambit of this study.

made up mainly of macroeconomic factors such as GDP, inflation and interest rate, cannot be diversified. The sensitivity of each factor to changes is represented by factor-specific beta-coefficient.

The many limitations and restrictive assumptions associated with the CAPM informed the introduction of the multifactor model by Fama (1970). The model, which assumes market efficiency (Market Efficiency Hypothesis[8]), states that markets are efficient only when asset prices fully reflect all available information. It identified three forms of market efficiencies namely; the weak-form, the semi-strong form and the strong-form market efficiencies, depending on the existing available information. The weak-form market efficiency consider asset price as being a reflection of all past publicly available information, implying that the price of asset cannot be consistently predicted on technical basis given the accessibility of all investors to the same information. While the semi-strong form efficiency state that stock prices are a reflection of both past prices and all other public information, the strong-form market efficiency assumes that markets are perfect and asset prices reflect all available information.

Other common approaches adopted in the literature include the multifactor regression models used to measure such metrics as industry returns, market risks, interest rate risk, exchange rate risk, inflation rate risk and oil price risks. The popularity of this method is enhanced by the increasing acceptance in the literature that macroeconomic factors, such as oil price, could be good parameters for pricing assets, against the generally held view of capital asset pricing model postulation that assets can only be priced according to their covariance with market portfolio. The CAPM was, thus, modified to multifactor specifications with a view to ascertaining whether "macroeconomic variables constitute a source of systematic asset price risk at the market and industry

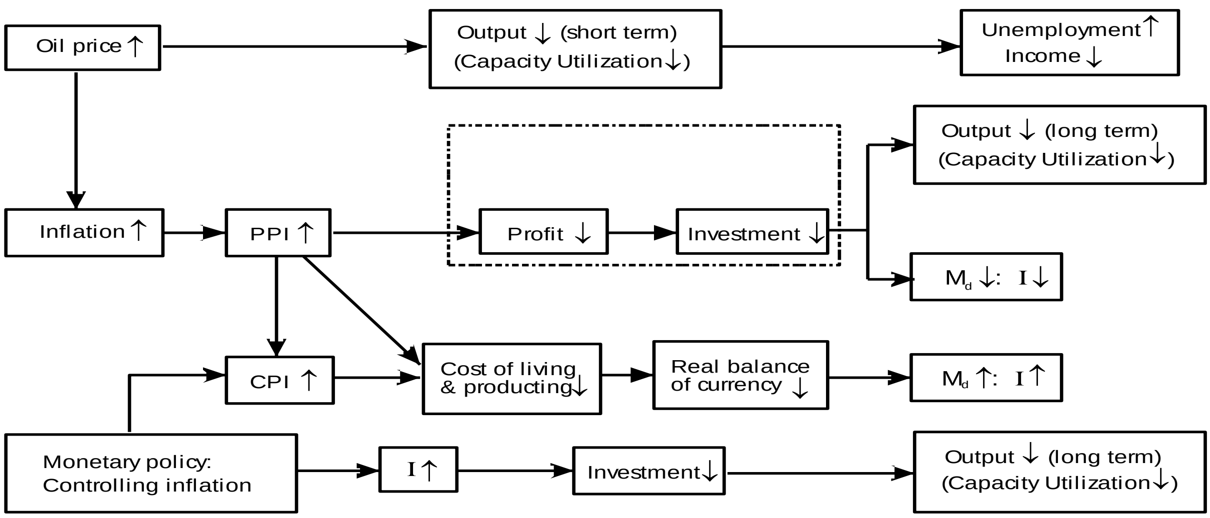
[8] An efficient market is that "in which firms make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information" (Fama, 1969:1).

level" (McSweeney and Worthington, 2008:1). Among the various macro-economic factors, oil price has received the most research attention, explained plausibly by its critical role as key factor input for production and determinant of financial firms' performance in the economy. This thesis follows this strand of literature to specify a multifactor regression model to investigate whether oil price innovation provides any hindsight about the behaviour of sector stock returns beyond the market portfolio.

3.1.1 Oil Price Shocks Transmission Mechanisms

The transmission channels through which oil price shocks impact domestic prices and output in the economy has been a subject of interest to economic managers and stakeholders. Consequently, several studies including Dornbursh, *et al., (*2001), Brown and Yucel (2002), Jones, *et al. (*2004), Tang, *et al. (*2010) and Adenuga, *et al. (*2012) had investigated these channels and broadly categorised them into the supply-side and demand-side channels. The surge in economic research is based on the need to properly understand the relationship and magnitude of impact of oil price innovation on output growth in recognition of the role of oil resource as a critical input in the industrial production process. Some empirical evidences and findings from available literature are summarised in the next section (3.2).

Figure 3.1: Transmission Channels of Oil Price Shock



Transmission channels of oil-price shocks.

Source: Adapted from Tang *et al.* (2010)

Figure 3.1, thus, depicts the various channels through which oil price influence economic activities as illustrated by Tang, *et al* (2010). From the supply side perspective, a shock in oil price, according to Baro (1984) and Brown and Yucel (2002) increases the marginal cost of production (increased production cost) resulting in the shrink in investment, decline in capacity utilisation, rise in unemployment and the eventual fall in output. The decline in output negatively impact on real wages causing price-wage loops. For energy intensive economies, oil price shocks, engender the shift in wealth from oil importing to oil exporting economies (Fried and Schultze, 1975; Dohner, 1981; and Hamilton, 1996). The uncertainty often associated with the availability of oil resources and the variability in price usually lead to the postponement of investment decisions and increased cost of intermediate goods. The result is the deterioration of terms of trade of the oil importing economy and the intensification in domestic inflationary pressures, pushing the producers' profit downward.

The shift in purchasing power (income) results in a reduction in aggregate demand and a fall in investment linked with high production cost, higher unemployment and decline in output growth. This is particularly attainable for industrial energy-intensive economies, compared with developing economies such as Nigeria, which are less energy intensive and prices are sticky downward as a result of infrastructural and structural rigidities in the economies. Hunt, *et al.* (2003) enthused that the transfer of income from oil-importing to oil-exporting economies dampens global aggregate demand as the decline in demand in the oil-importing economy could be higher than the increase in the oil-exporting economy. The result is lower aggregate demand and slow economic growth. This seem to mirror the case of Nigeria especially as a recovery of investment in the short-run, as a result of dying oil price shock, would not curb output decline in the long-run.

From the demand side channel, Adenuga, *et al.* (2012) noted oil price shocks as a fundamental factor for inflationary pressures and slow output growth in the economy. Increase oil price influence the price of products in the market resulting in worsening cost of living as the purchasing power of economic agents decline (Jimenez-Rodriguez and Sanchez, 2005). Tang, *et al.* (2010) argue that increased oil price shock contracts the demand for real balances in the face of increased real interest rate and decreased investment. This decelerates consumption through the reduction in disposable income as prices rises amidst rising cost of production. Pierce and Enzler (1974) and Mork (1994) traces the increase in the demand for money to oil price increase owing to the mismatch between money demand and money supply resulting in the increase in interest rate and retardation of real output growth.

The central bank response to inflationary pressure induced by oil price shock, by adopting a tight monetary policy stance to mitigate the adverse effect of the shock, could influence aggregate demand in the economy. However, the inflation management process of the central bank is distorted as it's response to oil price shock is moderated by the desire to achieve inflation target without losing its credibility through avoidance of contractionary and inconsistent policy actions (Hunt, *et al.,* 2003). In the literature, Ferderer (1996) has shown that oil price increase do not only cause inflation but also reduce demand for real balances in the economy through the real money balances channel. In which case adopting a contractionary monetary policy stance would cause interest rate to rise, reduce investment and eventually slow output growth in the long-run. The implication is that output growth might be sacrificed, as a restrictive monetary policy stance, aimed at curbing inflationary pressure, could invariably result in reduced output growth.

It is important to note that persistence in oil price shocks might lead to structural change in the production process from oil intensive to less intensive production methods, causing frictional unemployment. According to Lougani

(1986) such changes naturally alter the relative cost of goods, shift demand and cause unemployment for the affected sectors. It has also been shown that beyond oil price level increase, volatility in oil price is a major cause of oil price uncertainty, a factor responsible for wealth reduction and investment deterioration.

3.2 Review of Empirical Literature

3.2.1 Empirical Links between Oil Price and Economic Activities

Empirical literature on the relationship between oil price uncertainty and economic aggregates generally sought to synchronise the implicit impact of oil price shock with investment. A major intuition underlying these studies is the desire to ascertain how the investment channel amplify the effects of oil price uncertainty on the economy through the investment decisions of economic agents.

Prominent among these is the pioneering work by Hamilton (1983), which demonstrated a negative link between oil price movement and economic activities for the US economy. Bohi (1991) used the supply-side and demand-side models to examine the dependence of aggregate output and found consistent results. In determining the sensitivity of firms' investment decisions to fluctuations in oil price uncertainty, Kellogg (2010) observed steady decline in Texas oil well drilling activities. Inference from Elder and Serletis (2010) investigation of the impact of oil price uncertainty on the economic activities of the US and G-7 countries, based on GARCH-in-mean VAR, show negative and statistically significant effect on several measures of investments, durable consumption and aggregate output.

For selected member economies of the G-7countries, Bredin, *et al.* (2010) explored the theoretical claim that oil price uncertainty delayed investment decisions, with focus on the potential effect of uncertainty in the futures market. Estimating a multivariate GARCH-M SVAR, the study results suggest that energy futures market negatively affected industrial production activities, especially the energy intensive manufacturing sector of Canada, France, the UK and the US. Interestingly, similar conjectures were drawn by Jo (2012), who showed oil price uncertainty exerting significant negative effects on real economic activity as measured by the industrial production index. The study attributed the deceleration in industrial production growth wholly to increased oil price uncertainty.

For a better appreciation of the impact of oil price effect on the economy, Mork (1994) and Brown and Yucel (2002) used the demand-side models to distinguish between oil-importing and oil-exporting economies. They noted that while increased oil price generated income and stimulated aggregate demand in the oil-exporting economies, the reverse obtained for oil-importing countries. In evaluating the income effect of oil price volatility using error correction framework, Yang, *et al.* (2002), found significant contribution of oil price volatility to increased uncertainty in both oil-exporting and oil-importing countries. They further indicated that a 4.0 per cent cut in OPEC production could potentially trigger oil prices increase except during regimes of recession. Similarly, Park and Ratti (2008) showed stock markets in oil-exporting countries experiencing positive growth during oil price increase, contrary to the negative response by oil-importing countries. Employing a structural VAR model, Bjornland (2009) corroborated Park and Ratti findings as it found increase in oil prices stimulating activities in the oil-exporting Norwegian economy. Kang and Ratti (2013) demonstrated the significant role of economic policy uncertainty in reducing real stock returns for the oil-exporting country of Canada and oil-importing Europe.

Contrary to common economic assertions, Kilian (2010) empirically showed increased oil price shocks benefiting both the exporting and importing economies. According to the findings, revenues that accrue to oil exporters are often recycled into the global financial system through the financing of imports from the rest of the world. This does not only contribute to stabilising oil-importing economies but also correct their short-run external deficits.

Moreover, owing to the limited domestic absorptive capacity, coupled with the need to smoothen expenditure by diversifying the economy; oil-exporters naturally often invest the excess revenue in major international stocks and sovereign wealth funds usually warehoused by the oil-importing economies. The parking of these excess funds in international banks serves to ease global credit conditions, though it portends a threat to international financial system stability given the frequent fluctuations in oil price. This recycling process successfully balances the gains from oil price increase between the exporters and importers of oil.

Evidence from the survey of six net oil-exporting and oil-importing countries by Filis, *et al.* (2011), using DCC-GARCH model, revealed inverse relationship between stock returns and oil price increase during the 2008 global financial crisis. However, findings by Arouri, *et al.* (2010), presented mixed impact of oil price change on stock markets for the oil-exporting Gulf Cooperation Council (GCC) countries in spite of the regional homogeneous economic structures. The paper observed sensitive and significant stock market returns response to oil price shocks with a non-linear relationship that vary with price change in four of the sampled countries. Awartani and Maghyereh (2013) findings for the same region were consistent, displaying a bi-directional and asymmetric effect spill over of returns and volatility between oil price and stock market equities. Examining this relationship for 12 oil-importing European economies using VAR and VECM, Cunado and de Gracia (2014) found real stock returns varying in response to whether oil price shock was demand - or supply-driven. Specifically, the result suggested negative and significant impact of oil price shock on most European stock market returns and driven mostly by supply-side factors.

3.2.2 Empirical Links between Oil Price and Stock Market

The imperatives for scrutinising the impact of oil price innovations on the global financial system, especially the stock market, became more compelling, sequel to the economic globalisation and financial integration.

While various pioneering researches including Jones and Kaul (1996), Sadorsky (1999) and Cunado and Perez de Gracia (2014), establish negative effects on the one hand, Sadorsky (2001) and El-Sharif, *et al.* (2005) and others noted positive implications on the other. Using the standard cash flow dividend valuation model to examine the influence of oil price volatility on stock returns of four developed economies of United States, the UK, Canada and Japan, Jones and Kaul (1996) showed negative response of stock returns in the US and Canada to oil price, while Japan posted mixed after-effects. Sadorsky (1999), Papapetrou (2001) and Ciner (2001) also reported significant negative consequence of oil price shocks on stock price movement.

Using monthly data for an extended sample size that include the US and 13 European economies, Park and Ratti (2008) found consistent evidence of a debilitating effect of real oil price change on real stock price performance for 12 of the sampled European countries. Meanwhile, for the US and the oil-exporting country of Norway, the study observed dissimilar response of real stock returns to real oil price movement. Haung, *et al*. (1996) argued that since oil price shocks affected economies, which in turn affected company earnings, equity prices invariably are affected by innovations in oil price. However, the degree of such impact was relative to the significance of oil resource to firms' and economic agents' activities and more importantly the reaction of policy makers to such shocks (Clare and Thomas, 1994). Meanwhile, examining international stock market returns for eight European countries, Apergis and Miller (2009) failed to establish a significant link between oil price changes with stock returns using a vector autoregressive framework.

A recent study by Dhaoui and Khraief (2014), which investigated eight international stock markets using EGARCH-M framework, found an inverse correlation between oil price innovation and stock returns, albeit with some variations in significance level. The paper demonstrated that increased oil price, given its critical role as factor input, potentially induce cost-push inflation, worsen unemployment, impose inflation tax, increase risk and uncertainty, and ultimately cause stock prices to be bearish. Narayan and Narayan (2010) confirmed a positive and significant effect of oil price volatility on stock prices for the Vietnamese stock market. Using the EGARCH model and testing for asymmetry and persistence of shocks for the full and sub-samples, the authors observed permanent and asymmetric effect on volatility for the full sample but inconsistent evidence of asymmetry and persistence of shocks for the sub-samples.

For the Thai economy, Jiranyakul (2014) estimated a GARCH model and pairwise Granger causality using monthly data. The paper revealed evidence of volatility transmission from oil price shocks to domestic stock returns, suggesting increased portfolio risk if oil price shocks and volatility increased. Employing a structural VAR model for South Africa and the Chinese economies, Tang, *et al.* (2009) and Aye (2015), respectively, showed that aggregate demand-driven oil price shocks exerted more influence on stock market volatility than the supply-side and oil-specific demand shocks. For the Chinese economy also, Cong, *et al.* (2008) found no meaningful oil price shock effect on stock returns even though elements of negative effect on the stock of oil companies were detected.

Antonakakis, *et al.* (2013) investigated the time-varying correlation of stock returns and policy uncertainty for the Greek economy. Using a modified version of the policy uncertainty index developed by Baker, *et al.* (2012), the authors observed a consistently negative relationship over time. In addition, it was also shown that the combination of increased stock market volatility and policy uncertainty cumulatively dampen stock returns. In a similar study that applied structural VAR model in the examination of how structural oil price shock and uncertainty in economic policy jointly affect stock returns, Kang and Ratti (2013) found structural oil shocks contributing more (32.0 per cent) than economic policy uncertainty (19.0 per cent) to variability in real stock returns in the long-term. A Markov regime-switching model adopted by Aloui and Jammazi (2009) to examine the conditional correlations and volatility spill overs of crude oil returns and stock returns index showed significant role of oil price increase in the determination of stock returns volatility and the probability of transition across regimes.

Similarly, Lin, *et al.* (2014) considered the transmission of volatility from oil price to the regional stock market returns for Ghana and Nigeria using VAR-GARCH, VAR-AGARCH and DCC-GARCH frameworks. They found significant spill overs and interdependence between oil and the two stock market returns, albeit with stronger spill over effects noticed for Nigeria. Sadorsky (2014) employed a VARMA-GARCH to explore the consequences of increased financial integration of emerging economies and the financialisation of commodity markets with specific emphasis on volatilities. The reported conditional correlations between stock market returns and commodity prices showed stock prices and oil prices displaying leverage effects, while negative residuals tend to increase the variance more than the positive ones.

3.2.3 Sector Stock Returns Response to Oil Price Change

Industry level literature on stock returns and oil price volatility are recent and very few compared with aggregate analysis. Some of the early works in this direction are those of Fama and French (1993) that employed both the CAPM and three factor models in the analysis of 48 US industry sector returns. The sector by sector analyses of the Australian stock market by Faff and Brailsford (1999) exhibited mixed outcomes as oil, gas and diverse resources industries were found to positively respond to oil price increase against the negative reaction of papermaking, packing, and transportation industries. Using the market factor model, Nandha and Faff (2008) investigated the short-term relationship between oil price change and 35 global industry stock returns and demonstrated the existence of significantly negative relationships for all sectors except oil and gas industry. The findings by Kilian and Park (2009) for US stock returns to oil price changes, as confirmed by Degiannakis, *et al.* (2014) for the European industrial sector indices in a time-varying framework, showed stock returns response to oil price change typically determined by the source of the shock (supply-side or demand-side factors).

On the causal relationship between oil price shocks and 13 sectors stock returns for the US, Elyasiani, *et al*. (2011) used a GARCH model to find negative effects, which is in consonance with previous literature. Arouri, *et al.* (2011) employed the VAR-GARCH model in examining the widespread direct spill over of volatility between oil price shock and sector returns for the European and the US industry sectors. The result highlighted industry heterogeneity across sectors and strong asymmetric features in the face of oil price increase. This assertion was confirmed by Jouini (2013) for the Saudi Arabian stock sectors where weekly data was used to estimate a VAR-GARCH model. The result further suggests the existence of volatility transmission between oil price and sector stock returns. The paper by Arouri and Nguyen (2010) adopted different techniques of analysis in the examination of the short-term oil price and stock market relationship for Europe from the aggregate market and the sector to sector levels perspectives. The paper observed significant linkages between stock returns and changes in oil price for most European countries, though the degree of such sensitivity vary markedly depending on the sector.

For the Chinese stock market, a disaggregated analysis by Cong, *et al*. (2008) documented evidence of mixed response to oil price shocks as the real stock returns of many industry sectors were not considered substantially affected, except for the manufacturing and oil companies. Applying a panel cointegration framework that accounted for cross-sectional dependence and multiple structural breaks for the Chinese stock, Lee, *et al*. (2012) substantiated the existence of structural breaks and a long-run positive effect of oil price shock on sectoral stocks. Salisu and Fasanya (2013) affirm the existence of structural breaks in the volatility model for Nigeria, and observed that for oil-dependent economies; there are possibilities of imminent fiscal crises (booms) that might accompany revenue loss (gains) due to variability in oil prices.

The study by Hamma, *et al.* (2014) focused on the link and interaction between oil price volatility and stock returns of seven industry sectors and the optimal hedging strategy for oil stock portfolio against risk of a possible decline in stock prices in the Tunisian stock market. Using a GARCH-BEKK representation the result indicated that the conditional variance of stock sector returns was largely affected by the combination of stock market and oil price volatilities. The study result further showed unidirectional spill overs from oil price to stock market with varying intensity for most of the sectors.

Cueppers and Smeets (2015) evaluated the impact of oil price change on stock returns of 17 German DAX companies using panel estimation and noted an asymmetric relationship between oil price and stock returns with only certain specific industries being affected by oil price shocks. Similar studies by Huang *et al.* (1996) and Dreisprong, *et al.* (2008) found statistically significant negative effect of oil price movement on international stock returns. Though Lee, *at al.* (1995) found time-varying volatility of individual stock prices highly sensitive to oil price uncertainty shock in the short and long-run, the effect on firm-level investment was rather neutral.

The oil-exporting small open economy of Nigeria has had a fair share of empirical studies devoted to examining the impact of oil price shock on stock market performance. For instance, Adebiyi, *et al*. (2010) used quarterly data to estimate the effect of oil price shocks and exchange rate on real stock returns employing multivariate VAR for Nigeria. The result indicated that though real stock returns demonstrated negative response to oil price shocks, interest rate shock comparatively impacted more on stock returns than oil price shock. Mordi and Adebiyi (2010) used SVAR to evaluate the asymmetric impact of oil price shock on output and inflation and found the effect of oil price decrease being significantly greater than oil price increase. Tajudeen and Abraham (2010), adopted ARDL model and found oil price to have positive impact on stock prices, suggesting a sensitivity of stock market returns to oil price movement in Nigeria.

Okany (2014) investigation of the influence of oil price volatility on stock prices of major oil-exporting economies, including Nigeria, showed oil price as a relevant predictor of future stock price trajectory. Riman, *et al.* (2014) explored the vulnerability of the domestic economy to spill over effect of the US inflationary pressure and energy prices on Nigeria. The findings showed a slow but gradual response of stock returns to oil price increase and US inflationary pressures. Ogiri, *et al*. (2013) investigated the relationship between oil price and stock market performance in Nigeria and established significant links and implications for sustainable economic development in the long-run. Using quarterly data and adopting the error correction and bivariate GARCH techniques Uwubanmwen and Omorokunwa (2015) observed oil price volatility significantly affecting the behaviour of stock price volatility.

3.3 Summary

Predicated on the literature surveyed above, it could be deduced that, overall, the interlinkages between oil price shocks and the macroeconomy was fostered on validated theoretical underpinning with robust empirical evidences. Research analyses covered aggregate, regional, international and market specific areas including industry sectors. Significant links between oil price and economic activities, stock market and sector stocks returns was noted. Research evidence established mixed economic and stock returns sensitivities to oil price change depending largely on whether the economy is oil-exporting or oil-importing. Extant literature also pointed to the fact that the developed economies had been the fulcrum of most studies, which adopted the aggregate analyses as the most widely applied approach. Empirical literature further recognised that the body of literature on industry level analysis is recent and is still evolving. This suggests little research attention to the developing and emerging economies with spates of industry level analysis recorded. However, the institution of an efficient data collection, compilation and dissemination mechanism, supported by the advancement in information technology, is paving way for more micro studies.

Prevalent gaps identified sequel to the review of literature include, but not limited to the dearth of studies for developing and emerging economies, the use of low frequency data, and the absence of industry stock returns studies especially for sub-Saharan Africa extraction. Consequently, this thesis intends to bridge these identified gaps as a contribution to the growing wealth of knowledge for the developing economies. With the benefits of the market reforms of 2009 being consolidated, coupled with the growing availability of higher frequency sector level data, the analysis of this relationship becomes imperative, which is the focus of chapters 5, 6 and 7. However, to properly situate the analyses in the foregoing chapters, the next chapter would examine the techniques of analysis and the data properties and transformation processes to ensure the reliability of the estimates.

CHAPTER FOUR

ECONOMETRIC METHODOLOGIES, DATA DESCRIPTION AND VARIABLES DEFINITION

4.0 Introduction

From the array of alternative methodologies examined and the insights garnered from the review of literature in chapter three, the setup and structure of the two selected frameworks, namely the simple multifactor ordinary regression model for chapter 5 and structural vector autoregressive model for chapters 6 and 7 analyses, are concisely discussed. The simple model has three component equations: the first considers the oil price and stock returns relationship taking into account the effects of 2007 – 2009 global financial crisis; the second captures the oil price asymmetry (net oil price increase and decrease), and the third include several lags of oil price to explore whether lagged oil price impact on stock returns extends over several months. Using the SVAR, the theoretical concepts of impulse response function, forecast error variance decomposition and historical decomposition are adopted in the analyses in chapters 6 and 7 of the thesis.

The various diagnostics and statistical procedures including unit root test are conducted to determine the suitability and reliability of the selected series for analysis. The specified models are estimated and analysed in chapters 5, 6 and 7 to form the basis of the findings and policy recommendations of this study. Of particular interest is the discussion on how the uncertainty measures (conditional variances) are generated using the GARCH procedure in line with Lee, *et al.* (1995) and Elyasiani, *et al.* (2001).

This chapter consists of three sections namely: the econometric methodology, data description and variables definition and summary and conclusion. The chapter provides the platform and basis for the empirical analyses undertaken in the subsequent chapters. The central bank of Nigeria and the national bureau of statistics serve as the primary sources of data for the study, while oil price is sourced from the US Energy Information Administration (EIA). The methodology and data selection is primarily guided by economic theory, insights from empirical literature and expert knowledge of the economy of interest.

4.1 Econometric Methodologies

4.1.1 The Multifactor Regression Model

4.1.1.1 Analytical Framework

In financial econometrics literature, the relationship between financial market and the aggregate economy has been explored extensively. This is driven primarily by the desire of economic agents to properly identify as well as understand the underlying factors that determine stock market returns behaviour. In spite of the existence of this large body of empirical works, Chen, *et al*. (1986) nevertheless noted the absence of a generally accepted theory guiding this relationship. According to Arouri and Nguyen (2010:2) to the extent that "theoretical and empirical works focused on asset pricing; there is no consensus about both the nature and number of factors of stock returns". The lack of consensus, according to Chen, *et al.* (1986) is as a result of the influence of external and domestic economic conditions on the stock market returns.

Stock prices in financial econometrics literature is a barometer for measuring the economic conditions and macroeconomic variables[9] and are analytically described as the discounted value of expected future cash flow computed as

[9] Economic conditions and macroeconomic variables include inflation rate, interest rate, production costs, income, economic growth, investor and consumer confidence and other macroeconomic events that could be potentially influenced by oil price (Arouri and Nguyen, 2010)

$$P = \frac{E(c)}{E(r)} \quad (4.1)$$

Where P represents the price of stock, c equals the cash flow stream, r is the discount rate and $E(.)$ is the expectation operator. This translates to the realised returns in any period as

$$R = \frac{d(E(c))}{E(c)} - \frac{d(E(r))}{E(r)} \quad (4.2)$$

Where $d(.)$ is defined as the differentiation operator. It follows from equation (4.2) that stock returns are typically determined by forces that change expected cash flows and discount rate. Jones *et al*. (2004) and Cueppers and Smeets (2015) expressed the opinion that the computation of stock market returns as the present discounted value of the future profits renders it the best measuring parameter for the future profitability of firms in the economy.

According to Chen, *et al.* (1986), discount rates are average rates that vary with the prevailing rates and the term structure of interest rate spread across the various tenors of instruments. All things being equal, a change in interest rate would potentially influence the future value of cash flows as well as stock returns. On the changes in expected cash flow, Chen, *et al.* (1986) further expressed the opinion that both nominal expected cash flows and interest rates are, in turn, influenced by changes in the expected rate of inflation. So an unanticipated change in the general price level, they argue, could influence asset valuation especially where pricing is done in real terms. Similarly, apart from inflation and interest rates, expected real value of cash flow is also determined by the changes in expected level of real output, particularly if the risk-premium did not include uncertainty in industrial output.

Kim and Loungani (1992) further identified oil price change as another major determinant of cash flow and discount rate. According to them, since crude oil serve as critical factor input to aggregate production in any economy, changes in energy prices are very likely to result in higher expected production cost, which in turn dictate the business cycle that would ultimately affect stock returns. It follows by implication that stock price would depend largely on whether the industry or economy is a net producer or consumer of oil and by extension the level of exposure of its trading partners to oil price movements.

More importantly, the expected inflation rate and the expected interest rate, which make up the discount rate, are equally dependent on oil price. This is the hypothesis of Huang, *et al.* (1996), which posits that for net oil-importing countries, an increase in oil price naturally results in balance of payment disequilibrium, depletion of external reserves, exacerbation of domestic exchange rate and price pressures. They argue that since oil price positively relate with the discount rate (but inversely with stock returns); an expected change in oil price would invariably track the direction of inflation expectation in the economy. As a result, interest rate is expected to rise since increase in oil price has triggered inflationary pressures in the economy. The result is the deceleration in investment and the ultimate decline in stock prices.

4.1.1.2 The Multifactor Regression Model Specification

This study follows McSweeney and Worthington (2008) to specify the standard multifactor model in line with Khoo (1994), Chan and Faff (1998), Faff and Brailsford (1999), Sadorsky (2001) and Sardorsky and Henriques (2001). The approach adopts the ordinary least squares (OLS) technique to measure the industry level exposure to oil price change. The objective is to elicit the contribution of oil price innovations to sector stock returns behaviour beyond the signals from the market. Three multifactor models are estimated to investigate the relationship between macroeconomic factors and sector returns at industry level.

4.1.1.2.1: The Effects of Oil Price Change on Sector Stock Returns

The first model follows the works of Khoo (1994), Chan and Faff (1998), Faff and Brailsford (1999), Sadorsky (2001), Sadorsky and Henrique (2001) and

McSweeney and Worthington (2008), to specify a multifactor regression model as

$$R_{i,t} = \alpha_o + \alpha_1 opr_t + \alpha_2 mkt_t + \alpha_3 exr_t + \alpha_4 tbr_t + \alpha_5 \inf_t + \alpha_6 dumCr_t + \varepsilon_t \qquad (4.3)$$

where $R_{i,t}$, opr_t, mkt_t, exr_t and $\inf_t$ are the log of return on stock index of sector i at period t $(where\ i = 1, 2, ..., 5)$, change in oil price (WTI), return on aggregate market portfolio, change in exchange rate and inflation rate, proxied by the change in consumer price index, respectively, while tbr_t is the monthly yield on 90-day treasury bill rate (risk free interest rate) is used to represent interest rate in the economy. A multiplicative dummy variable ($dumCr$) was introduced to capture the impact of the global financial crisis of 2007 and is computed as $dummy * opr$ (where the period between 2008M12 and 2011M07=1 and otherwise = 0). The slopes (α_1 ... α_6) are the parameters sensitivities for the i^{th} industry to be estimated and ε_t is the standard error term.

4.1.1.2.2: Sensitivity of Sector Stock Returns to Oil Price Change

The second model investigates the sensitivity of industry stock returns to oil price change. Consequently, equation 4.3 is modified to include two variables namely the net oil price increase ($NOPI$) and the net oil price decrease ($NOPD$) to test for asymmetric effect[10] of oil price variation. Asymmetric effects show sector sensitivities to changes in oil prices, which may be more severe for some sectors than others. This depends on the degree to which the sector is directly or indirectly exposed to oil effect, "its degree of competition and concentration, and its capacity to absorb and transfer oil price risk to its customers" Arouri and Nguyen (2010:3). Several approaches have been used to measure asymmetric effect but Hamilton (1996) adjudged the NOPI and NOPD method best for extracting the exogenous components of oil price fluctuations from a model and for capturing the effect of oil price rise and fall

[10] Mork (1989) and Mork, *et al.* (1994) defines asymmetric effect as a situation where oil price hike negatively affect output but declines in oil price do not necessarily impact on output positively, and if they do, not of the same magnitude

on the spending decisions of consumers and firms. Kilian (2008) also consider the method superior to the traditional binary approach that uses dummy variables that essentially differentiate between positive and negative values or changes and that it is a better measure for extracting the exogenous components of oil price fluctuations. The modified model is, thus, specified as

$$R_{i,t} = \alpha_o + \alpha_1 opr_t + \alpha_2 mkt_t + \alpha_3 exr_t + \alpha_4 rir_t + \alpha_5 \inf_t + \alpha_6 nopi_t + \alpha_7 nopd_t + \varepsilon_t \qquad (4.4)$$

Where NOPI and NOPD are measured as the net increase and decrease of oil price at time t and interpreted as the log of oil price in excess of its maximum value over the past 12 months (Hamilton, 1996 and Ramos and Veiga, 2011). According to Hamilton (1996), the impact of oil price change on the spending decisions of consumers and firms is better measured and captured when the current oil price is compared with its maximum position over the last twelve months rather than over the last month[11]. Thus, net oil price increase is defined as

$$NOPI_t = \max(0, \ln(opr_t) - \ln(\max(opr_{t-1} ... opr_{t-12}))) . \qquad (4.5)$$

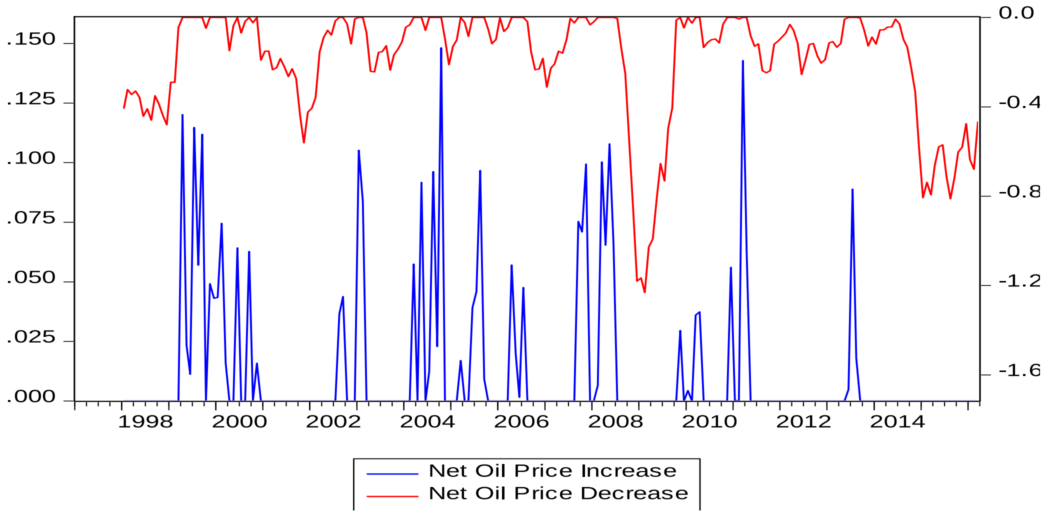
Similarly, Ramos and Veiga (2011) computes net oil price decrease (NOPD) at time t as negative when price of oil is below its peak value over the last 12 months and is defined as

$$NOPD_t = \min(0, \ln(opr_t) - \ln(\max(opr_{t-1,} ... opr_{t-12}))) . \qquad (4.6)$$

Figure 4.1 depicts the plots of net oil price increase and decrease where price peaks exhibits clustering features during1999-2000 and 2004-2006 periods. On the other hand, episodes of price troughs are evidently pronounced during the global financial crisis and in the 2014 – 2015 global recession that follow declines in oil prices.

[11] See Hamilton (1996) and Kilian (2008) for detailed discussions

Figure 4.1: Net Oil Price Increase (NOPI) and Net Oil Price Decrease (NOPD)



These models assume market efficiency in both the oil and stock sectors, suggesting a contemporaneous response by the stock market to a change in the price of oil (Huang, *et al.* 1996; Faff and Brailsford, 1999; and Sadorsky, 2001).

4.1.1.2.3: Persistence of Oil Price Change on Sector Stock Returns

Faff and Brailsford (1999), Sadorsky (2001) and El-Sharif, *et al* (2005) had argued that stock market returns move contemporaneously with oil price, against McSweeney and Worthington (2008) suggestion that such impact may not be immediate. In this third model, therefore, the persistence of the effect of oil price change on stock returns in the market beyond contemporaneous response is measured. A dynamic model that relaxed the market efficiency assumption of model 2 is estimated. In other words, the model investigates the relationship between stock returns and lagged oil price for each sector to the degree of persistence of oil price effect and the regression is estimated for the five sectors for the entire sample as

$$R_{i,t} = \alpha_o + \alpha_1 mkt + \alpha_2 opr_t + \alpha_3 opr_{t-1} + \alpha_4 opr_{t-2} + ... + \alpha_{14} opr_{t-12} + \alpha_{15} dumCr_t + \varepsilon_t \qquad (4:7)$$

The model is specified with aggregate market returns, change in contemporaneous oil price, twelve lags of oil price change and the dummy[12] capturing the global financial crisis. The inclusion of the dummy is intended to account for structural breaks in the data series, while the number of lags is chosen based on the rule of thumb that the series frequency is monthly.

4.1.2 Structural Autoregressive (SVAR) Model

4.1.2.1 Analytical Framework

Though the VAR framework has come to be regarded as the workhorse for macroeconomic and financial analysis, the traditional approach, as introduced by Sims (1980), was fraught with limitations. Among the shortcomings are the *ad hoc* imposition of dynamic restrictions (which render the VAR *atheoretical),* the adoption of exogeneity assumption (which models the equations individually rate than jointly), and the economically meaningless coefficients. These shortcomings attracted sharp criticisms by Cooley and LeRoy (1985), which resulted in the introduction of structural vector autoregressive (SVAR) technique by Sims (1986), Bernanke (1986) and Shapiro and Watson (1988) to circumvent the factorisation and variable ordering limitations associated with the traditional vector autoregression (VAR) models.

The SVAR is a dynamic simultaneous equations model with identifying restrictions founded on economic theory. The framework resolves the *ad-hoc* identification problem of the VAR by formulating structural equations for each of the errors in the system. Restrictions are imposed on the system following the relative importance of the variables based on economic theory and institutional knowledge. More restrictions are equally employed to identify the system (over-identification) making SVAR just-identified. Identification is

[12] The inclusion of a multiplicative dummy variable for each of the explanatory variables allows the intercept and each partial slope to vary, implying different underlying structures for the two conditions (0 and 1) associated with the dummy variable (Asteriou and Hall, 2007).

achieved through the use of economic information in the form of recursive structures, coefficient restrictions, variance or covariance restrictions, symmetry restrictions or long-run multiplier values (Kennedy, 2008). The SVAR uses economic theory rather than Cholesky decomposition to recover the structural innovations ε_t from the residual e_t. That is, the causal effect of the shocks on the model variable can be assessed after the forecast errors are decomposed into structural shocks that are mutually uncorrelated and have economic interpretation.

The SVAR approach allows for the validation of economic theory, drawing structural inferences and policy analysis as well as predicts possible outcomes in the event of structural shocks, such as oil price innovations or other similar exogenous shock to the system. In other words, it assigns economic meaning to structural shocks or innovations arising from the movement of a variable, hence its preference in evaluating the effect of oil price shocks on stock returns. Kilian and Park (2008), Apergis and Miller (2008), Mordi and Adebiyi (2010) are some of the studies that employed the SVAR framework to examine the impact of higher oil prices on the returns of stock market.

According to Kilian (2011:1), other advantages of the SVAR, include the use of the technique to "study the average response of the model variables to a given one-time structural shocks…allow the construction of forecast error variance decomposition that quantify the average contribution of a given structural shock to the variability of the data…provide historical decomposition that measure the cumulative contribution of each structural shock to the evolution of each variable over time…and allow the construction of forecast scenarios conditional on hypothetical sequences of future structural shocks". The structural economic interpretation feature of the SVAR, coupled with the associated impulse response function, has proven to be very useful tools for macroeconomic policy analysis.

In this thesis, we follow Kilian and Park (2009) to introduce the SVAR model that examines the reaction of sector stock indices to oil price uncertainty in Nigeria. The standard structural model is specified as:

$$A_o y_t = \alpha_o + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \qquad (4.8)$$

Where y_t is a 8 x 1 vector of endogenous variables, A_o represents a 8 x 8 matrix of contemporaneous coefficient, measuring interactions among variables, α_o is a 8 x 1 vector of constant terms, A_i is a 8 x 8 autoregressive coefficient matrices in the $i-th$ lag with a maximum lag of p, ε_t is 8 X 8 vector of structural disturbances assumed to be serially and mutually independent and interpreted as structural innovations. The endogenous variables in the model include oil price (*opr*), exchange rate (exr), banking (*bnk*), oil and gas (*oag*), insurance (*ins*), food beverages and tobacco (*fbt*), consumer goods (*cog*) and market index (*mkt*). Since it is unclear whether the variables in the model are actually endogenous or exogenous, they are thus, treated symmetrically. The optimal lag length, based on Schwarz information criterion is 2. Hamilton and Herrera (2004) had argued for longer lags (12 lags) and Kilian (2009) and Kilian and Park (2009) (24 lags) for monthly data, in order to capture the dynamics of oil price shock on stock market, as well as allow firms adequate time enough to adjust production and strategy in the face of oil price fluctuation. However, evidence from our estimate using 12 and 24 lags do not show meaningful results, hence the resort to the use of 2 lags as determined by the model.

The contemporaneous terms on the left hand side of equation (4.8) allow current and past realisations to affect the time path of each other, but do not contain information about the "deep parameters" or "structural parameters" (Harris and Sollis, 2003). This implies that the structural model is directly observable, and hence a reduced form VAR is estimated to avoid inconsistent parameter estimation. The reduced form representation is derived by multiplying both sides of equation (4.8) by A_o^{-1}. The resulting equation, which expresses the endogenous variable in terms of predetermined and exogenous variables, is considered by Kang and Ratti (2013) as having a recursive structure such that the errors e_t of the reduced form are linear combinations of the structural errors ε_t resulting in

$$y_t = \beta + \sum_{i=1}^{p} B_i y_{t-i} + e_t \tag{4.9}$$

where $\beta = A_0^{-1}\alpha_0$, $B_i = A_0^{-1}A_i$, and $e_t = A_0^{-1}\varepsilon_t$ Suffice to note that the reduced form error terms e_t are correlated between each equation, while the structural shocks ε_t are white noise with zero covariance terms, implying that structural shocks are from independent sources. Since equation (4.9) had been stripped of its contemporaneous terms in the left hand side, and its coefficients cannot be derived as a result of limited sampling information, its parameters can only be computed with the imposition of additional identifying restrictions. This is usually an arduous task as the VAR is usually not fully identified. The number of unknown parameters in the standard VAR becomes higher than the reduced form VAR, leading to imposition of restrictions on the coefficients of the contemporaneous terms. Consequently, a recursive structure is imposed on the contemporaneous terms while the structural shocks ε_t are identified by decomposing the reduced form error e_t.

4.1.2.2 SVAR Model Identification Scheme

Traditionally, vector autoregression (VAR) models propose an identification restriction based upon a recursive structure known as structural factorisation. This statistical decomposition separates the residuals into orthogonal (uncorrelated) shocks by imposing restrictions on the basis of an arbitrary ordering of the variables. The Cholesky decomposition implies the ordering of the most exogenous variables first, which responds contemporaneously only to its own shocks but not contemporaneously to shocks from other variable while other variables react to its shocks. The second variable responds to shocks from the first variable and to own shocks and so on. This follows the small open economy assumption where domestic shocks are assumed not to exert influence on major foreign economies, which is still a subject of debate in the research circles. This is regarded as the block exogeneity restriction in the literature.

It is important to note that these restrictions are limited to contemporaneous relations only as after one period, all variables in the system respond to all shocks. The resulting structure is referred to as being lower triangular, where all elements above the principal diagonal are zero. The recursive structure assigns the correlations between the errors to the first equation in the ordering, implying that a shock to the lower or endogenous variables cannot affect contemporaneously the exogenous variables (Riman, *et al.* 2014).

Identification restrictions have been noted in SVAR literature as a critical challenge. Restrictions show how the macroeconomy works and the conditions for the different shocks. There are basically three types of restrictions in the literature namely: making the system recursive, imposing parametric restrictions on the diagonal matrix and, imposing parametric restrictions on the impulse responses to the shocks (Ouliaris, Pagan and Restrepo, 2016). This thesis follows Kilian and Park (2009), Abhyankar, *et al*. (2013), Kang and Ratti (2013), and Wang, Wu and Yang (2013) to adopt the recursive approach premised on the assumption that as a small open economy, sector indices in Nigeria are incapable of influencing oil price that are internationally determined and highly exogenous to domestic fundamentals.

4.1.2.3 SVAR Model Specification

The recursive system, first introduced by Wold (1951), is typically lower triangular with uncorrelated structural shocks. These features make it assume the form of Cholesky decomposition and render the shocks economically interpretable. It basically assumes that variables ordered up in the system are not determined by those lower down. This ordering is guided by economic theory and institutional knowledge of the economy. In order to estimate the reduced form representation and then compute the Cholesky factorisation from the VAR covariance matrix, restrictions were not imposed on the major diagonal to allow for own shocks in the system. An exact identification of the structural equations requires imposing $n(n-1)/2$ restrictions on matrix A since one of the matrices is assumed to be an identity (see Breitung, *et al.* 2004). The recursive structure (structural factorisation) of the contemporaneous terms is such that the reduced form errors e_t are linear combinations of the structural errors ε_t as follows

$$e_t = \begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{oagu} \\ e_t^{insu} \\ e_t^{fbtu} \\ e_t^{cogu} \\ e_t^{bnku} \\ e_t^{mktu} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{21} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{31} & 0 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{41} & 0 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{51} & 0 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{61} & 0 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & a_{71} & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & a_{88} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{opru} \\ \varepsilon_t^{exru} \\ \varepsilon_t^{oagu} \\ \varepsilon_t^{insu} \\ \varepsilon_t^{fbtu} \\ \varepsilon_t^{cogu} \\ \varepsilon_t^{bnku} \\ \varepsilon_t^{mktu} \end{bmatrix} \quad (4.10)$$

Where ε_t^{opru}, ε_t^{exru} ε_t^{oagu}, ε_t^{insu}, ε_t^{fbtu}, ε_t^{cogu}, ε_t^{bnku} and ε_t^{mktu} captures the uncertainties in oil price; exchange rate; oil and gas; insurance; food, beverages and tobacco; consumer goods; banking and market all share index, respectively. Guided by economic intuition and judgment, we follow Kilian (2009) to assume that oil price is contemporaneously exogenous within a given month. This implies that though oil price influence other variables in the model, it does not itself respond to contemporaneous change in other variables within a given month. This assumption is underpinned by the fact that Nigeria is a small open economy, and changes in oil price is considered driven primarily by external factors such as international and regional political economy and production quotas set by organisations such as OPEC rather than domestic macroeconomic fundamentals.

Secondly, the assumption is also justified on the basis that over 90.0 per cent of foreign exchange earnings are derived from crude oil exports even as it is also heavily import-dependent, on the other hand. A change in oil price is, therefore, assumed to potentially impact on key economic outcomes owing largely to the huge dependence of the economy on crude oil export for foreign exchange earnings. The ordering of the sector stock returns also followed the exogeneity arguments. The oil and gas sector is ordered next after oil price and above other sectors given its capital-intensive nature and dominance by foreign investors whose activities are suggestively influenced by factors outside the purview of the domestic economy. Investments funds for the sector are sourced mainly from external or international capital markets while insurance is largely underwritten by foreign firms. It is, therefore, placed higher up and assumed to induce a response for other sectors but itself may not be significantly influenced contemporaneously.

Though the line of determining for certain, which among the insurance, food beverages and tobacco and consumer goods sectors, is more exogenous is thin, the fact remains that they all contribute to the activities in the banking sector, given the latter's financial intermediary role in the economy. It is also important to note that firms in the oil and gas sector constitute a high proportion of banks' high net worth customers. This implies that activities in all other sectors are very likely to reflect in the stock prices of the banking sector due to the interlinkages in the market. Consequently, the banking and stock market returns are ordered last, following Pastor and Veronesi (2012), which argue that, on the average, stock performance is dependent on the announcement effect of policy change. The inclusion of the stock market returns in the model is intended to capture the productive sector or output growth in the economy. It is modelled to contemporaneously respond to all variables in the economy and tracks the shifts in demand for commodities and business cycle.

Having specified the SVAR, the model was estimated at levels. The standard information criterion is used to determine the optimal lag length. The usual diagnostic tests were conducted to ascertain the stability of the model. Appropriate statistical tests were employed to examine the stochastic properties of the series. The impulse response functions, forecast error variance decomposition and historical decomposition are estimated and analysed.

4.1.3 Generating Uncertainty Measures

A fundamental challenge to financial decision making that includes risk and portfolio management, asset allocation and foreign exchange is the volatile feature of financial data evolutions. Several studies including Engle (1982), Bollerslev (1986), Nelson (1991), Engel and Ng (1993), Glosten, *et al.* (1993), among others, show that unconditional probability distribution of financial log-returns suffers from volatility clustering[13] that causes positive autocorrelation of squared log-returns. Meanwhile, conventional time series models operate with the assumption of constant variance and independent error terms. Since most macroeconomic time series fail to satisfy this assumption, and in order to estimate alternative models that deal with time series heteroscedasticity, Engle (1982) introduced the Autoregressive Conditional Heteroscedasticity (ARCH). The ARCH model, which is regarded as the workhorse of financial econometrics, is the most commonly-used and widely-implemented method in financial econometrics literature used to measure uncertainty in financial time series that exhibit time-varying volatility clustering.

The simple ARCH model is built on the notion that information from the recent past influences the conditional disturbance variance, leaving the unconditional variance constant. Engel's seminal framework has been severally extended to include Bollerslev (1986) Generalised ARCH (GARCH); Engel and Bollerslev (1986) Integrated GARCH (IGARCH); Engle, *et al.* (1987)

[13] Volatility clustering connotes periods of high or low variances which render policy making very challenging due to the associated uncertainty.

ARCH-in-Mean (ARCH-M); Baba, *et al*. (1990) multivariate GARCH (MGARCH); Nelson (1991) exponential GARCH (EGARCH); Zakoian (1994) threshold GARCH (TGARCH) and a host of other GARCH family of models. The principal uses of these models are to provide volatility measures that serve as input to financial decision making especially concerning risk analysis, portfolio selection and derivative pricing. This study measures uncertainty using the conditional variance estimated from GARCH(1,1). The GARCH approach has the advantage of allowing a split-up of the sources of uncertainty into anticipated and unanticipated changes much more than variability, which is what the variance or standard deviation method yields.

4.1.3.1 Evaluation of Time Series Properties and ARCH Effects

The GARCH model operates on the ARCH(q) model platform, made up of two equations or components, namely the conditional mean equation (conventional regression equation) and the conditional variance equation, which model the time-dependent variance of the mean equation. Both are simultaneously estimated. The autoregressive first order mean and variance equations are, respectively, expressed as:

$$y_t = a_0 + a_1 y_{t-1} + \varepsilon_t \text{, where } \varepsilon \approx D(0, h_t) \quad (4.11)$$

and

$$h_t = \omega + a_1 \hat{\varepsilon}_{t-1}^2 \quad (4.12)$$

The simple ARCH disturbance is built on the notion that information from the recent past influences the conditional disturbance variance. The ARCH (1) model suggests that a shock in the last period will necessarily cause the value of ε_t to be bigger, in absolute terms, because of the squares. It follows, therefore, that when ε_t^2 is large/small, the variance of the next innovation ε_t is also equally large/small. It says that the variance of the error term at time t depends upon the squared error terms from previous periods. Since the variance represents the second moment of the process, it follows that the two equations constitute a system. In this case, the mean is an AR (1) process and the variance process is also an autoregressive process of the first order. Generally, we have an ARCH process as:

$y_t = \mathrm{E}\{y_t \mid I_t\} + \varepsilon_t$, the mean process,

Where $\varepsilon_t \sim D(0, h_t)$

$h_t = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2$, the variance process, ARCH (q)

4.1.3.2 The Generalised Autoregressive Conditional Heteroscedasticity (GARCH)

Bollerslev (1986) modified Engel's ARCH model to include the lagged conditional variance terms as autoregressive terms, which modelled the variance process as Generalised Autoregressive Conditional Heteroscedasticity (GARCH). As stated earlier, financial data is characterised by volatility clustering, where large changes in stock returns are followed by further large changes. GARCH(1,1) model specification, which is consistent with this volatility clustering and has a wide application in modelling volatility is used to generate measures of conditional variance (GARCH variance series) that serve as approximations for oil price uncertainty in the SVAR models used in chapters 6 and 7. According to Sadorsky (1999), the relationship between oil price shocks and stock returns is better understood when oil return volatility is derived from GARCH(1,1). Furthermore, in forecasting oil return volatility using various GARCH models, Sadorsky (2006) identified the GARCH(1,1) model as the most suitable. Consequently, we follow Lee, *et al.* (1995) and Elyasiani, *et al.* (2011) to generate oil return volatility using the GARCH(1,1). In its general form, a GARCH (p,q) modelled to include the AR and MA terms take the following form:

$$h_t = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j}^2 \qquad (4.13)$$

Where p and q capture the significant spikes in the autocorrelation function, ω is a constant term, the ARCH term ε_{t-i}^2 represents the $q-th$ squared residual from the mean equation and captures update about the volatility from the previous period, and the GARCH term h_{t-1}^2 represents $p-th$ period forecast variance. The value of the scaling parameter h_t depends on the past values of the shocks, which are captured by the lagged squared residual terms, and on past values of itself, which are captured by lagged h_t terms. If there is no ARCH or GARCH effect, the sum of the coefficients should be equal to zero such that:

$$\sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=j}^{p} \beta_j h_{t-j}^2 = 0 \qquad (4.14)$$

The sum of the coefficients $(\sum \alpha_i + \sum \beta_j)$ shows the long-run solution of the GARCH process. Where the coefficients sum to unity $(\sum \alpha_i + \sum \beta_j = 1)$, it becomes an Integrated GARCH (IGARCH) process, implying the persistence or permanent effect of volatility shocks.

Thus, oil price volatility was generated from the estimation of equations (4.13) and (4.14) on the basis of the model parsimony, the coefficients satisfying the non-negativity constraint and the absence of ARCH effect. These volatility measures are used here to proxy for oil price uncertainty in the SVAR models in chapters 6 and 7. The computation and measurement of industry sector returns uncertainties followed the same process.

4.1.4 Unit Root Tests

A common feature of macroeconomic and financial time series established in the literature is the existence of the trending behaviour or non-stationarity in the mean. In order to remove the trend, the data has to be transformed to stationarity prior to analysis. Usually, two trend removal or de-trending procedures namely differencing and time trend regression are used to render the data stationary. Pre-testing for unit root becomes a prerequisite for cointegration analysis to avoid spurious regressions. More so, determining the mean-reverting behaviour of the prices of assets is a common trading strategy in finance and unit root is often used in that regard to identify which assets exhibit this behaviour.

The investigation of the existence of long-term relationship between changes in oil price and sector stock market returns in Nigeria, thus, begins with the test for the presence of unit root in the oil and stock price series in logarithm. The three standard tests in the literature, namely the augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests were employed in that regard.

4.1.4.1 Augmented Dickey-Fuller (ADF) Unit Root Test

The augmented Dickey-Fuller (ADF) test, introduced by Dickey and Fuller (1979) is computed as

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i-1} + \varepsilon_t \qquad (4.15)$$

Where

$$\gamma = -\left(1 - \sum_{i=1}^{p} a_i\right) \text{ and } \beta_i = -\sum_{j=i}^{p} a_j$$

The coefficient of interest in equation (4.15) is γ based on the t-statistic estimated from an OLS equation. According to Lutkepohl (2004), the test does not have an asymptotic standard normal distribution. Critical values are obtained by simulation and are different when a constant or linear term is included. So if $\gamma = 0$, the equation is in the first difference and adjudged as having a unit root or stationary and if the coefficient of a difference equation sums to one $(\sum a_i = 1)$, $\gamma = 0$ and the system has unit root. The test assumes that the errors are independent and have constant variance. The non-rejection of the null hypothesis suggest that the time series under consideration is non-stationary

4.1.4.2 Philip-Perron (PP) Unit Root Test

The Philip-Perron (PP) test, introduced by Philip and Perron (1988), is a modification of the ADF test with a mild relaxation of the stringent assumption with respect to the distribution of errors. The test takes an AR(1) process and is specified as

$$\Delta y_{t-1} = \alpha_0 \gamma y_{t-1} - e_t \qquad (4.16)$$

According to Asteriou and Hall (2007:298) "while the ADF test corrects for higher order serial correlation by adding lagged difference terms on the right hand side, the PP test made correction to the t-statistic of the coefficient γ from the AR(1) regression to account for the serial correlation in e_t". The null hypothesis for the PP test, just as the ADF is the existence of a unit root I(1), implying a rejection of the null hypothesis if the series are stationary I(0). Both test are similar in the use of the same asymptotic distribution of the t-statistic and can be conducted with the option of including a constant, a constant and a linear time trend or neither in the test regressions.

4.1.4.3 Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Unit Root Test

The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, which complements the previous two test approaches, is also used to examine the integrating properties of the series. The null hypothesis is that the series is stationary I(0) and is not rejected while the alternative hypothesis is that the series is non stationary I(1). The test assumes the absence of linear trend term and is expressed as

$$KPSS = \frac{1}{T^2} \sum_{t-1}^{T} s_t^2 / \hat{\sigma}_\infty^2 \qquad (4.17)$$

where

$S_t = \sum_{j=1}^{t} \hat{\omega}_t$ with $\hat{\omega}_t = y_t - \bar{y}$ and $\hat{\sigma}_\infty^2$ is an estimator of the long-run variance. If y_t is a stationary process, S_t becomes integrated of order one I(1).

In addition to the ADF procedure, testing for PP or KPSS involves the choice of the kernel and the bandwidth parameter needed to estimate the residual spectrum at zero frequency, following the Bartlett kernel and the Newey-West (1994) method. Generally, while the ADF test exhibit high propensity of rejecting the null hypothesis (that the series has a unit root); the PP test differs principally in the treatment of serial correlation and heteroscedasticity in the errors. The KPSS complements both the ADF and PP tests as it tests for the unit root and the stationarity hypotheses. As a practice, if the order of integration of the series or the number of unit root in the AR operator are not clear, implying the rejection of the null hypothesis, the series is differenced as many times as possible (conventionally twice) to make it stationary. This becomes a differenced series I(1). In using the three tests, we are also faced with the choice of the number of lagged difference terms of the dependent variable y_t sufficient to remove serial correlation in the residuals. The choice is based on model selection criteria. Usually the number of lags that minimise information criteria is chosen following the sequential elimination of insignificant coefficient, traditionally from the general to specific.

4.1.5 Cointegration Tests

In economic theory, the determination of long-run relationship between variables, which is a required condition when dealing with non-stationary time series data, is called cointegration. The concept is particularly important in SVAR analysis given its connectivity to the existence of long-run equilibrium relationship among non-stationary variables. According to Granger (1981), it is an equilibrium state where there is no endogenous tendency of economic variables to deviate, thus, making the drawing of meaningful interpretations from the relationship possible.

Though the Granger approach corrects for the trend feature of time series, the test, however, is fraught with limitations such as not stating which variable should be the regressor and which to be regressand; difficulty in handling more than one cointegrating relationship and reliance on two-step estimation procedures (Asteriou and Hall, 2007 and Enders, 2010). Consequently, Stock and Watson (1988), Johansen (1988) and Johansen (1995) introduced standard econometric techniques for dealing with non-stationary data, which are integrated and cointegrated. The approach circumvents the Granger shortcomings, implying the formation of several equilibrium relationships governing joint evolution. The procedure, which is a multivariate generalisation of the Dickey-Fuller test, uses the reduce-rank method to test for the rank of π in a typical higher autoregressive process expressed as

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t \qquad (4.18)$$

where y_t is a n-vector of nonstationary I(1) variables $(y_{1t}, y_{2t}, \ldots, y_{nt})$; and ε_t represents iid n-dimensional vector with zero mean and variance matrix $\sum_\varepsilon$.

Analogous to the augmented Dickey-Fuller test, equation (4.18) can be rewritten in compact form as

$$\Delta y_t = \pi y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + \varepsilon_t \qquad (4.19)$$

where

$\pi = -\left(1 - \sum_{i=1}^{p} A_i\right)$ and $\pi_i = -\sum_{j=i+1}^{p} A_j$

According to Enders (2010), the notable feature in equation (4.19) is the rank of the matrix π, which is equal to the number of independent cointegrating vector. If rank $\pi = 0$, the matrix is considered null, but if π is rank n, the vector process is stationary. If rank $\pi = 1$, there exist a single cointegrating vector and πy_{t-1} is the error correction term, while multiple cointegtrating equations exist if $1 < \pi < n$.

In determining the number of cointegrating relationships, the test uses the maximum statistic and trace statistic to compute the number of characteristic roots that are insignificantly different from unity as follows

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_i) \qquad (4.20)$$

and

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \qquad (4.21)$$

Where $\hat{\lambda}_i$ is the characteristic roots (eigenvalues) estimated from π matrix while T is the number of observations. The maximum test is ordered from the largest to the least considering whether they are significantly different from zero. The trace test is a likelihood ratio test, which traces the matrix to detect if the addition of eigenvalues will increase the statistic, with the null hypothesis being that the number of cointegrating vectors is less than or equal to r. In both cases, the convention is to consider the values of r associated with the test statistic that exceeds the displayed critical values in a descending order.

4.1.6 Impulse Response Function

Impulse response function (IRF) measures the responses of each of the variables in the system to a one-time innovation from other variables. It decomposes the total variance of a time series into the percentages attributable to each structural break and help to identify sources of business cycles as well as importance of such economic fluctuations. The SVAR residuals are necessarily orthogonalised so as to appropriately display the pattern of the shock in the system. In an SVAR, it is the imposition of restriction on parameters that accord the shocks an economic interpretation. Considering a moving average representation of an identified SVAR as

$$y_t = C(L)e_t \qquad (4.22)$$

The variance of y_{it} is given by

$$\text{var}(y_{it}) = \sum_{k=1}^{n}\sum_{j=0}^{\infty} C_{ik}^{j2}\,\text{var}(e_{kt}) \qquad (4.23)$$

$= \sum_{k=1}^{n}\sum_{j=0}^{\infty} C_{ik}^{j2}$ where $\sum_{j=0}^{\infty} C_{ik}^{j2}$ is the variance of y_{it} generated by the k^{th} shock, implying that

$\frac{\sum_{j=0}^{\infty} C_{ik}^{j2}}{\sum_{k=0}^{n}\sum_{j=0}^{\infty} C_{ik}^{j2}}$ is the percentage of variance of y_{it} explained by the k^{th} shock.

4.1.7 Forecast Error Variance Decomposition

The forecast error variance decomposition (FEVD) measures the percentage of the forecast error in each sector return contributed or explained by other market returns. It shows the relative impact of one market on another and provides complementary information that aid the understanding of the dynamic relationship among the variables jointly analysed in the model. FEVD intrinsically show the extent to which the behaviour of a variable in the system is influenced by its own shock and the different structural innovations in the model at different horizons. Put differently, it allows for the comparison of the roles played by different variables in causing reactions in other variables (Bernanke, 1986, Blanchard and Quah, 1989 and Shapiro and Watson, 1988).

Generally, the *n*-step ahead forecast error denote the *n*-period forecast variance of y_{t+n} as $\sigma_y(n)^2$, then

$$\sigma_y(n)^2 = \sigma_y^2[\phi_{11}(0)^2 + \phi_{11}(1)^2 + \ldots + \phi_{11}(n-1)^2]$$
$$+\sigma_{y2}^2[\phi_{12}(0)^2 + \phi_{12}(1)^2 + \ldots + \phi_{12}(n-1)^2]$$
$$\vdots$$
$$+\sigma_{yk}^2[\phi_{jk}(0)^2 + \phi_{jk}(1)^2 + \ldots + \phi_{jk}(n-1)^2] \qquad (4.24)$$

Consequently, the n-step-ahead forecast error variance proportion due to each shock is obtained by dividing equation (4.24) by $\sigma_y(n)^2$, which gives the percentage contribution of one variable to the n-step forecast error variance of another variable. This is algebraically expressed as

$$\frac{\sigma_y^2[\phi_{11}(0)^2+\phi_{11}(1)^2+...+\phi_{11}(n-1)^2]}{\sigma_y(n)^2}$$

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$$\frac{\sigma_{yk}^2[\phi_{jk}(0)^2+\phi_{jk}(1)^2+...+\phi_{jk}(n-1)^2]}{\sigma_y(n)^2} \qquad (4.25)$$

Since FEVD explains the proportion of variance due to its own shock and those of other variables, it follows that if a shock fails to explain any forecast variance error of another variable at all forecast horizons, the sequence could be said to be exogenous. On the other hand, if the shock explains all of the forecast error variance of another variable, the sequence is considered endogenous. Empirically, it is a common phenomenon for a variable to explain almost all of its forecast error variance at short horizon and smaller proportions at longer horizons.

4.1.8 Historical Decomposition

The historical decomposition measures the contribution of observed values of the endogenous variables relative to the structural shocks and the path of the exogenous variables. It computes the historical effect and the relative importance of shocks as well as evaluates the path of the series in the past in terms of recovered values for the structural shocks and the observed path of the exogenous variables. In other word, historical decomposition is used to trace the source of a shock and its effect on the variable of interest over a long time. Given that all shocks and exogenous variables act simultaneously, historical decomposition make a comparative analysis of their relative effects over the endogenous variables possible. It is particularly useful when the consideration is the relative importance of shocks over some sets of variables (Ocampo and Rodriguez, 2012). Historical decomposition, an in-sample exercise conditioned on the initial values of the series and the structural vector moving average representation conditional on the initial values of the endogenous variable is defined as

$$y_t = \sum_{i=0}^{T-1} C_i \varepsilon_{t-i} + K_t \qquad (4.26)$$

The K_t in the equation above represents a function of the initial values of the endogenous variable that capture the effect of the shocks realised in the preceding sample as well as the parameters of the reduced form model defined as

$$K_t = f_t(y_o, ..., y_{-(T-1)})$$

If the VAR model is stable, K_t approaches infinity when t increases as too far away shocks have no effect on current values. K_t, therefore, becomes the reference value of the historical decomposition. To decompose the deviations of y_t from K_t into the effect of the current and past values of the structural shocks (e_i for i from 1 to t), an auxiliary variable y_t is introduced such that

$$\tilde{y}_t = y_t - K_t = \sum_{i=0}^{T-1} C_i \varepsilon_{t-i} \qquad (4.27)$$

The historical decomposition of the $i-th$ variable of $\tilde{y}_t$ into $j-th$ shock is given by

$$\tilde{y}_t^{(i,j)} = \sum_{i=0}^{t-1} C_i^{ij} \varepsilon_{t-i}^{ij} \qquad (4.28)$$

When t increases, and K_t is close to y_t, $\tilde{y}_t^{(i,j)}$ can be interpreted as the deviation of the $i-th$ endogenous variable from its mean caused by the recovered sequence for the $j-th$ structural shock[14].

4.2 Data Description and Variable Definition

4.2.1 Data Description

Monthly data spanning January 1997 to March 2016, consisting 219 observations, is used in the analysis of the time-varying impact of oil price

14 (See Ocampo and Rodriguez, 2012 for more detailed discussions).

uncertainty on sectoral stock returns in Nigeria. The preference for the monthly series is premised on the fact that it is devoid of the noise and anomalies often associated with higher frequency data and capture much of the information content of stock indices and oil price volatility (Sadorsky, 2001 and Aleisa, *et al.* 2003).

The reclassification of industry sectors by the Nigeria Stock Exchange (NSE) in 2009, with a view to aligning the market with the global industry classification standards (GICS), led to the streamlining of the number of industry sectors from thirty-three to twelve. Of the twelve broad representative industry sectors, the study used only five sectors' indices namely: the banking (*bnk*); insurance (*ins*); food, beverages and tobacco (*fbt*); oil and gas (*oag*) and consumer goods (*cog*). Other sectors in the market were excluded from the sample due to paucity of data for meaningful analysis. Each index describes the overall performance of large-capitalisation firms in the sector. Stock price index, in domestic currency, is obtained from the Nigerian Stock Exchange, while the West Texas Intermediate (WTI), representing world oil price series, expressed in US dollar per barrel, is obtained from the US Energy Information Administration. WTI is an international benchmark for oil pricing and is highly correlated with the price of Brent, Dubai and Nigeria's Bonny Light crude oil streams.

4.2.2 Variables Definition

4.2.2.1 Sector Stock Returns:

In the study, sector stock returns, used as the dependent variable for each of the equations in the multifactor regression models (chapter 5) and regressands in the SVAR models (chapter 6 and 7) is computed as the annualised growth rate of sector stock index

$$R_{i,t} = \ln\left[\frac{spi_t}{spi_{t-s}}\right] \qquad (\text{s} = 12)\ ;\ i = 1,\ 2, ..., 5 \qquad (29)$$

where $R_{i,t}$ is defined as the log of the returns of sector i at time t, $s = 12$ reflects the year-on-year changes, while epi_t and epi_{t-s} represent the current and lagged value of sector price index in month t and $t-s$, respectively.

4.2.2.2 Market Returns

The inclusion of market portfolio in multifactor models is informed by the theoretical works of Sharpe (1964) and Merton (1973). This study follows Sadorsky (2001) and Agusman and Deriantino (2008) to introduce market returns, represented by the market all share index (ASI), to estimate what Gogineni (2007) called the incremental impact of oil price change on aggregate demand or economic activity of the sector. Since many macroeconomic indicators are nested in the market index, the inclusion of market returns is, therefore, with a view to determining how macroeconomic variables dynamically influence equity prices (wealth effect). Its coefficient captures the impact of changes in expected aggregate demand or economic activity. Sadorsky (2001) believes that the direction and magnitude of such change affect the risk premium and expected returns of stocks. Market return is computed as

$$mkt_t = \ln\left[\frac{asi_t}{asi_{t-s}}\right] \qquad (s = 12) \qquad (4.30)$$

where, as in previous definitions, asi_t and asi_{t-s} are the contemporaneous and lagged market all share index in month t and $t-s$, respectively.

4.2.2.3 Oil Price

Oil is a critical production input and its price change is reflected in firm value. Since crude oil is usually quoted in US dollars, currency changes, thus, constitute a risk in foreign investment, especially in the oil industry. According to Nandha and Hammoudeh (2007), the domestic price of oil affects stock returns in two major ways: directly through future cash flows and indirectly through discount rate. In determining the sensitivity of sector returns to changes in the currency, this study adopts the international oil price component given that Nigeria, as an OPEC member country, is a price taker. More so, implicit in the international oil prices are taxes and retailer margin elements. Consequently, the West Texas Intermediate (WTI), identified by EIA as the international benchmark or "marker" for the pricing of a number of crude oil streams is used. Oil price in all the models is, thus, calculated as the logarithmic changes in the price of WTI and expressed as

$$opr_t = \ln\left[\frac{wti_t}{wti_{t-s}}\right] \quad (s = 12) \qquad (4.31)$$

where wti is the logarithm of the price of WTI expressed in US dollar (since oil is an international commodity), $s=12$ is set to obtain year-on-year growth and wti_t and wti_{t-s} is oil price in month t and $t-s$, respectively.

Sector stock returns and output are not exclusively determined by oil price movement but also by other economic fundamentals. Consequently, some selected macroeconomic variables including market returns, exchange rate, inflation, interest rate and output (proxied by index of industrial production) are incorporated in the model. The inclusion of the variables is in tandem with the literature given their critical roles in the transmission of oil price impulses to the macroeconomy, as well as their ability to capture the direct and indirect linkages among the variables of interest in the model.

4.2.2.4 Exchange rate

Exchange rate is included to capture foreign exchange risk, premised on the argument that international oil prices strongly influence stock price movements and the domestic economy especially under volatile circumstances (Nandha and Hammoudeh, 2007 and Faff and Brailsford, 1999). For import-dependent economies, such as Nigeria, with a high proportion of foreign assets held in foreign currency and most of its trading and international obligations transacted in US$ denomination, a change in exchange rate would inevitably set in motion a chain of ripple effects with dire economic consequences, particularly on stock returns, particularly if the reserve level is low. Here, the interbank foreign exchange rate $(ibxr)$ is used due to its responsiveness to market activities compared with the average nominal exchange rate. In order to ensure the correctness and consistency of the log transformed variables, exchange rate was computed using the direct quotation as

$$exr_t = \ln\left[\frac{ibxr_t / usd_t}{ibxr_{t-s} / usd_{t-s}}\right] \qquad (s = 12) \qquad (4.32)$$

where $ibxr_t / usd_t$ and $ibxr_{t-s} / usd_{t-s}$ are the log change in the monthly interbank exchange rate of the Naira expressed as the number of units of Naira price per one US dollar in the current and lagged periods, respectively. A negative (positive) outcome indicates the appreciation (depreciation) of the Naira against the US dollar using the direct quote. An increase (reduction) in the exchange rate means that more (fewer) units of the domestic currency are needed to purchase one unit of the foreign currency, which is a depreciation (appreciation) of the domestic currency.

4.2.2.5 Inflation Rate

While Chen, *et al.* (1986) included inflation rate in their specification in view of its observed correlation with real interest rate, Fama (1981) included it because of its inherent information content about future real economic activity. Hence, inflation is defined as the year-on-year first difference in the logarithm of the consumer price index (Base November 2009=100) for period t, and is algebraically expressed as

$$\inf_t = \ln\left[\frac{cpi_t}{cpi_{t-s}}\right] \qquad (s = 12) \qquad (4.33)$$

where cpi_t and cpi_{t-s} are the consumer price index in the current and lagged periods, respectively.

4.2.2.6 Interest Rate

Flannery and James (1984) empirically found the inclusion of interest rate in the market model to have substantially improved the explanatory power of the models. Term structure of interest rate (term premium) in macroeconomic literature is often defined as the difference between short-term, represented by the 90-day Treasury bill rate (tbr_t) and the long-term interest rate in the market, represented by the 10-year government bond rate (gbr_t). Thus, Chen, *et al.* (1986), Hamao (1988) and McSweeney and Worthington (2008) compute term premium rate as

$$trm_t = (gbr_t - tbr_t) - (gbr_{t-1} - tbr_{t-1}) \qquad (4.34)$$

where $(gbr_t - tbr_t)$ is the term premium at current period time t and lagged period $t-1$, respectively.

However, in the case of Nigeria, the bond market segment is grossly shallow (dominated by Federal government development stocks), following the suspension of the issuance of instruments in 1986. Though the suspension was lifted in 2003, however, a wide data gap on bond rate made the data series not suitable for analysis. Consequently, this study adopts the short-term interest rate, represented by the 90-day Treasury bill rate (tbr_t), as the proxy for term premium. Theoretically, in a high interest rate regime, resources move from consumption to savings, while low interest rate spurs domestic investment and consumption at the expense of savings. It has also been severally argued in the literature that in a regime of high international capital mobility, investors rationally move capital to markets with high interest rate, fuelling speculations in equities, real estates and exchange rates.

4.2.2.7 Index of Industrial Production

The index of industrial production $(iipd)$ is a composite measure of the short-term changes in the growth of a basket of industrial sectors usually in a given period compared to a reference (base) period. It represents the measure of changes in the level of real output in the industrial sector of the economy. In Nigeria, the index measures the output of three broad industrial sector activities namely manufacturing, mining and electricity. The contribution to gross domestic product (GDP), which averaged 1.8 per cent between 2007 and 2016 and an all-time peak of 20.1 per cent in 2011, is minimal owing largely to infrastructural inadequacies and structural rigidities. The monthly series, which better reflects the growth of the various sectors of the economy, is published by the national bureau of statistics. The growth of the index is computed as

$$iip_t = \ln\left[\frac{iipd_t}{iipd_{t-s}}\right] \qquad (s = 12) \qquad (4.35)$$

Where $iipd_t$ and $iipd_{t-1}$ represents the contemporaneous and lagged index of industrial production.

4.2.2.8 Credit to the Private Sector

Credit to the private sector (crps) represents the quantum of domestic credit devoted to financing private economic activities, excluding government operations, by the banking system. It is used here to measure the extent to which government borrowing crowds out private credit as both lay claims to the available domestic credit. Lower credit to the private sector is an indication of a crowding out suggesting that higher interest rate in government securities could have shifted patronage from private sector financing to risk free and high yielding government securities. The growth in the series is computed as

$$cps_t = \ln\left[\frac{crps_t}{crps_{t-s}}\right] \qquad (s = 12) \qquad (4.36)$$

Where cps_t and cps_{t-1} represents the contemporaneous and lagged credit to the private sector. While a negative cps indicates government crowding of private sector credit, a positive cps indicates otherwise.

CHAPTER FIVE

ESTIMATING INDUSTRY STOCK RETURNS SENSITIVITY TO OIL PRICE CHANGES IN NIGERIA

5.0 Introduction

Against the background outlined in the previous chapter, this chapter presents the application of the multifactor regression model as discussed in section 4.1.1 of chapter four. Three models (equations 4.3, 4.4 and 4.7) are estimated to highlight the effects of oil price change on the returns of the individual industry sector; measure the exposure or sensitivity of the sector returns to innovations in oil price returns, and determine the persistence of such disequilibria in the system. In model one, a multiplicative dummy is included to capture the impact of the global financial crises, while in model two, the study follows Hamilton (1996) and Kilian (2008) to employ net oil price increase (NOPI) and net oil price decrease (NOPD) to represent oil price asymmetric effect. This is in contrast to the traditional approach that differentiates between positive and negative binary oil price change in the construction of dummies (Agusman and Deriantino, 2007 and McSweeney and Worthington, 2008). In the third model estimates oil price change with 12 lags and stock market to ascertain the level of persistence of oil price innovation on the sectors.

Overall, five equations, one for each sector, are estimated and analysed. The results confirm varying levels of sector exposure to oil price fluctuations. In each of the models, the dependent variable is the sector's stock return index, while the regressands remain same for all models. Other variables are included in the models on the argument that industry stock returns is not exclusively determined by oil price but also by a conglomeration of macroeconomic factors. Though emphasis in the analysis is placed on the effect of oil price returns, other control variables are employed in the model to determine the degree of interdependence or dynamic interactions within the system. Evidence from the third model is intended to determine the length of time (persistence) impulses of oil price change remain and influence activities of the various sectors of the stock market. A general inertia was noticed across all sectors with oil price manifesting stronger interaction within the first six months after the shock period. Total market was included to measure the relative cumulative or aggregate impact for comparative purposes.

The five chosen sectors are broad and representative of the cross section in the market. The choice of variables and frequency is informed by data limitation occasioned by the introduction of new series by the NSE following the reclassification of the market in the 2009 reforms. This led to the discontinuation of some sub-market series resulting in their exclusion from the analysis. The data transformation process is as described in section 4.2.2 in the previous chapter.

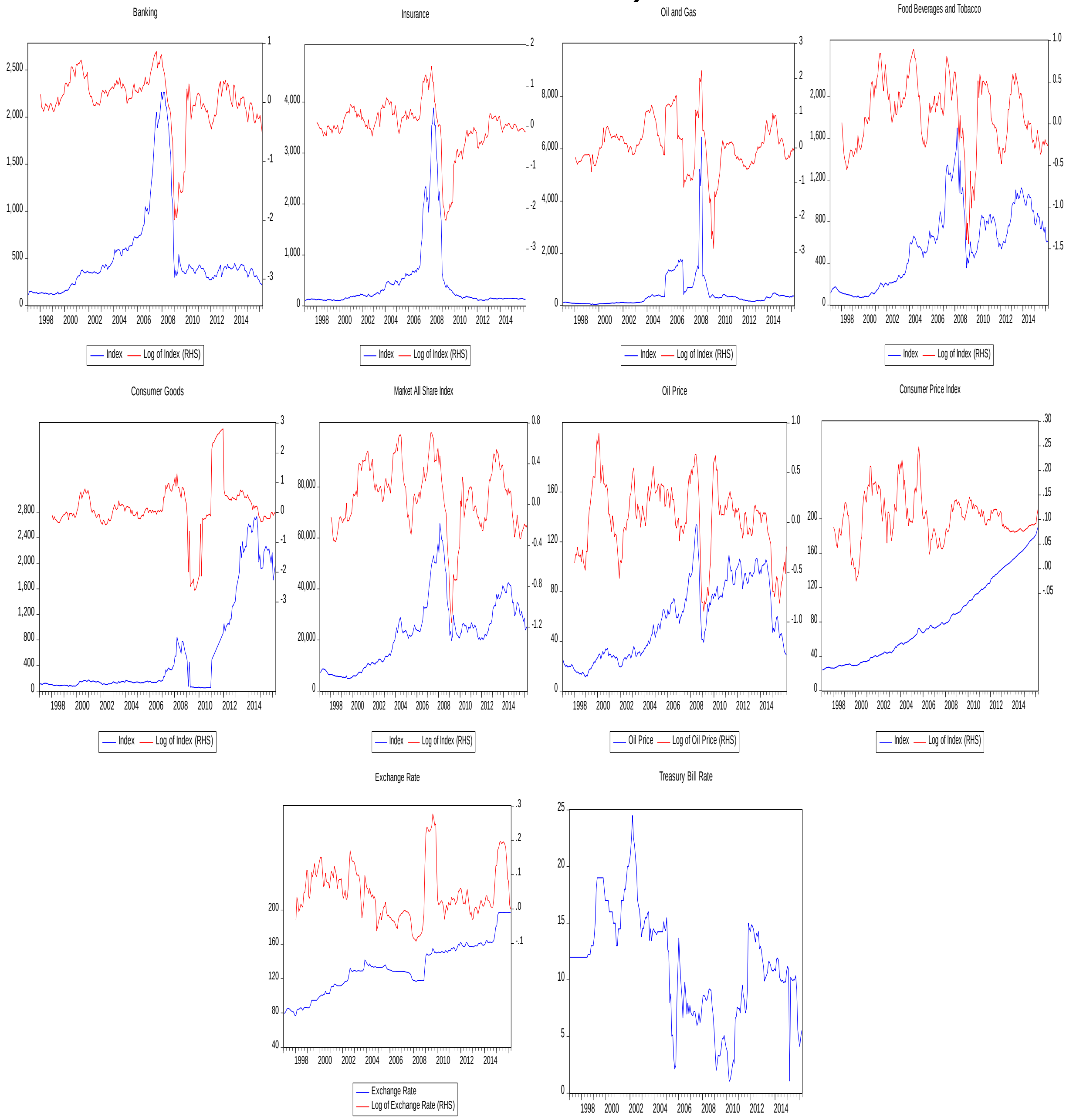
5.1 Preliminary Estimation and Analysis

The multifactor regression model as specified in equation 4.3 is estimated with the OLS technique. Since the interest in this section is to ascertain whether or not oil price provides additional information about the behaviour of industry stock returns, the statistical properties of the series is first examined, adopting the standard unit root test procedures discussed in section 4.1.4 of chapter four. The graphical plots (Figure 5.1) give a visual assessment of the data properties and the transformation that would be needed. The unit root test displays the non-stationary characteristics of the series, a common and dominant behaviour of aggregate economic time series data. In other words, it basically shows how the movement of the series grows around or deviates from the population mean (mean reverting). Where the elements in the series are found non-stationary, the series is transformed, usually by differencing, to achieve stationarity and establish the existence of long-run equilibrium relationships (cointegration).

5.1.1 Graphical Plots

Figure 5.1 provides the visual impulse of the trends. An assessment of the graphs suggests that all the variables exhibit volatility that may be non-normal. An assessment of the graphs reveals seeming episodes of troughs (deepening) and spikes (upswings) between 2008 and 2010, which coincides with the global financial crisis.

Figure 5.1: Plots of Log Returns of Market Indices and Macroeconomic variables (Jan. 1997 – Mar. 2016)



This suggests evidence of the presence of structural breaks in the system. The deep plunge in oil price during the crisis is reflected in the significant crash in the market and industry returns, followed by the steep depreciation in the exchange rate and the sharp rise in inflation and interest rates. Though the post-crisis period was marked with a general rebound, a downward moderation, especially from 2014, is observed.

5.1.2 Unit Root Tests

The relationship between oil price innovations and stock returns is examined from the individual sector perspectives. The results of the unit root test, presented in Table 5.1, shows that all the variables are stationary at level, that is, integrated of order zero 1(0) at 1 and 5 per cent level of significance. This denotes the rejection of the null hypothesis, rendering the series suitable for regression analysis, justifying the existence of cointegration in the model.

Table 5.1: Unit Root Tests

		Level			Order of integration
		ADF test-stat	PP test-stat	KPSS LM-test	
Banking		-12.399**	-12.518**	0.059*	1(0)
Insurance		-7.739**	-13.129*	0.083*	1(0)
Food, beverages and tobacco		-13.336*	-13.405**	0.103*	1(0)
Consumer Goods		-22.384*	-21.010*	0.041*	1(0)
Oil and gas		-9.714**	-16.408*	0.062*	1(0)
Oil price		-11.248*	-11.232*	0.088*	1(0)
Market All Share Index		-13.171**	-13.336**	0.089*	1(0)
Exchange rate		-10.524*	-10.183*	0.109*	1(0)
Consumer Price Index		-12.003*	-11.708*	0.034*	1(0)
Interest Rate		-15.259	-15.268	0.124	I(0)
Critical Values	(1%)	-3.999		0.216	
	(5%)	-3.429		0.146	
	(10%)	-3.138		0.119	

Source: Author's computation

Notes: All variables are in their log returns form as defined in chapter 4. ADF and PP tests are conducted without trend and intercept while the KPSS test was with the intercept only. The Bartlett Kernel spectral estimation method was selected for KPSS. *, ** and *** indicate the rejection of the null hypothesis at 1%, 5% and 10%, respectively.

5.1.3 Descriptive Statistics

The descriptive statistics for individual sector returns as well as the changes in the macroeconomic factors in their log returns form is presented in Table 5.2.

The results suggest that while significant variation in the series was evident in the marked difference between the minimum and maximum values, the sample mean and median vary across sectors.

In Table 5.2, *bnk*, *ins*, *fbt*, *cog*, and *oag* are the log returns of banking, insurance, food beverages and tobacco, consumer goods and oil and gas sector indices, respectively, with other variables as earlier defined. Adopting the standard deviation as the measure of volatility, a cursory analysis shows that among the five activity sectors, consumer goods sector exhibits the highest index return volatility at 0.89, followed by oil and gas (0.72) and insurance (0.62).

Table 5.2: Descriptive Statistics

	BNK	*INS*	*FBT*	*COG*	*OAG*	*OPR*	*MKT*	*EXR*	*INF*	*TBR*
Mean	0.043	0.005	0.089	0.160	0.067	0.042	0.074	0.048	0.105	11.261
Median	0.102	0.039	0.111	0.062	0.074	0.081	0.103	0.029	0.103	11.300
Maximum	0.865	1.487	0.896	2.809	2.220	0.894	0.704	0.277	0.249	24.500
Minimum	-1.994	-2.297	-1.440	-2.598	-2.886	-0.892	-1.155	-0.094	-0.025	1.040
Std. Dev.	0.483	0.623	0.432	0.886	0.719	0.368	0.342	0.077	0.046	4.929
Skewness	-1.945	-1.487	-0.635	-0.081	-0.378	-0.442	-0.672	0.768	0.202	0.040
Kurtosis	8.308	7.068	3.665	6.672	5.149	2.868	3.866	3.282	3.767	2.503
Jarque-Bera	395.18	231.75	18.777	123.28	47.396	7.291	23.329	22.256	6.856	2.313
Probability	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.000	0.032	0.314

Source: Author's computation

Notes: OPR=oil price; EXR=exchange rate; OAG=oil and gas; INS=insurance; FBT=food beverages and tobacco; COG=consumer goods; BNK=banking and MKT=market all share index

Among the macroeconomic factors, consumer price index exhibits the most relative stability with the least volatility (0.05), while interest rate displays high fluctuations with a standard deviation of 4.93 per cent. In terms of statistical distribution, all the series, except exchange rate, inflation rate, and interest rate show evidence of negative skewness, implying the extreme fatness of the left tail. With respect to normality, the kurtosis indicates a leptokurtic distribution across the five activity sectors, except oil price, implying fatter than normal tails. The claim of non-normality of the distribution, as indicated by the skewness and kurtosis, is further confirmed by the high probability values of the Jarque-Bera (JB) statistic.

5.1.4 Correlation Matrix

Table 5.3 illustrates the correlation relationship among the variables in the model. The correlations between oil price and the various sector returns appear generally moderate and positive. This finding is in tandem with the observations of Arouri and Nguyen (2010) for the European countries, where the positive relationship suggested higher expected economic growth and earnings in the face of rising oil price and vice versa. The highest co-movement is recorded for the banking sector (0.50), while food beverages and tobacco, and oil and gas sectors recorded 0.43 and 0.41, respectively. The consumer goods stock returns surprisingly recorded the lowest correlation of 0.30.

A significant inverse relationship is observed between exchange rate and the various sector returns, indicating a dampening effect of exchange rate depreciation on the performances of stock returns. However, it is expected that the reverse would hold when international oil price increase improves foreign exchange position. While oil price show positive linkages with all sector returns, the relationship between inflation and the sector returns is mixed; contracting the activities of the banking, insurance and consumer goods sectors but expanding others.

Table 5.3: Correlation Matrix

	BNK	*INS*	*FBT*	*COG*	*OAG*	*OPR*	*MKT*	*EXR*	*INF*	*RIR*
Banking	1									
Insurance	0.888	1								
Food Bev Tobacco	0.828	0.694	1							
Consumer Goods	0.439	0.539	0.299	1						
Oil and Gas	0.488	0.551	0.473	0.297	1					
Oil Price	0.504	0.362	0.428	0.296	0.405	1				
Market All Share Index	0.882	0.798	0.935	0.394	0.478	0.438	1			
Exchange Rate	-0.553	-0.575	-0.445	-0.478	-0.468	-0.437	-0.488	1		
Consumer price index	-0.059	-0.072	0.174	-0.112	0.258	-0.130	0.053	0.014	1	
Treasury Bill Rate	0.311	0.317	0.207	0.176	0.135	0.146	0.293	0.093	-0.017	1

Source: Author's computation

Notes: OPR=oil price; EXR=exchange rate; OAG=oil and gas; INS=insurance; FBT=food beverages and tobacco; COG=consumer goods; BNK=banking and MKT=market all share index

Overall, there are evidences of strong and positive co-movements between market returns index and the returns of the food, beverages and tobacco, banking and insurance sector at 0.94, 0.88 and 0.80, respectively. Oil price is inversely related with exchange rate and inflation rate but positively related with interest rate, consistent with theoretical expectations. Similarly, exchange rate relates with inflation and interest rate positively.

5.1.5 Serial correlation and Heteroscedasticity tests

A preliminary estimation of model 1 (equation 4:3 in chapter four) is conducted for the five industry sectors to ascertain the compliance and satisfaction of the classical assumptions of least square residual. The test for the presence of serial correlation and heteroscedasticity, as depicted in Table 5.4, are conducted using the standard Breusch-Godfrey Lagrange multiplier and White's heteroscedasticity procedures. Where serial correlation and heteroscedasticity are detected, the Newey and West method is used for correction. Finally, a check for multicollinearity was also carried out using the variance inflationary factor (VIF)[15].

Table 5.4 depicts the serial correlation, heteroscedasticity tests and variance inflationary factor results. The results reject the null hypothesis of no serial correlation, implying the presence of serial correlation of the first order due to the statistical significance of the first lagged residual term. Equally the null hypothesis of homoscedasticity for all the industry sectors is rejected, suggesting a heteroscedastic error variance as the LM statistic is larger than the critical value and the *p-value* is less than 0.05 significance level. This implies that the slope coefficients are simultaneously equal to zero in these models at different orders. White's heteroscedastic test was used due to its

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[15] Variance Inflationary Factor is computed as $VIF = \frac{1}{1-R^2}$ where R^2 is the unadjusted R-squared or correlation coefficient. While there is no table of formal critical VIF values, a common rule of thumb is that if a given VIF is greater than 5, then multicollinearity is severe and if it is less than 5, it is considered to be at a tolerable level. (Studenmund, 2011).

superiority and flexibility over other methods, especially in the inclusion of the F-statistic that indicates the loss of degree of freedom.

These conclusions are drawn from the relatively high values of both the LM-statistic and F-statistic and the associated small *p-values* that are less than 0.05 for a 95 per cent confidence interval, which suggest the rejection of the null hypothesis of no serial correlation. It is also noted that while the first lagged residual term is statistically significant at 5 per cent, indicating the presence of first order serial correlation, the same cannot be said of the second order residual term for all sectors except consumer goods.

Table 5.4: Serial Correlation and Heteroscedasticity Tests

		Industry Sectors				
		Banking	**Insurance**	**Food & Bevg**	**Oil & Gas**	**Con Goods**
Serial Correlation*	F-Stat	**398.728**	**309.207**	**80.397**	**241.213**	**371.273**
	p-values	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	LM-stat	**172.520**	**163.484**	**94.969**	**152.581**	**170.719**
	p-values	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Heteroscedasticity**	F-Stat	**14.301**	**11.594**	**4.947**	**3.947**	**13.141**
	p-values	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	LM-stat	**63.099**	**54.105**	**26.897**	**78.432**	**59.367**
	p-values	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Reside 1	Coefficient	**0.885**	**0.808**	**0.662**	**0.748**	**0.587**
	p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Reside 2	Coefficient	0.009	0.069	-0.002	0.105	**0.331**
	p-value	(0.895)	(0.319)	(0.979)	(0.127)	(0.000)
Variance Inflationary Factor		5.8	4.85	11.36	1.85	1.38

Source: Author's computation
Notes: *Breusch-Godfrey Langrange Multiplier Test, **White Heteroscedasticity test, excluding White Cross terms.

The rejection of the null hypothesis implies that economically, the variance of the dependent variable across the data in the regressions is influenced by the volatility in oil price. To correct for the bias that could be introduced by the observed autocorrelation and heteroscedasticity in the models, the estimation procedures for standard errors and *p-values* incorporated the HAC Newey-West (1987).

To check for the presence of multicollinearity, a common challenge with multifactor modelling in the literature, the variance inflationary factor (VIF) was computed and presented in Table 5.4. The result indicates that the VIF values for all the sectors, except food beverages and tobacco, are far from the restrictive critical value (VIF > 5). This implies that though multicollinearity is present in the model, it is at a tolerable threshold and do not pose any serious threat to the overall result.

5.2 Analysis of Results and Discussion

Having established the reliability and stability of the variables as well as their long-run relationship from the preliminary analysis, the ordinary least squares estimates of the three models, estimated independent of each other, for the five industry sectors was undertaken. Each model include real interest rate and the logarithm of oil price, market returns, exchange rate, and consumer price index (inflation) as independent endogenous variables and are reported in Tables 5.5, 5.6 and 5.7. The returns of the various sectors are the dependent variables. The tables show the parameter estimates, the t-statistic (in parenthesis) and the p-values of the coefficients used in evaluating model robustness. The explanatory power of the models, measured by the adjusted R^2, the goodness of fit, measured by the F-statistic as well as its p-values are also reported as model diagnostics in the tables. The goodness of fit statistic suggests good explanatory power for the sector returns data employed in the estimation.

5.2.1 Model 1: Estimated Contemporaneous Multifactor Model by Sectors

The regression results in Table 5.5 are quite instructive and elucidating especially when benchmarked against the fundamentals of the Nigerian economy. The constant term of the estimated sector models is statistically significant for three of the five sector activities. This is inconsistent with the findings of Faff and Brailsford (1999), McSweeney and Worthington (2008) for

Australian industry stock returns and Bredin and Elder (2011) for the US. A decomposition of the sensitivity terms show that the banking and oil and gas stock returns exposure to oil price returns have the unexpected positive sign though statistically significant. This implies that the exposure of these sectors to oil price risk translates to increase activities, and by extension, increased returns rather than constraining production as generally alluded in the literature.

From the perspective of the small open oil-exporting economy of Nigeria, an unexpected increase in the price of oil serve as a precursor for increased activities in the banking and oil and gas sectors. Rising oil price implies increased revenue and ultimately increased aggregate demand, which would by extension, improve share price. This is in tandem with the arguments by Faff and Brailsford (1999) that banks' profits are driven primarily by the profitability of their customers' businesses. It follows that the positive and significant coefficients are, therefore, plausible since most of banks' clientele comprise of oil and gas and other energy firms. In addition, an increase in oil price potentially induces rational investors and shareholders to adjust portfolio holdings in favour of energy and banking stocks in order to take advantage of higher yields and relatively less risks in these sectors.

Stock returns of the insurance, food beverages and tobacco and consumer goods, do not show evidence of significant sensitivity to the oil price factor albeit the responses are theoretically consistent. Increase in oil price is expected to constrain the spending space of economic agents (households and firms) in these sectors as the increased weight of energy expenditure in the consumption basket crowd out other expenditures. Aggregate demand is expected to contract, at least in the short-run, and consequently decrease sector returns.

The indirect exposure to oil price movement from the regression estimates show that the coefficient of the market index returns is highly significant and in excess of unity for three of the five sectors indicating the excess risk exposure of these sectors to market risk. The high coefficients indicate a strong contribution of market returns to the fluctuations in sector returns, a common feature identified in the literature with the capital asset pricing model (McSweeney and Worthington, 2008 and Agusman and Deriantino, 2008). The more than one-on-one coefficients indicate the complete pass-through effect from the market to the sectors, which heightens the market risk. Thus, a 1.0 per cent increase in market risk presupposes a more than 1.0 per cent sector associated risks. This result is not unexpected since all the sector returns are nested in the aggregate (market) returns, which in turn are affected by factors other than changes in oil price.

Table 5.5: Regression Analysis of models by Sector

		Model 1				
		Banking	**Insurance**	**Food & Bevg**	**Oil & Gas**	**Con. Goods**
Constant	Coefficient	0.027	**0.178***	**-0.129***	**-0.302***	0.193
	t-Statistic	(0.533)	(2.464)	(-3.934)	(-2.244)	(1.025)
	p-values	0.595	0.015	0.000	0.026	0.306
Oil Price	Coefficient	**0.146***	-0.003	0.023	**0.566***	-0.055
	t-Statistic	(3.201)	(-0.049)	(0.796)	(4.651)	(-0.323)
	p-values	0.002	0.960	0.427	0.000	0.747
Market	Coefficient	**1.011***	**1.064***	**1.233***	**0.295***	**0.478***
	t-Statistic	(19.525)	(14.371)	(36.916)	(2.134)	(2.469)
	p-values	0.000	0.000	0.000	0.034	0.014
Exchange Rate	Coefficient	**-0.889***	**-1.891***	0.082	**-2.134***	**-5.004***
	t-Statistic	(-3.924)	(-5.839)	(0.564)	(-3.525)	(-5.906)
	p-values	0.000	0.000	0.674	0.001	0.000
Inflation	Coefficient	**-0.707***	**-0.812***	**0.989***	**5.045***	**-2.537***
	t-Statistic	(-2.321)	(-1.865)	(5.036)	(6.199)	(-2.228)
	p-values	0.021	0.064	0.000	0.000	0.027
Treasury Bill Rate	Coefficient	**0.006***	0.001	-0.001	-0.002	**0.035***
	t-Statistic	(1.850)	(0.129)	(-0.327)	(-0.233)	(2.662)
	p-values	0.066	0.897	0.744	0.816	0.008
dumCr	Coefficient	**-0.002***	**-0.007***	**0.002***	**-0.006***	**0.004***
	t-Statistic	(-3.023)	(-8.604)	(0.0003)	(4.425)	(2.662)
	p-values	0.003	0.000	0.000	0.000	0.043
Diagnostics						
Adjusted R^2		0.83	0.79	0.91	0.44	0.28
F-Stat		175.694	136.196	369.558	30.029	15.321
p-value		0.000	0.000	0.000	0.000	0.000

Source: Author's computation. *=significant at 5 per cent level. Notes: Each equation was estimated using the OLS regression technique. The log return of each sector was used as the dependent variable while the independent variables remain unchanged for all equations.

This finding underscores the crucial role of stock market in dictating the trajectory of the aggregate economy, that is, the income or wealth of economic agents. Though the signs of the oil and gas and consumer goods are right and significant, the magnitude of the market risk is considerably lower, whereas, the risk composition of the oil and gas is expected to be high given the degree of involvement of the stock market in the sector activities.

Exchange rate is included in the model to capture the intensity of the global economic activities on the domestic economy through international trade and related partnerships. Coefficients from the estimates show that, except for the returns of food beverages and tobacco, which is not rightly signed and not significant, exchange rate exerts market-wide negative and statistically significant influence on stock returns across sectors. This finding is consistent with Sadorsky (2001), McSweeney and Worthington (2008) and Agusman and Deriantino (2008), which observed similar pattern but noted that such linkages vary in line with the peculiarities and fundamentals of individual economies. The negative sign indicates the potentially weakening impact of exchange rate depreciation on the prospects of the sector returns, especially for an economy that is highly import-dependent and relies on a single commodity for foreign exchange earnings. The estimated exchange rate coefficient, which exceeded unity for insurance (1.89), oil and gas (2.13), and consumer goods (5.0 per cent) suggest the extent of vulnerability of the sectors to exchange rate risk.

The inflation risk parameters for oil and gas and consumer goods sectors are sensitive with evidence of a more than one-on-one risk exposure. This underscores the role of prices in the sectoral activities. Evidence from the result shows that only the banking, insurance, and consumer goods satisfied the theoretically expected inverse relationship between sector returns and domestic prices, indicating the degree of sensitivity to inflationary movements. The positive response of food, beverages and tobacco sector and oil and gas is similar with the findings of Fama (1981). Though the high positive coefficient of the oil and gas sector could be puzzling, it probably represents the increase in money supply through the monetisation of excess foreign exchange earned during periods of rising oil prices.

For interest rate, it is interesting that the coefficients of the banking and consumer goods sector stock returns exhibited significant association. This outcome had been argued severally in the literature as to which sign interest rate should theoretically assume. Chen (1991), for instance has argued for a positive relationship since it is positively correlated with future real activities and business cycles. In contrast, McSweeney and Worthington (2008) suggests a countercyclical response given that negative interest rate premium implies inverse relationship with the sector returns. Chen, *et al.* (1986) opined that since interest rate premium measures real rate of interest, a negative interest rate spread coefficient, and by extension, real interest rate, will make stocks more valuable.

The implication is that given a negative or inverse relationship, a wide (narrow) spread will induce investors to demand for less (more) of the sector stocks. It follows that an increase in oil price accompanied by an increase in investor demand will ultimately increase the return of affected industries and vice versa. The negative reaction of the food beverages and tobacco, consumer goods and oil and gas to interest rate is in line with the findings of McSweeney and Worthington (2008). On the other hand, the banking, consumer goods and insurance positive returns response to interest rate accords with the findings of Chen, *et al.* (1986). More importantly, the statistical insignificance of interest rate could be an indication of the inefficacy of the monetary policy transmission mechanism in Nigeria in transmitting monetary policy actions and impulses to the real sector.

The coefficient of the dummy variable introduced to capture the effect of the 2007-2009 global financial crises satisfies the *apriori* expectation for three out of the five sector stock returns namely: banking, insurance and oil and gas. The negative coefficients are consistent with economic literature that postulates increased cost of production during depressions or financial crisis periods. The increased cost of doing business, in addition to contagion and panic selling, which are common features of crises, often translate to a decline in cash flow as well as prices and returns in the stock market. Estimates suggest that the risks are highest for the insurance and oil and gas sectors at 0.007 and 0.006 per cent, respectively. The estimated food beverages and tobacco coefficient and consumer goods were significant and positive, suggesting that the global crises rather serve as incentive for higher sector returns.

Surprisingly, the consumer goods sector, which depend heavily on imported raw and intermediate materials, industrial equipment as well as technology for productive purposes, show no negative sensitivity to global crisis factor, though highly affected by exchange rate. However, the banking sector, at 0.002 per cent, exhibits some measure of resilience to the global crisis pressures, owing largely to the banking sector consolidation exercise embarked on in 2005, the subsequent huge bail outs and other unconventional monetary policy intervention measures taken by the central bank. These reform measures and interventions strengthened the capital base of banks and cushioned the sector from the turbulence spewed by the global financial crisis until the second round effect in 2008.

In summary, though the findings from the estimates are consistent with previous studies by Huang, *et al.* (1996), Bredin and Elder (2011) and others, they are, nevertheless, conclusive. In spite of the strategic importance of the oil sector to the economy, only the returns of the banking and oil and gas sectors show evidence of sensitivity to the exposure in changes in oil price. An examination of the indirect exposure of the sectors to oil price change shows a market risk that is in excess of unity, while exchange rate risk exerted vulnerability across sectors. Though the effect of interest rate is limited to two sectors only, the inflationary factor is found very crucial for all the sector returns as the parameters measuring the risk far exceeded unity for some sectors. The dummy variable effectively tracked the effect of the behaviour of the sector returns index significantly well during the global financial crises with the impact being more on the insurance and oil and gas sectors. These conclusions are supported by the significant adjusted R^2, which measures the explanatory power of the models. The models were adjudged adequate as attested to by the significant F-statistics with the associated very small p-values indicating the goodness of fit.

5.2.2 Examining the Sensitivities of Sector Stock Returns on Oil Price Changes

In the literature, Hamilton (2003), Lardic and Mignon (2006) and Cologni and Manera (2009) variously demonstrated the non-linearity between oil price and economic activities. They showed that oil price shock affect stock market asymmetrically, suggesting that an increase (negative shock) or decline (positive shock) in oil price impact differently on growth. Using the entire sample period, equation (4.4) was modified and estimated to include net oil price increase ($NOPI$) and net oil price decrease ($NOPD$). The resulting coefficients and t-statistic (in parenthesis) presented in Table 5.6 largely mimic the outcome of model one. Evidence from the table suggests the existence of oil price asymmetry, implying that i) the effects of oil price increase differs markedly in magnitude from oil price decline ii) oil price decline do not necessarily impact output positively and iii) the sensitivities of the sectors to oil price change vary among sectors. The observed asymmetry is akin to the observations of Arouri and Nguyen (2010) for European industries.

Net oil price increase in the literature is theoretically expected to decelerate the rate of growth, exacerbate inflationary pressures, increase investor uncertainty and exert downward pressure on stock prices as a result of the increase in the cost of production. However, regression results reveal sector-wide positive effect (though not significant) of net oil price increase, except for food beverages and tobacco returns. This suggests that some sectors are less affected by or better still benefit from oil price rise. The positive impact is in tandem with the findings of Agusman and Deriantino (2008) for Indonesia but contradict Hasan and Ratti (2012), which find increases in oil price return reducing industry stock return for Australia. Overall, only the insurance sector returns coefficient was found significant and in excess of unity, indicating the degree of exposure of the sector to oil price risk, while food beverages and tobacco was the only sector with the rightly signed expectation, though not statistically significant.

Table 5.6: Analysis of Sector Stock Return on Oil Price Change

		Model 2				
		Banking	**Insurance**	**Food & Bevg**	**Oil & Gas**	**Con. Goods**
Constant	Coefficient	**-0.053***	**-0.218***	**-0.076***	**-0.768***	0.175
	t-Statistic	(-0.894)	(-2.328)	(-1.875)	(-4.797)	(0.794)
	p-values	0.372	0.021	0.062	0.000	0.427
Oil Price	Coefficient	**0.152***	0.038	**0.136***	**0.851***	0.282
	t-Statistic	(1.875)	(0.299)	(2.453)	(3.894)	(0.940)
	p-values	0.062	0.765	0.015	0.000	0.348
Market	Coefficient	**1.054***	**1.277***	**1.179***	**0.558***	**0.509***
	t-Statistic	(18.581)	(14.287)	(0.038)	(3.661)	(2.433)
	p-values	0.000	0.000	0.000	0.000	0.016
Exchange Rate	Coefficient	**-1.084***	**-2.827***	**0.299***	**-3.066***	**-4.765***
	t-Statistic	(-4.738)	(7.844)	(1.919)	(-4.979)	(-5.639)
	p-values	0.000	0.000	0.056	0.000	0.000
Inflation	Coefficient	**-0.864***	**-1.385***	**1.202***	**4.494***	**-2.041***
	t-Statistic	(-2.817)	(-2.867)	(5.758)	(5.449)	(-1.804)
	p-values	0.000	0.004	0.000	0.000	0.073
Treasury Bill Rate	Coefficient	**0.012***	**0.024***	**-0.007***	**0.022***	**0.024***
	t-Statistic	(3.818)	(4.865)	(-3.314)	(2.587)	(2.055)
	p-values	0.000	0.000	0.001	0.010	0.041
NOPI	Coefficient	0.058	**1.941***	-0.464	0.531	0.604
	t-Statistic	(0.111)	(2.366)	(-1.307)	(0.379)	(0.314)
	p-values	0.912	0.018	0.193	0.705	0.754
NOPD	Coefficient	-0.099	**-0.588***	-0.084	**-0.949***	-0.540
	t-Statistic	(-0.771)	(-2.885)	(-0.955)	(-2.728)	(-1.131)
	p-values	0.442	0.004	0.341	0.006	0.259
Diagnostics						
Adjusted R2		0.82	0.73	0.89	0.41	0.27
F-Stat		142.948	85.824	267.526	22.767	12.524
p-value		0.000	0.000	0.000	0.000	0.000
Wald Test (χ^2)		0.735	0.001	0.285	0.021	0.493

Source: Author's computation

Notes: Each equation was estimated using the OLS regression technique. The log return of each sector was used as the dependent variable while the independent variables remain unchanged for all equations.

From the perspective of the Nigerian economy, the counterintuitive response to a positive oil price shock could be explained by a combination of factors. First, for oil-exporting economies, increase in oil price connotes additional revenue inflow, which when monetised and shared among the tiers of government surfeit domestic liquidity conditions, moderate interest rate downward and expands credit. These features spur investments and stimulate aggregate demand, culminating in the eventual boost in equity earnings. Second, the positive outcome could also be attributed to the implementation of the petroleum products subsidy programme, in which price differentials are picked by the government as subsidy payments, leaving domestic prices unchanged. This shields households and firms from direct international oil price moods as a strategy to alleviating poverty and protecting infant industries. Since energy cost remains almost unchanged at regulated prices, the positive upshot recorded for most of the sectors is, therefore, not unexpected. This is consistent with the findings by Agusman and Deriantino (2008) for Indonesia, where the transmission of oil price impulses to sector stocks was largely subdued until the liberalisation of domestic oil price in 2005.

In addition, despite the theoretical association of oil price increase with rising production cost, erosion of cash flow positions and weakening firms' profit margin through lower stock prices (Sadorsky, 2001 and IMF, 2000), there are claims in the literature that this is limited only to large capital-intensive industrialised economies (Pollet, 2005 and Driesprong, *et al.,* 2008). According to Gogineni, (2008) in economies where infrastructure is poor and the business environment is inclement, the labour-intensive small industrial sector response to changes in oil price is usually sluggish. It is, therefore, not surprising that, except for food beverages and tobacco, all the sectors evidenced positive returns to oil price increases. Gogineni (2008) would further associates the positive response to equity price correlation with oil price movement, which according to him, is determined by the negative (positive) expectation of future economic activities by economic agents. A perceived boom (recession) induces a positive (negative) response from stock returns and oil price.

Although lower oil prices are theoretically expected to boost economic growth through the stimulation of aggregate demand and lower inflation expectations, conjectures from the regression estimates show net oil price decline rather exerting a dampening effect on stock returns across sectors. The negative net effect suggest excess spending on imports over export proceeds by the oil-exporting economy of Nigeria, coupled with high production cost occasioned by structural rigidities, weak legal and economic infrastructure and poor power supply.

Other underlying factors such as the degree of pass-through of oil price innovation to households and firms' consumption and the reactions of monetary authority to the changes in oil price could also explain the phenomenon. A combination of these factors far outweighed the expected beneficial effect that could arise from oil price decrease, compress profit margin and render the impact counterintuitive for all sectors. The insensitivity of the sector returns, except insurance and oil and gas, mirrors the sticky nature of oil price regime in Nigeria, which very often, respond swiftly to price rise but sluggishly to price decline. The indication is that oil price decline does not necessarily translate to a reduction in production cost in Nigeria, which is in tandem with extant literature (see Agusman and Deriantino (2008) for Indonesia).

An examination of the response of the individual sectors to the influence of other macroeconomic variables in the model is equally revealing and fundamental. The stock returns of the food beverages and tobacco and oil and gas sectors demonstrated positive and significant sensitivity to contemporaneous oil price returns. While the outcome of food beverages and tobacco could be considered a puzzle, the high coefficient of oil and gas returns is expected given that its revenues are closely linked to developments in oil price. The increase in oil price benefits firms in the energy (oil and gas) industry and serves as incentive for shareholders to increase equity holdings in energy stocks by divesting from other assets in the market. This drives prices of energy stocks upward and, thus, enhances corporate returns. Though other sectors exhibit positive sensitivity, they were nevertheless not significant.

Another emerging inference from the models is the significant and positive sector-wide influence of market returns, with estimated coefficients that are above unity for banking, insurance and food beverages and tobacco. This suggests a more than one-on-one risk sharing between the market and the sample sectors over the period, meaning that stock returns of these sectors are riskier than market returns. Higher coefficients indicate the level of possible risks of the changes in macroeconomic factors to the sectors' consumers, which of course, depends on the peculiarity of the industry and the elasticity of its products. This high sensitivity is also explained by the link between market returns and sector returns, especially as sector returns are nested in the aggregate market returns and are related to the same business cycle.

The negative effect of exchange rate depreciation on sector returns performance is consistent with theoretical expectation, especially for import dependent economies such as Nigeria. Except for food beverages and tobacco stock returns, significant industry-wide inverse influence was observed for all sectors. The relatively high coefficients for the estimated regression at -2.83, -3.07 and -4.77 per cent for the insurance, oil and gas and consumer goods sector returns, respectively, underscores the level of exchange rate risk prevalent in the economy. The negative sign suggest that a depreciation of the local currency deeply hurt the revenue and cash flow streams of these sectors arising from the increased cost of production through importation of raw materials and technology. This finding agrees with economic theory especially for small open economies that are highly import-dependent. Sadorsky (2001) cautioned that credible as this result is, it must be interpreted with caution as the exchange rate and stock returns nexus vary across countries and industries in line with the nature and structure of the economy.

The mixed sensitivity of stock returns to general price level (inflation) follows the polarised arguments in the literature. For instance, while Fama (1981), Fama and Schwert (1977) and Spyros (2001) argue for a negative relationship, Firth (1979) and Gultekin (1983) contends otherwise. However, overwhelming evidence supports a negative stock price and inflation relationship, arguing that unexpected rise in inflation should negatively affect stock prices (Olufisayo, 2013). It follows, therefore, that banking, insurance and consumer goods stock returns decline under a precipitating inflation trend, suggesting a negative sensitivity, while food beverages and tobacco and oil and gas stocks tend to exhibit positive pattern. Overall, inflation is found to exert negative effect on sector earnings in Nigeria, which is consistent with extant literature, as firms adjust activities to accommodate the higher inflation rate. The negative sensitivity to inflation rate is quite understandable since domestic prices are known to be the primary drivers of aggregate demand in the economy. The coefficients of four industry sectors exceeded unity, indicating relatively high exposure of these sectors to inflation risks that is greater than unity.

For interest rate, it is expected that a decrease (increase) in the rate would lead investors demanding less (more) of the stocks of the affected industries. Hence as rates increases (decreases) with increasing (decreasing) investor demand, sector returns naturally increase or decrease. The counterintuitive interest rate result, coupled with marginal coefficients that are near zero line, suggests the relative disconnect in the transmission mechanism between the central bank's interest rate policy impulses and the real sector. This finding, which is consistent with the observations in model 1, suggests that economic agents source investment funds at rates far in excess of the policy rates due to embedded structural rigidities in the system (inadequate infrastructure and weak legal and institutional structures).

This supposition is dissimilar to Flannery and James (1984) findings that indicate sensitivity of bank returns to interest rate changes in their study of 67 banks exposure to interest rate risk for the US. The insensitivity of oil and gas sector to real interest rate could be explained by the exogenous nature of the sector that is largely dominated by foreign firms that have access to international financial markets at very concessionary rates. Even at the domestic fronts, they are considered as prime or high net worth customers and are funded at prime rates, lower than the maximum rates obtainable for all bank customers.

Overall, inference from the results supports McSweeney and Worthington (2008) assertion on the critical role of macroeconomic factors in explaining fluctuations in stock returns at the sector level. This conclusion is supported by the high explanatory power of the models measured by the adjusted R^2 value of between 30 and 90 per cent for all the sectors. Specifically, the stock market, exchange rate and inflation rate returns exert significant sector-wide effect that satisfies theoretical expectation. The effect of interest rate was noted to be weak in the models indicating a break down in the transmission mechanism and affirming the reluctance of banks to extend credit lines to the manufacturing and agricultural sectors considered as highly risky. Similarly, nonlinear oil price measures of net oil price increase and decrease display asymmetric effects indicating that declining oil price do not necessarily imply simultaneous decrease in cost of production for investors.

To test for asymptotic response for positive or negative oil price changes, the Wald chi-squared test was conducted to determine the joint significance of the NOPI and NOPD parameters in the model. The null hypothesis is that the two parameters are simultaneously equal to zero ($Ho: \alpha_6 = \alpha_7 = 0$) at 5 per cent significant level. The computed probability value of the chi-square for all the sectors, reported along with other diagnostics in Table 5.6, failed to reject the null hypothesis, except for the insurance and oil and gas sector returns. This means that price rise or fall makes no significant difference for sector stock returns, given the insignificant probability values. However, for the insurance and oil and gas sectors, the null hypothesis was rejected, concluding that there is significant difference when the conjectures of oil price rise or fall are tested.

5.2.3 Estimated Dynamic Market Model with Contemporaneous and Lagged Oil Dependencies by Sector

In model 3, a dynamic regression is estimated to measure the relative persistence of oil price change on stock returns using the entire sample size in line with the arguments of McSweeney and Worthington (2008). Included in the model are aggregate market returns, the change in contemporaneous and twelve lags of oil price returns and the dummy capturing the global financial and economic crises. The five sectors equations were estimated with the Newey and West (1987) heteroscedasticity and autocorrelation consistent standard errors. It is assumed that if investors perceive oil price as important input to production, then the effect of oil price change would be immediate and could linger or persist over time. Table 5.7 in the appendix show the estimated coefficients with the accompanying t-statistic (in parenthesis).

Results from the estimates show that the various sectors exhibit significant lagged dependencies to oil price at various lags. However, the estimated coefficients of the oil and gas and consumer goods sector returns indicate the absence of significant lagged effect (persistence) to market returns contemporaneously. This is in contrast to other sectors result, which responses were statistically significant and in excess of unity. Suffice to note that none of the five sectors responded to current and one month lagged oil price change. This suggests the existence of market inefficiency and is in contrast to the findings of Jones and Kaul (1996), where stock returns of most countries responded immediately to both current and one lagged oil price variables.

Pollet (2005) and Driesprong *et al.* (2008) argue that immediate response to oil price change applies only to stocks of industries directly dependent on oil resource.

Among the five activity sectors, the banking sector returns exhibit the strongest and most sustained lagged dependencies to oil price change that lasted from month two through twelve. This is borne out of the arguments by Faff and Brailsford (1999) that the profitability of banking business is dependent on the profitability of its high net worth customers. If assumed that the sector funds activities of all other sectors in the economy, it naturally implies that negative coefficients of these sectors would impinge on the profitability of the banking stock, depending on the degree of exposure of the funded sectors to oil price change. It also means that the sector would also suffer from spill over effects from other sectors as a result of interactions in the system.

The persistence of the oil and gas returns to oil price change is not very different from the banking sector, except that it demonstrated significant lagged effect from month five all through month twelve, again indicating the persistence of oil price effect in the sector. Significant lagged dependencies to evolutions in oil price by other sectors include insurance (three to seven months lag), indicating that the impact of oil price change last only for seven months after which it dies off. For the consumer goods sector, lagged dependencies to oil price change are noted at the sixth, eighth, eleventh and twelfth months. This indicates that impulses of oil price innovations are felt only after month six and could linger up to twelve months, implying that current activities of the sector would be impacted by price changes that took place in the past twelve months. The persistence of oil price for the food beverages and tobacco sector returns is short-lived, exhibiting lagged dependences between months four and six only. The effect on the sector last significantly for three months after which it fizzles out.

The observed significant lag effect at various months, according to McSweeney and Worthington (2008), suggests the persistence of oil price shock in the industries at those periods. The banking sector is identified as the fastest respondent to oil price change at approximately month two followed by insurance (month three) and food beverages and tobacco (month four). Generally the impact is intense between months four and six after which it starts dying out for some sectors. The implication is that it takes approximately two months before the impulse of an oil price change ultimately manifest in the banking sector activities. This suggest that investors in the sector react to oil price change only if the change persists for more than one month, indicating the approximate cycle of time it takes for the impact of oil price change to transmit through the sector and the economy. It is also worthy of note that the returns of the banking and oil and gas sectors further confirm the findings attained in model 2 as persistence seem to be stronger in these sectors and the impact higher as indicated by the high values of the coefficients for the significant lagged months. The least impact is on the stock returns of food beverages and tobacco.

Several plausible explanations could be adduced for the initial inertia experienced. First is the transaction of crude oil sales on futures, forward trading contract and other trading windows that hedge against unpredictable international oil price. Futures trading shield the market from immediate response to oil price changes occasioned by incessant incidence of adverse demand - and supply-side disruptions. Second, the building of buffers or special accounts such as the Excess Crude Account and the Sovereign Wealth Fund by oil exporting countries to warehouse oil revenue earned in excess of the budget benchmark is also a contributory factor to the lack of immediate response to price change.

The third reason is traced to the instituted petroleum subsidy, which mask the economy from direct effect of oil price change. This delinks sector returns performance from immediate oil price change owing largely to structural market rigidities associated with the acquisition and distribution of imported petroleum products. However, though products are dispensed at government regulated prices, when the rise persists, resulting in huge revenue loss (payment of subsidy to major marketers); prices are adjusted after many negotiations with stakeholders and labour unions. It implies that while it takes approximately two months for oil price shock to permeate the economy, such effect could linger for as long as twelve months.

5.3 Summary and Conclusion

This chapter employs monthly data spanning January 1997 to March 2016 to analyse the sensitivity of five sectors stock returns to oil price change using the multifactor regression model. The sectors were examined based on availability of data while the included macroeconomic factors were selected guided by economic theory and extant empirical literature. Three models were estimated in all. Evidence from model 1 reveals oil and gas and banking sector returns exhibiting significant sensitivity to the oil price factor. This pronounced sensitivity to oil price evolution may not be unconnected with the dominance of the energy investors in the clientele base of the banking sector. This is in addition to the overt dependence of the economy on oil export for foreign exchange earnings.

Consistent with the findings of McSweeney and Worthington (2008) and Agusman and Deriantino (2008) for the Australian and Indonesian stock markets, respectively, the parameter estimates of market returns for all the sectors were significant and in excess of unity, suggesting the proportionately high risk of the sectors over market returns. Similarly, exchange rate exerted industry-wide negative effect, indicating that the depreciation of the domestic currency (exchange rate risk) severely dampen sector returns for the high import-dependent economy of Nigeria.

The implications of the findings are enormous and should be carefully considered by policymakers in the formulation of policy. The negative response of all the sectors to exchange rate movement calls for prudent management in addition to informed and timely intervention in the market by the monetary authority to keep the rate stable. A stable rate would aid planning and development of alternatives for imports with a view to lessening the oil dependence of the economy. The weak impact of interest rate in the model is an indication of the apparent disconnect between monetary policy transmission mechanism and the real sector of the economy. This suggests that factors other than monetary policy actions, especially social and economic infrastructure, power inadequacy and other related cost of doing business, drive interest rate and, by extension, economic activities.

Sector returns were equally unduly exposed to inflationary pressures, which prompted the central bank to raise its base rate (monetary policy rate). This crowd out private sector credit, stifles investment, reduce aggregate demand and worsen stock returns. It is expected that low inflation regime, coupled with conducive business environment, all things being equal, would promote investment, especially for firms listed on the Exchange. This is critical to the achievement of the laudable inclusive growth objective of government.

Finally, the financial and economic crisis dummy generally depressed the market. This is a recurring signal for the economy to undertake wide-ranging strategies to expand the foreign exchange earnings basket with a view to reducing the vulnerability of the economy to global vagaries and forestall or better still minimise the impact of future crisis.

Appendix 5

Table 5.7: Sector Analysis of Oil Price Shock Persistence in Nigeria

		Model 3				
		Banking	**Insurance**	**Food & Bevg**	**Oil & Gas**	**Con. Goods**
Constant	Coefficient	**0.072***	**0.106***	**0.073***	**0.109***	**0.149***
	t-Statistic	(2.713)	(3.075)	(2.658)	(2.454)	(2.426)
	p-values	0.007	0.002	0.008	0.015	0.016
Market	Coefficient	**1.992***	**1.268***	**2.054***	-0.258	-0.681
	t-Statistic	(5.349)	(2.610)	(5.301)	(-0.410)	(-0.785)
	p-values	0.000	0.009	0.000	0.682	0.433
Oil Price Lag=0	Coefficient	0.163	0.212	0.057	0.028	-0.257
	t-Statistic	(0.557)	(0.557)	(0.187)	(0.058)	(-0.378)
	p-values	0.577	0.578	0.852	0.954	0.706
Oil Price Lag=1	Coefficient	0.299	0.051	0.132	-0.136	-0.339
	t-Statistic	(984)	(0.128)	(0.415)	(-0.263)	(-0.478)
	p-values	0.326	0.897	0.678	0.793	0.633
Oil Price Lag=2	Coefficient	**0.658***	0.561	0.473	0.261	0.322
	t-Statistic	(2.174)	(1.420)	(1.501)	(0.509)	(0.456)
	p-values	0.031	0.157	0.135	0.611	0.649
Oil Price Lag=3	Coefficient	**0.684***	**0.811***	0.478	0.682	0.517
	t-Statistic	(2.254)	(2.049)	(1.514)	(1.326)	(0.731)
	p-values	0.025	0.042	0.132	0.186	0.466
Oil Price Lag=4	Coefficient	**0.814***	**0.983***	**0.715***	0.655	0.716
	t-Statistic	(2.699)	(2.501)	(2.278)	(1.283)	(1.020)
	p-values	0.007	0.013	0.023	0.201	0.309
Oil Price Lag=5	Coefficient	**0.742***	**0.674***	**0.552***	**1.138***	0.707
	t-Statistic	(2.453)	(1.712)	(1.754)	(2.221)	(1.003)
	p-values	0.015	0.088	0.081	0.027	0.317
Oil Price Lag=6	Coefficient	**0.679***	**0.769***	**0.542***	**1.095***	**1.343***
	t-Statistic	2.237	(1.942)	1.715	(2.129)	1.898
	p-values	0.026	0.054	0.088	0.034	0.059

Table 5.7: Sector Analysis of Oil Price Shock Persistence in Nigeria (cont.)

		Model 3 Cont.				
		Banking	**Insurance**	**Food & Bevg**	**Oil & Gas**	**Con Goods**
Oil Price Lag=7	Coefficient	**0.722***	**0.769***	0.459	**1.182***	0.729
	t-Statistic	(0.2.378)	(1.942)	(1.455)	(2.300)	(1.032)
	p-values	0.018	0.053	0.147	0.023	0.303
Oil Price Lag=8	Coefficient	**0.669***	0.535	0.467	**1.026***	**1.201***
	t-Statistic	(2.198)	(1.347)	(1.473)	(1.989)	(1.692)
	p-values	0.029	0.179	0.142	0.048	0.092
Oil Price Lag=9	Coefficient	**0.578***	0.561	0.450	**1.129***	1.063
	t-Statistic	(1.884)	(1.399)	(1.409)	(2.169)	1.486
	p-values	0.061	0.163	0.160	0.031	0.139
Oil Price Lag=10	Coefficient	**0.539***	0.329	0.359	**0.890***	0.919
	t-Statistic	(1.745)	(0.815)	1.117	(1.699)	(1.276)
	p-values	0.082	0.416	0.265	0.091	0.203
Oil Price Lag=11	Coefficient	**0.584***	0.533	0.440	**1.422***	**1.529***
	t-Statistic	(1.903)	(1.330)	(1.378)	(2.732)	(2.137)
	p-values	0.058	0.185	0.169	0.007	0.034
Oil Price Lag=12	Coefficient	0.377	0.421	0.403	**1.156***	**1.753***
	t-Statistic	(1.258)	(1.078)	(1.293)	(2.277)	(2.509)
	p-values	0.209	0.282	0.197	0.024	0.013
dumCr	Coefficient	**-0.005***	**-0.012***	-0.001	**-0.007**	-0.002
	t-Statistic	(-7.071)	(-10.659)	(-1.581)	(-4.904)	(-1.006)
	p-values	0.000	0.000	0.116	0.000	0.316
Diagnostics						
Adjusted R2		0.45	0.44	0.26	0.29	0.12
F-Statistics		13.470	12.577	6.143	7.062	3.014
p-values		0.000	0.000	0.000	0.000	0.000

Source: Author's computation.
Note: All regressions incorporate Newey and West (1987) heteroscedasticity and autocorrelation consistent standard errors. The lags are in months. Each equation was estimated using the OLS regression technique. The log return of each sector was used as the dependent variable while the independent variables remain unchanged for all equations.

CHAPTER SIX

OIL PRICE UNCERTAINTY SHOCK AND SECTOR STOCK RETURNS UNCERTAINTY IN A SMALL OPEN OIL-EXPORTING ECONOMY: THE CASE OF NIGERIA

6.0 Introduction

The implications of time-varying volatility in oil prices on the performance of stock returns have been extensively examined in the literature (Park and Ratti, 2008; Cong, *et al.* 2008; Elyasianni, *et al.* 2011; Chen, *et al.* 1986 and Jones and Kaul, 1996). However, the exploration of the transmission of the effect of oil price return uncertainty to sector stock returns uncertainty has remained largely ignored for emerging and developing economies. This chapter of the thesis, thus, sets out to examine how oil price uncertainty shocks influence the uncertainties in the sector stock returns in Nigeria. The purpose is to identify the level of exposure of sectoral stocks returns to oil price uncertainty shock, which has implications for efficient portfolio diversification, taking cognisance of the heterogeneous features of the sectors (McSweeney and Worthington, 2008). Uncertainty measures for oil price and the sector indices are computed by logging the series and using the GARCH (1,1) specification and process explained in section 4.1.3 of chapter four to generate the uncertainties.

A SVAR framework (equation 4.10) is employed to determine the impact of oil price and exchange rate uncertainties on the various sectors' uncertainties using the structural parameters, impulse response function and variance decomposition explained in sections 4.1.6 and 4.1.7, respectively. This chapter comprise two broad sections with the first discussing the preliminary empirical analysis and the second focusing on the estimation and discussion of results. In the former, data properties such as unit root and graphical plots as well as descriptive statistics, Granger causality and stability tests are examined. The objective is to ensure that only relevant and reliable data is used for the estimation in a bid to avoid spurious regressions. The VAR stability test, for instance, ensures that the model is stable and that inferences made from the impulse response functions are reliable and should the need for forecast arise, the projections are dependable with minimal deviations. Data characteristics also inform the appropriateness of the methodology or technique of estimation to be adopted.

The section, which focused on the estimation and discussion of results, is sub-divided into the larger 8 variable system model comprising all the sector returns uncertainties, and the 4 – variable sector-by-sector analysis featuring the impact of oil price, exchange rate and market on the individual sector returns. This is meant to facilitate model comparison and elicit more explicitly sector exposure to these shocks. The resulting structural parameters and impulse response functions are analysed based on the model specification outlined in the second section of chapter four. The model assumption, identification scheme and parameter restrictions are also drawn from discussions in the previous chapter. In addition to the forecast error variance decomposition, the historical decomposition is estimated and analysed to further highlight the historical contribution of sector shocks in the variation of other variables in the system. The chapter is concluded with a summary and recommendations.

6.1 Aggregate SVAR: Preliminary Empirical Analysis

6.1.1 Unit Root Tests

In Table 6.1, the results of the ADF, PP and KPSS unit root tests, using optimal lag length determined by the Schwarz Information Criterion (SIC) are presented. Tests are conducted on the stock returns uncertainty series with constant term only.

Table 6.1: Results of Unit Root Tests

		ADF test-stat	PP test-stat	KPSS LM-test	Order of integration
Oil Price		-4.52* (0.0000)	-4.65* (0.0003)	0.056*	I(0)
Exchange Rate		-4.32* (0.0035)	-8.12* (0.0000)	0.079*	I(0)
Oil and Gas		-4.99* (0.0003)	-10.18* (0.0000)	0.213*	I(0)
Insurance		-3.80* (0.0180)	-3.76* (0.0202)	0.225*	I(0)
Food, beverages and tobacco		-5.15* (0.0001)	-5.40* (0.0001)	0.167*	I(0)
Consumer Goods		-7.82* (0.0000)	-10.30* (0.0000)	0.176*	1(0)
Banking		-5.09* (0.0002)	-5.14* (0.0002)	0.158*	I(0)
Market		-3.79* (0.0184)	-5.25* (0.0001)	0.196*	I(0)
Critical Values	(1%)	-3.9988		0.739	
	(5%)	-3.4296		0.463	
	(10%)	-3.1383		0.347	

Source: Author's computation
Note: Unit root test performed on the covariance series (uncertainty series) generated with GARCH (1, 1). ADF = augmented Dickey-Fuller test, PP = Phillips-Perron test, and KPSS = Kwiatkowski-Phillips-Schmidt-Shin test,
**, represents rejection of the null hypothesis at 1%.*

Inference from the Table shows that, using the ADF and PP tests, all the variables rejected the null hypothesis of no unit root at 1.0 per cent, suggesting stationarity when the deterministic term is constant without a time trend at levels. This is supported by the alternate or confirmatory KPSS test result. The implication is the expectation of robust impulse responses since there is no loss of asymptotic efficiency, which usually results from the differencing of the series and expanded error band.

6.1.2 Descriptive Statistics

Table 6.2 provides a summary of the descriptive statistics of the model variables for oil price uncertainty shock and the five sector returns uncertainty indices for the period January 1997 to March 2016. Evidence from the table identifies the consumer goods sector as having the highest mean (0.23) during the sample period, followed by oil and gas (0.18), while oil price, food beverages and tobacco, banking and the exchange rate record the least (0.001).

In terms of the coefficient of variation, measured by the degree of dispersion and represented by the standard deviation, consumer goods records the highest (1.33).

Table 6.2: Descriptive Statistics

Variable	Mean	Median	Std Dev.	Skewness	Kurtosis	J-Bera
Oil Price	0.007	0.006	0.005	4.486	29.661	7583.22 (0.000)
Exchange Rate	0.001	0.0003	0.002	6.572	54.779	27349.36 (0.0000)
Oil and Gas	0.184	0.031	0.646	6.339	46.308	19514.86 (0.000)
Insurance	0.015	0.007	0.233	5.170	33.459	9915.53 (0.000)
Food, bev. & tobacco	0.009	0.006	0.012	5.565	41.357	15286.91 (0.000)
Consumer Goods	0.226	0.042	1.325	7.623	60.245	33632.57 (0.000)
Banking	0.012	0.006	0.028	6.816	54.648	27344.29 (0.000)
Market All Share Index	0.005	0.004	0.005	4.447	26.266	5945.45 (0.000)

Source: Author's computation
Note: *The covariance series (uncertainty series) generated with GARCH (1, 1) used.* Probability values in parenthesis

The high variability intuitively suggests higher returns uncertainty compared with the relative stability exhibited by all variables except oil and gas and insurance sector uncertainties. The distributional properties represented by the skewness and kurtosis statistic, supported by the Jarque-Bera statistic, suggest the rejection of the null hypothesis, indicating the non-normality of the variables. This is again supported with the associated *p-value* that is equal to zero. With the kurtosis for all the variables exceeding three, a leptokurtic distribution is denoted, implying the prevalence of extreme values across all sectors. The measures of skewness exhibit fat tails indicating the probability of positive returns for the sectors during the period.

6.1.3 Granger Causality and Block Exogeneity Wald Test

The Granger causality and Block exogeneity test report in Table 6.3 show high interactions among the variables in the system. A unidirectional causality is evidenced from oil price uncertainty returns to insurance, food beverages and tobacco and banking returns uncertainty. Similarly, exchange rate show unidirectional causality with oil price, insurance and food beverages and tobacco returns uncertainty but a bidirectional interaction with consumer goods, banking and market. While oil and gas and insurance returns uncertainty Granger cause market returns, banking and market show causality with consumer goods returns unidirectionally. Market returns leads to oil price and consumer goods returns at 5.0 per cent significance level.

Table 6.3: Granger Causality and Block Exogeneity Wald Test

Variable	OPR	EXR	OAG	INS	FBT	COG	BNK	MKT
Oil Price	-	1.72	0.12	**77.48***	**35.39***	1.05	**77.80***	2.34
		(0.42)	(0.94)	(0.00)	(0.00)	(0.59)	(0.00)	(0.32)
Exchange Rate	**14.72***	-	0.38	**37.59***	**26.69***	**11.15****	**27.59****	**10.14****
	(0.00)		(0.83)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Oil and Gas	**19.45***	1.96	-	0.39	**15.14****	1.30	2.21	**20.95***
	(0.00)	(0.36)		(0.82)	(0.00)	(0.52)	(0.33)	(0.00)
Insurance	4.49	2.44	0.88	-	**15.69***	**5.65****	**6.72****	**7.30***
	(0.11)	(0.29)	(0.64)		(0.00)	(0.05)	(0.03)	(0.02)
Food Bevg & Tobacco	2.76	4.43	**23.14****	3.45	-	3.34	**7.83***	**6.98****
	(0.25)	(0.11)	(0.00)	(0.18)		(0.19)	(0.01)	(0.03)
Consumer Goods	0.10	**23.25****	0.26	**4.68****	**8.74***	-	1.85	**30.90****
	(0.95)	(0.00)	(0.88)	(0.09)	(0.01)		(0.39)	(0.00)
Banking	0.19	**7.88****	**11.83***	**10.27****	4.07	**17.69***	-	**9.23****
	(0.91)	(0.01)	(0.00)	(0.01)	(0.13)	(0.00)		(0.01)
Market	**6.17***	**49.94****	1.01	**19.66****	**21.36****	**19.22***	**17.81****	-
	(0.04)	(0.00)	(0.60)	(0.00)	(0.00)	(0.00)	(0.00)	

Source: Author's computation
Note: *, and ** indicate unidirectional and bi-directional causality, respectively. Probability values in parenthesis. OPR=oil price; EXR=exchange rate; OAG=oil and gas; INS=insurance; FBT=food beverages and tobacco; COG=consumer goods; BNK=banking and MKT=market all share index

Of equal note is the observed bi-directional causality between oil and gas and food beverages and tobacco; insurance, consumer goods and banking; and between consumer goods and insurance and market. Market returns exhibited bi-causality with all sector returns uncertainty except oil price and oil and gas returns at various levels of significance (Table 6.3). This indicates significant feedback effect between the market and other variables in the system, corroborating earlier observations of significant interactions between the variables in the model. There is, however, no evidence of causality between oil and gas and other sectors in the models.

Generally, it could be deduced from the table that past values of exchange rate and market sector returns help explain or interact with six variables apiece. Banking interacts with 5 variables while four variables were each explained by consumer goods and insurance sector uncertainty returns. The food beverages and tobacco, oil and gas and oil price explained three variables apiece in the system. This result has some predictability implications for oil price and stock returns dynamics.

6.1.4 Conditional Variance Equations

In Table 6.4, the estimated conditional covariance and the implied coefficients are shown. The result, which shows the test of the null hypothesis of no GARCH effect against the alternative that the disturbance term follows a GARCH process, is clearly rejected at 5.0 per cent significance level, indicating that the parameters satisfy the GARCH conditions.

Table 6.4: Sectoral Returns and Conditional Variance Equation; GARCH(1,1)

	OPR	MKT	BNK	INS	FBT	OAG	COG	EXR
Mean Equation								
C	0.0053 (0.8678)	-0.0259 (0.6444)	-0.0472 (0.2856)	-0.1169 (0.0001)	0.0219 (0.5148)	0.2072 (0.0000)	-1.1039 (0.0000)	0.102 (0.000)
opr(-1)	1.0000 (0.0000)							
mkt(-1)		1.0038 (0.0000)						
bnk(-1)			1.0093 (0.0000)					
ins(-1)				1.0245 (0.0000)				
fbt(-1)					0.9977 (0.0000)			
oag(-1)						0.9491 (0.0000)		
cog(-1)							0.9476 (0.0000)	
exr(-1)							0.2968 (0.0000)	0.9799 (0.000)
Variance Equation								
C	0.0018 (0.1156)	0.0005 (0.0136)	0.0009 (0.0086)	0.0003 (0.1042)	-0.0019 (0.0046)	0.0016 (0.8595)	0.0033 (0.0000)	0.0001 (0.0000)
RESID(-1)^2	0.2085 (0.0074)	0.2546 (0.0094)	0.3769 (0.0000)	0.1882 (0.0000)	0.3704 (0.0012)	2.3018 (0.0000)	2.6556 (0.0000)	0.3889 (0.0019)
GARCH(-1)	0.5376 (0.0092)	0.6523 (0.0000)	0.5772 (0.0000)	0.8146 (0.0000)	0.4268 (0.0004)	0.3391 (0.0092)	0.0089 (0.0004)	0.4736 (0.0000)
ARCH-LM Test	0.613 (0.434)	0.321 (0.571)	1.083 (0.298)	0.601 (0.438)	0.197 (0.657)	0.139 (0.709)	0.2794 (0.5970)	0.1356 (0.9073)

Source: Author's computation

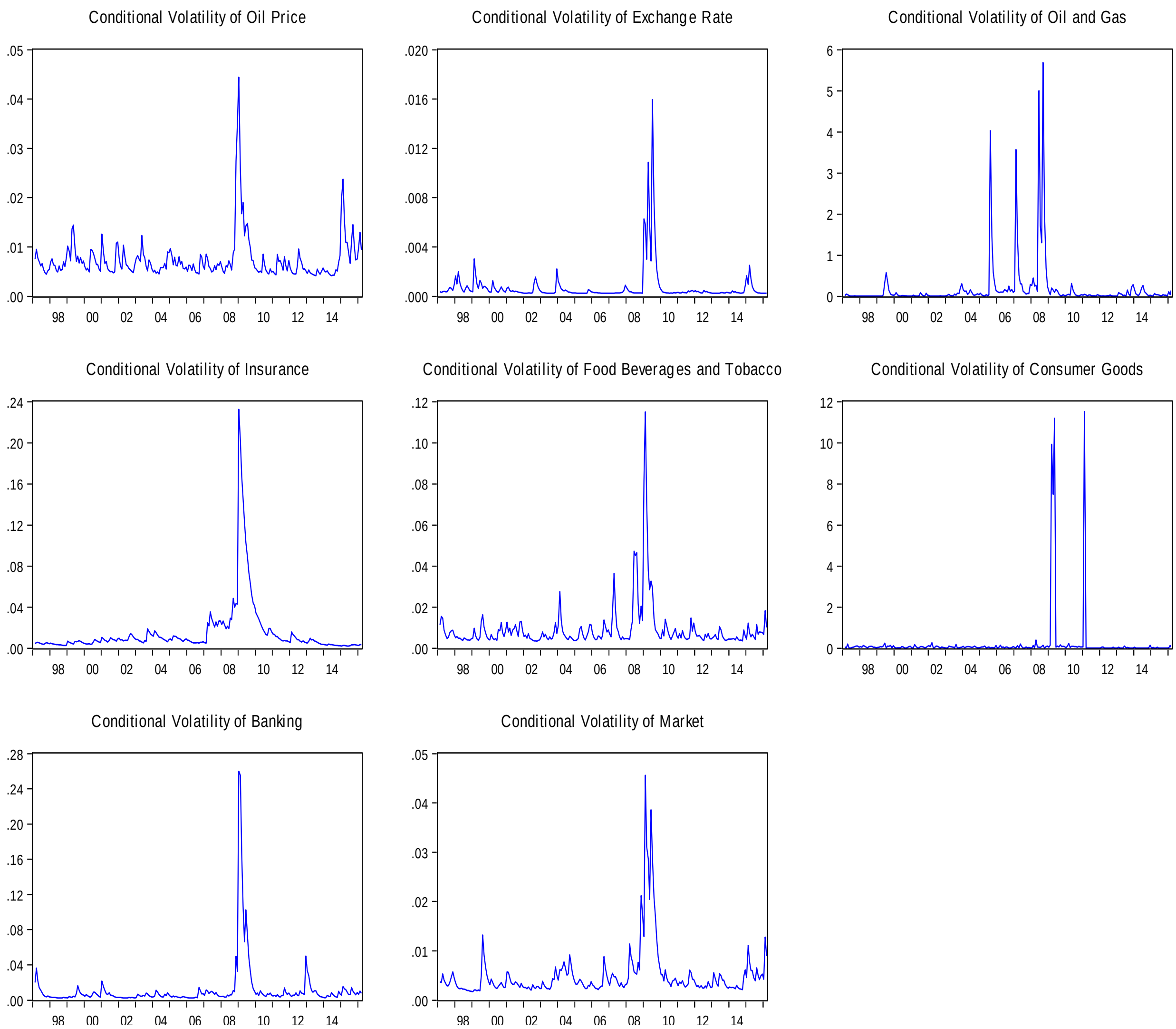
Note: Probability values in parenthesis
OPR=oil price; EXR=exchange rate; OAG=oil and gas; INS=insurance; FBT=food beverages and tobacco; COG=consumer goods; BNK=banking and MKT=market all share index

The economic implication is that the variance is influenced by the contemporaneous volatility of the various indices. This makes GARCH (1,1) the suitable technique for generating the conditional variances. This conclusion is strongly supported by the residual diagnostics (Table 6.4), which show that the GARCH models of the conditional means and variances adequately describe the joint distribution of the disturbances. The insignificant ARCH-LM test implies the absence of serial correlation in the residual, which is adequately captured by the GARCH (1,1) model.

6.1.5 Graphical Plots of Conditional Volatility

Figure 6.1 reports the graphical plot of the conditional volatility for oil price, exchange rate, market all share index, banking, insurance, oil and gas, food beverages and tobacco, and consumer goods sectors returns.

Figure 6.1: Plot of Conditional Volatility



A cursory examination of the plots reveals evidence of the impact of the global financial crisis across all sectors and the market with sparse episodes of short-lived spikes over the sample period, especially in the later segment of the sample. The sharp decline in the international oil price that accounted for the erratic behaviour of the series during the sample period is not unconnected with the impact of the global financial crisis.

One of the major significant impacts of the crisis was the crash of the stock market as market capitalisation declined considerably from ₦13.0 trillion in 2008 to ₦4.9 trillion in 2009. Volatility is more pronounced in the oil and gas sector, with three distinct episodes in 2005, 2007 and 2008, reflecting the prevailing policies and macroeconomic conditions such as the banking sector reforms and the global financial crisis. This was followed by the consumer goods sector, which witnessed two major episodes in 2009 and 2011 with relative stability for the rest of the sample period.

6.1.6 VAR Stability Test

A stable model is a prerequisite for a robust and economically meaningful impulse response function and forecast error variance decomposition. Variables in the SVAR are expected to be covariance stationary (implying their independence of time) even as the model is characteristically invertible and has an infinite order vector moving average representation. Stability test checks for normality, stationarity and autocorrelation properties of the residuals. Lutkepohl (2005) and Hamilton (1994) show that if the modulus of each of the eigenvalues of a matrix is strictly less than one, the estimated VAR is stable. Hence Table 6.5 is adjudged stable since it satisfies this stability condition as the modulus of the estimated VAR, with a lag specification of order 2, is less than one, with no root lying outside the unit circle. The variables were ordered based on Block Exogeneity test.

Table 6.5: Roots of Characteristic Polynomial

Roots of Characteristic Polynomial
Endogenous variables: Oil Price, Exchange Rate, Oil and Gas, Insurance, Consumer Goods, Food Beverages and Tobacco, Banking, and Market
Lag specification: 1 2

Root	Modulus
0.916495	0.916495
0.734830 - 0.115701i	0.743883
0.734830 + 0.115701i	0.743883
0.628011 - 0.285928i	0.690038
0.628011 + 0.285928i	0.690038
0.382609 - 0.458933i	0.597502
0.382609 + 0.458933i	0.597502
-0.101231 - 0.571477i	0.580374
-0.101231 + 0.571477i	0.580374
-0.302925 - 0.329280i	0.447425
-0.302925 + 0.329280i	0.447425
0.249150 - 0.321309i	0.406590
0.249150 + 0.321309i	0.406590
-0.232049 - 0.148890i	0.275707
-0.232049 + 0.148890i	0.275707
-0.150204	0.150204

No root lies outside the unit circle. VAR satisfies the stability condition.

6.1.7: VAR Serial Correlation LM Test

Further tests such as VAR residual serial LM test and normality test indicate absence of serial correlation and the normal distribution of the VAR model. The null hypothesis of no autocorrelation is not rejected for the residual serial LM test, while the joint *p-values* of skewness, kurtosis and Jarque-Bera statistic at 0.000 significance suggests the rejection of the null hypothesis for VAR normality test.

Table 6.6: VAR Serial Correlation LM Test

Null Hypothesis: no serial correlation at lag order h
Sample: 1997M01 2016M03
Included observations: 228

Lags	LM-Stat	Prob
1	315.1714	0.0000
2	196.2000	0.0000
3	176.2801	0.0000
4	163.3649	0.0000
5	133.2947	0.0000
6	184.7526	0.0000
7	193.0186	0.0000
8	42.76006	0.9811
9	91.73762	0.0131
10	145.9635	0.0000
11	60.96532	0.5845
12	94.07157	0.0085

Probs from chi-square with 64 df.

6.2 Empirical Results and Discussions

6.2.1 Short-Run Structural Vector Autoregression (SVAR) Estimates

The quantification of the impact of oil price uncertainty on sector stock returns uncertainty is motivated by existing investment theories that associated cyclical fluctuations in investment to oil price evolutions (Henry, 1974, Bernanke, 1983, Madj and Pindyck, 1987). The contemporaneous estimates of the structural factorisation for oil price shock are depicted in Table 6.7, showing the maximum likelihood estimation of coefficients of equation 4.34 along with the corresponding asterisk indicating the significance of the p-values. In this research, we follow Hasan and Ratti (2012) to define a positive association between oil price uncertainty with sector returns uncertainty as a detrimental relationship that affect both firm value and returns at the market. This is anchored on Bernanke (1983) and Pindyck (1991) arguments that uncertainty in future energy prices causes firms' delay in irreversible investment decisions. Such delays in investments, as indicated in the transmission mechanism of oil price to the economy (Section 3.1.1) eventually slow output growth. A higher (positive) uncertainty, thus, increases or worsens sector uncertainty and by implication, weak returns and lower prices and vice versa.

Table 6.7: Structural Parameter Estimates of Contemporaneous Oil Price Shock

$$\hat{A} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -0.02 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -10.88 & -33.63 & 1 & 0 & 0 & 0 & 0 & 0 \\ -1.35* & -2.38* & -0.001 & 1 & 0 & 0 & 0 & 0 \\ -0.09 & 0.01 & -0.002* & -0.31* & 1 & 0 & 0 & 0 \\ 40.45 & 114.40* & 0.05 & 6.16 & -19.67 & 1 & 0 & 0 \\ -0.77* & 0.83* & 0.001* & -0.98* & -0.35* & 0.001* & 1 & 0 \\ -0.23* & 0.06 & -0.001 & 0.19* & 0.05* & 0.0001 & 0.13* & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{opru} \\ \varepsilon_t^{exru} \\ \varepsilon_t^{oagu} \\ \varepsilon_t^{insu} \\ \varepsilon_t^{fbtu} \\ \varepsilon_t^{cogu} \\ \varepsilon_t^{bnku} \\ \varepsilon_t^{mktu} \end{bmatrix}$$

Note: *, **, and *** denotes significance at 1%, 5% and 10% significance level, respectively.

Parameter estimates indicate statistical significance for most of the contemporaneous structural coefficients in conformity with expectations for a small open oil-exporting and refined petroleum products importing economy. Generally, increase in oil price uncertainty shocks positively and significantly influence the banking, insurance and stock market sector stock returns uncertainty contemporaneously at one per cent confidence interval. The positive coefficient implies that a rise in oil price shock dampens sector stock returns as economic agents delay investment decisions affirming the potency of oil price in predicting stock market returns in Nigeria (Lee, Kang and Ratti, 2011). Though the impact on oil and gas and food beverages and tobacco are rightly signed, they are, however, not statistically significant. Higher oil price uncertainty significantly increases the stock returns uncertainty for banking (0.77 per cent), insurance (1.35 per cent), and market (0.23 per cent) but declined consumer goods stock returns uncertainty significantly. This further justifies the argument in favour of the dominant impact of oil price on the activities of the sectors.

Exchange rate uncertainty shock exerts significantly positive effect on the insurance uncertainty but negative or beneficial impact on the banking and consumer goods sector uncertainties. The reason for the beneficial effect, especially for the banking sector is attributed to sector's engagement in the foreign exchange transaction, where very often foreign currencies bought at official rates are traded at higher premium or arbitrage rate at the informal markets (round tripping) making huge profits margin. On the other hand, the negative effect on consumer goods sector is rather puzzling as the sector is a high utiliser of foreign exchange in the purchase of intermediate goods, acquisition of machines and skilled expertise for production.

The impact of all the sectors uncertainty shocks on the banking sector uncertainty is mixed as it responds negatively to exchange rate, oil and gas and consumer goods uncertainty shocks but positively to oil price, insurance and food beverages and tobacco. The increase in the banking sector uncertainty (8.0 per cent) is consistent with Hasan and Ratti (2012), which for the Australian economy attributed the positive outcome to the sector's association with energy stocks that are significantly exposed to oil price fluctuations. This implies that, to the extent that the banking sector reflects the general health and soundness of the economy, system instability would worsen the business outlook for the sector and vice versa. The effect of insurance on banking uncertainty is not unconnected with their operation within the same financial services sector and could be owned by the same corporate entity as the banks under the "financial supermarket" framework of the universal banking system in Nigeria.

Oil and gas sector uncertainty contemporaneously expands the insurance uncertainty. The immediate effect of increasing oil and gas, insurance and food beverages and tobacco on consumer goods is positive. The insurance uncertainty impacts positively on food beverages and tobacco and the banking sector. A one per cent banking uncertainty shock increases market uncertainty by 0.13 per cent while consumer goods significantly improve market uncertainty. From the foregoing, hypothesis that oil price uncertainty induces stock returns uncertainties in Nigeria is supported by data. The structural parameters suggest that increased uncertainty in oil price invariably triggers uncertainty in stock returns of the various sectors and slows economic growth, especially if the sectors are pro-cyclical and are highly dependent on oil.

Having identified and estimated the structural model, the effects of the shocks ε_t are investigated through an impulse response function analysis, which according to Breitung, *et al.* (2004) contain more information than the structural parameter estimates.

6.2.2 Impulse Response Function of Sectors' Stock Returns Uncertainties

This subsection ascertains the robustness of the consequence of a structural one standard deviation shock of oil price and exchange rate uncertainty on the uncertainties of the five sector returns. The dynamic response to the structural shock over a 36-month horizon is presented in Figures 6A.1 - 7 at the appendix. The two-standard error confidence interval is indicated by the short-dashed lines representing 95 per cent confidence band. Though these bands could be wide sometimes and may not represent the responses, it is nevertheless, important that they be provided to identify the uncertainty associated with point estimates (Brischetto and Voss, 1999). Consequently, analysis focused on point estimates rather than the bands as they offer the best responses to structural shocks in the model. Consistent with the interest of this thesis, analysis of the impulse response function focus primarily on the responses of the sample sectors to oil price uncertainty shock. However, in order to determine the dynamics in the system and ascertain the level of indirect effects (spillovers), the response of other variables to structural shocks in others is also analysed. Oil price uncertainty shock is treated in the system as contemporaneously exogenous as stated in earlier sections.

6.2.2.1 Response to positive oil price uncertainty shock

Since oil price shocks are propagated to the stock market through expected cash flow and discount rate, it is assumed that an increase in uncertainty shock should necessarily increase uncertainty in the stock returns of the sectors. Figure 6A.1 reveals the dominant influence of oil resource across sector activities exemplified by its significant impact on the uncertainties of all the sector stock returns and exchange rate. In line with expectations, the response of uncertainty for all sectors returns in the sample, except consumer goods, are positive and significant suggesting a weakening outlook for the various sectors as a result of oil price uncertainty shock. This result is in conformity with Mordi and Adebiyi (2010), which established a positive relationship between oil price and market returns. The impact is also not only generally large but persisted significantly throughout the forecast horizon, except for oil and gas and consumer goods, which impulses lingered only for about one month before returning to steady state.

Positive shock to oil price cause exchange rate returns uncertainty to worsen, implying its exposure to surges in oil price. The effect on exchange rate was the immediate depreciation of the currency, which persisted throughout the entire forecast horizon. Exchange rate fell by over 0.35 per cent below the value it would have otherwise been, stabilise after 15 months and exhibit signs of permanent effect as it tends towards zero line. The short memory in oil and gas reflects the moderating effects of fundamentals in the international market including the expansion in oil exploration, alternative energy sources, improved oil extraction technology and the continuous erosion of OPEC control over oil supply (Basher, *et al.* 2010). The observed transitory effect in the first month confirms the sensitivity of the upstream (crude oil and natural gas extraction) and downstream (petroleum refining and distribution) to oil price evolutions. The result further suggests that the impact is more pronounced in the first five months, when it attained its peak for all sectors.

The temporary and short-lived negative response of the consumer goods sector connotes improvement in the sector's uncertainty in the first month. Similarities are observed in the response of the banking and insurance sectors (financial sector), on the one hand, and the food beverages and tobacco and consumer goods (real sector), on the other, reflecting the peculiarities or homogeneity of the sector characteristics.

6.2.2.2 Response to positive exchange rate uncertainty shock

A standard exchange rate uncertainty shock shows the uncertainties of insurance, banking and food beverages and tobacco responding positively against the negative response of other sectors. The negative response indicates stability and boosting of sector activities. The effect on consumer goods was short-lived compared with the impact on other sectors that persisted throughout the experiment period. The oil and gas result is consistent with economic theory due to the capital intensive nature of the sector and the huge foreign investment component. Uncertainty in exchange rate induces investors to adjust portfolio to favour energy related stock to safeguard the value of their investment.

6.2.2.2 Response to positive oil and gas uncertainty shock

The contemporaneous sectoral response to a structural one standard deviation in oil and gas uncertainty returns shock is mixed as the banking, insurance; food beverages and tobacco and market returns uncertainties demonstrated significant positive influences, while a contraction is indicated for the oil price and consumer goods returns in the first five months. The negative response of consumer goods and exchange rate were quickly reversed within the first two months and remain permanently positive for the rest of the entire forecast horizon. The implication is that while the oil and gas uncertainty contributes negatively to the uncertainties of the oil price and consumer goods sector returns, the other sectors in contrast, experience dampening effect. The impulse response for market uncertainty returns is immediate and large in the first month, while the banking sector came with a lag, and remained above the mean throughout the forecast horizon. The magnitude of the effect of oil and gas uncertainty on all sectors show permanence as no sector uncertainty completely fizzled out though they all tended towards zero.

6.2.2.3 Response to positive Insurance uncertainty shock

An approximately one per cent structural innovation in insurance uncertainty shock significantly worsens consumer goods and stock market sector uncertainty shocks by 0.05 and 0.14 per cent, respectively. Being the economy's underwriters, uncertainty in the sector sends warning signals to investors about the safety and possible non-recovery of investments and assets should the system encounter any crises. A feature of the impact is the achievement of the steady state for almost all the sectors in the first half year, while the effect of oil price and exchange rate remained near zero from month ten and persisted for approximately 24 months.

Another feature is the immediate and sharp response of all the sector uncertainties except exchange rate and oil and gas. The inverse relationship between insurance returns uncertainty shock and oil and gas sector uncertainty is explained by the dominance of the latter by foreign underwriters, suggesting the insulation of the sector activities during high uncertainty period in the oil and gas sector. The impact of insurance uncertainty shock is generally momentary; with all the sectors achieving steady state in the first three months. The short-lived response could be attributed to the underdeveloped nature of the sector and the low insurance culture in the economy. The response is strongest for consumer goods uncertainty (0.6 per cent).

6.2.2.4 Response to positive Food Beverages and Tobacco uncertainty shock

A display of the endogenous uncertainty returns responses of each of the sectors following an increase in the food beverages and tobacco uncertainty shocks is shown in Figure 6A.4. The immediate response of a one per cent structural deviation shows a weakening future outlook for oil and gas, consumer goods, and banking sector uncertainty. This is evidenced by the positive effect it exerts on all the sectors within the first five months, except for the oil price, insurance and exchange rate. This implies that a surprise rise in food beverages and tobacco shock contemporaneously boost the confidence levels of the insurance and oil price sector uncertainties in the short-run. This is explained by the exposure of the sectors to the activities of other participating sectors especially banking (spill over effect). The highest impact is on oil and gas (approximately 14.0 per cent) and the effect is statistically significant. Apart from oil and gas, which effect dies off completely after fifteen months, other sectors responses persisted throughout the forecast horizon, worsening sectoral uncertainty in the long-run. An interesting feature of the response to food beverages and tobacco returns uncertainty is the meandering of the movement along the mean for all sectors such that as time waned, positive outlooks intermittently reverse to negative and vice versa.

6.2.2.5 Response to positive consumer goods uncertainty shock

A one standard structural shock in consumer goods returns uncertainty exerts a market wide improvement in the uncertainties at different levels of significance. Apart from the insurance uncertainty that show permanent impact, all other sectors move around the mean as they change from positive to negative and vice versa especially in the first two months. The consequence is that a positive shock from the sector stimulates and improves the activities of these sectors. The outcome substantiates the contracted contribution of the sector as a result of the relocation of most industrial firms (automobile and tyre, industrial and domestic products and textile firms) to neighbouring economies where the investment environment, especially enabling infrastructure, is adequate. The consequence is the resort to imports of consumer goods to bridge the supply gap and the ceding of its influence to the trading sector. This renders the sector's uncertainty shocks of no meaningful consequence on the economy.

6.2.2.6 Response to positive banking sector uncertainty shock

Evidence from figure 6A.6 shows that the influence of unexpected banking sector returns shock is beneficial for the oil and gas sector, which is not statistically different from zero from month 15 through the rest of the forecast horizon. This persistence strengthens the evidence of the interlinkages between these sectors as earlier alluded that the oil and gas firms constitute a high proportion of the banks' net worth clientele. The inverse relationship could also be explained by the fact that the sector holds about half of the market capitalisation (investors' portfolio). The implication is that an improvement in the performance of other sectors' earnings automatically boosts the banking sector outcome given its financial intermediary role in the economy. A positive shock would trigger portfolio adjustment and divestment from the sector to alternative stocks, explaining the reason for the huge and persistent response of the insurance sector.

6.2.2.7 Response to positive market uncertainty shock

The reaction of the variables in the system to structural shocks in market returns uncertainty, which nest the outcomes of all other sector indices and proxy the economy's activities and output, is presented in Figure 6A.8 in the appendix. Contrary to theoretical expectation, the impulse response function do not support the supposition of a positive relationship between market uncertainty shocks and all other uncertainty returns shocks, except for oil price and exchange rate. The industry wide negative impulses suggest improvement rather than diminishing effect on sector returns uncertainties in the first three months. The most significant impact is on the consumer goods sector (1.08 per cent) followed by oil and gas (0.02 per cent). While the response of the insurance sector is significant and statistically different from zero for most of the estimation horizon, uncertainty shock on all other sectors fizzled out at between months 10 and 20. The attainment of steady state and subsequent reversion of all sector uncertainties to positive suggest the effect of persistence. It is insightful to note that all the sectors remained positive throughout the remaining period with many lying very close to the mean.

In summary, prima facie evidence from the impulse response to a one standard deviation shock in oil price uncertainty shows the uncertainties of all the sectors, except consumer goods, responding positively to innovations in oil price uncertainty. Exchange rate response is significant and persisted over the estimation period. The findings are consistent with Ratti and Hassan (2013), which attributed the positive response to the significant exposure of the sectors to oil price fluctuations and their speculative positions in oil related instruments. Equally significant is the immediate and negative response of four out of the five sectors including the market to an unexpected shock in exchange rate. Exchange rate uncertainty improves investments in the oil and gas and banking sectors considered as safe havens in the case of crisis. The generally slow decay is an indication of market inefficiency in responding to oil price shocks in Nigeria since theoretically, shocks are expected to dissipate rather more rapidly if the market is functioning optimally. The oil and gas response is transitory and short-lived, while response of other sectors persisted throughout the estimation period.

6.2.3 Forecast Error Variance Decomposition

While impulse response estimates assesses the magnitude and direction of the responses of a variable to a one-time innovation in another, variance decomposition measures the percentage contribution of each type of shock to the forecast error variance of that variable (Kilian, 2009). It provides the relative explanation of each shock by other endogenous variables in the system. Table 6B in the appendix reports the fraction of sectors' stock uncertainty variation, including the market, explained by innovations in oil price and exchange rate uncertainty over the forecast horizon. A cursory analysis of the results suggest that oil price uncertainty meaningfully contributed to explaining the forecast error variance of the sector returns as evidenced by the relatively high percentage accounted for at time horizon of 10 months. This confirms previous assertion of the dominance of oil price uncertainty on the activities of oil-exporting economies, which is consistent with the findings of Wang, *et al.* (2013) where oil price shocks explain 20 – 30 per cent of variation in stock market returns.

6.2.3.1 Contribution of Oil Price Uncertainty Shocks to Variations of Stock Return Uncertainties

The percentage contributions of structural shocks in oil price uncertainty to own variation decayed slowly from 100 per cent in period one to 77.8 per cent in period six and further to 73.1 per cent after ten months (Table 6.8 abridged from Table 6A in the appendix). This implies that after 10 months, about 26.9 per cent of variation in oil price uncertainty is jointly explained by sector stock returns and exchange rate uncertainties. This is theoretically plausible as in the long-run, the dynamics in the system allow all variables to affect each other and further buttresses the arguments by Ewing and Thompson (2007), Kilian and Vega (2008), Arouri and Nguyen (2010) and Kilian (2014), that real oil price is also affected by endogenous economic fundamentals. The finding is also consistent with Riman, *et al.* (2014), which in their study on the effect of volatility transmission on domestic stock returns for Nigeria, noted that domestic market disturbances contemporaneously affect global stock market returns. They, thus, concluded that "small open domestic markets are significant sources of volatility in global market returns and are prime factors when considering portfolio investments" (Riman, *et al.* 2014:210), especially for oil producing economies.

The contribution of oil price innovation to exchange rate is generally consistent with the literature for import dependent economies. The forecast error variance of exchange rate improved from 0.3 per cent in period one to 25.6 and 36.9 per cent for months six and ten, respectively. This suggests that unanticipated changes in oil price exert significant effect on exchange rate outcome.

The relative contribution of oil price uncertainty to the forecast error variance decomposition of oil and gas sector was generally negligible rising from 0.2 per cent in the first period to 0.7 per cent in period six and 0.9 per cent after 10 months. This result is counterintuitive as a stronger explanatory power is theoretically expected between oil price and oil and gas sector activities.

However, additional information from Table 6A in the appendix further show that oil and gas explained about 83.2 per cent of its own variation after 10 months, descending from 99.6 per cent in period one. This is in tandem with the impulse response function from the preceding section. Food beverages and tobacco and banking sector returns uncertainties contributed 9.7 and 4.9 per cent variation in oil and gas uncertainty, respectively.

The proportion of insurance uncertainty variation explained by oil price uncertainty improved from 9.8 per cent in the first month to peak at 53.2 per cent in period 6 but weakened gradually to 50.5 per cent by period 10. It could further be inferred from Table 6A in the appendix that while oil and gas explained about 14.4 per cent variation, insurance explained 19.6 per cent of own variation. This indicates the level of endogeneity of insurance as over 80.4 per cent variation is explained by other sectors return uncertainty especially oil price (50.4 per cent).

Table 6.8: Percentage Contribution of Oil Price Uncertainty

	Percentage Contribution of Oil Price Uncertainty to Uncertainties in:							
Time Horizon	Oil Price Uncertainty	EXR	OAG	INS	COG	FBT	BNK	SMK
t+1	100.00	0.29	0.17	9.82	1.13	5.62	16.81	11.98
t+2	89.91	4.35	0.28	20.19	1.16	10.11	26.76	16.93
t+3	84.08	7.24	0.56	36.85	3.19	20.09	42.26	24.63
t+4	81.87	13.06	0.64	47.33	5.37	29.14	51.98	36.20
t+5	79.68	19.76	0.68	51.62	12.56	33.27	55.72	43.57
t+6	77.84	25.61	0.71	53.19	18.58	34.11	56.66	47.15
t+7	76.18	30.53	0.77	53.38	21.61	34.03	56.61	49.04
t+8	74.79	33.82	0.84	52.64	22.72	33.60	55.96	49.95
t+9	73.78	35.83	0.90	51.55	22.92	33.09	55.11	50.09
t+10	73.07	36.93	0.94	50.49	22.80	32.70	54.33	49.77

Source: Extracted from Table 6B in the Appendix.
Note: OAG = oil and gas; INS = insurance; COG = consumer goods; FBT = food beverages and tobacco; BNK = banking and SMK = market all share index

This suggests evidence of the presence of structural breaks in the system. The deep plunge in oil price during the crisis is reflected in the significant crash in the market and industry returns, followed by the steep depreciation in the exchange rate and the sharp rise in inflation and interest rates. Though the post-crisis period was marked with a general rebound, a downward moderation, especially from 2014, is observed.

The fraction of variance in food beverages and tobacco stock returns uncertainty, explained by oil price uncertainty, increased from 5.6 per cent in the first month to 34.1 per cent in period 6 but decelerated to 32.7 at month ten. Significant contributors to food beverages and tobacco variation from Table 6A in the appendix include insurance (18.7 per cent), oil and gas and own share at 17.9 per cent, apiece. The own share indicates the endogenous nature of the sector suggesting that about 82.1 per cent of variation is explained by factors other than its own uncertainty.

The contribution to variation in consumer goods by oil price uncertainty rose from a mere 1.1 per cent in period one to 18.6 per cent in period 6 and peaked at 22.9 per cent in month 9 before declining to 22.8 per cent in month ten. This fraction of variation is above the insurance contribution of 18.3 per cent but fell short of own shock ratio of 44.2 per cent at period 10 (see Table 6A in the appendix). This evidenced the influence of the oil price and insurance uncertainties in driving the uncertainty of the consumer goods sector during the forecast horizon.

Variation in the banking sector is found to be largely accounted for by the oil price uncertainty (54.3 per cent) at period 10 after achieving a peak of 56.7 per cent in period 6. Oil and gas and insurance sectors returns contribution to variation in the banking sector uncertainty forecast was 8.9 and 20.8 per cent, respectively. Oil price uncertainty contribution to the market uncertainty variance increased from 11.9 per cent in the first month to close at 49.8 per cent in periods 10. Other significant contributors to the sector's variation are the oil and gas (13.6 per cent), insurance (9.4 per cent) and own shock (13.5 per cent).

In summary, the result show that oil price innovation exerts significant influence across the various sectors of the market, implying that uncertainties associated with oil price contributes significantly to explaining the direction of sectoral uncertainties. This confirms the impulse response function results where similar conclusions were reached. At 0.9 per cent, oil and gas is intuitively considered as the most exogenous to oil price uncertainty shocks followed by consumer goods (22.8 per cent). On the other hand, the banking (54.3 per cent), insurance (50.5 per cent) and the market returns (49.8 per cent) are supposedly reckoned as the least exogenous implying that comparatively oil price shock contribution to the sectors variation are the highest.

The huge influence on banking and insurance is tied to the existing interlinkages, coupled with the share of these sectors in the market capitalisation (45.0 per cent). Unlike the financial sector returns, the real sector returns exhibit some element of resilience to oil price shocks ostensibly explained by their inability to react to short-term movements in oil price. This places greater burden on the monetary authorities to put in place stabilisation measures to protect the financial sector in order to mitigate systemic risks. It is also interesting to note that some of the sectors contributions kinked at period 6 after which they witnessed gradual weakening for the rest of the forecast horizon. These deductions are akin to the impulse response function analysis and consistent with the findings of Fayyad and Daly (2011) for the GCC countries. It goes to suggest that the impact of market dynamics last for about 6 months only after which the effect fizzles out or fades. Exchange rate contribution to variation in the various uncertainties ranged from 0.6 per cent for oil and gas to 8.7 per cent for food beverages and tobacco. This is followed by insurance (7.8 per cent) and banking (7.3 per cent), suggesting that though exchange rate is critical to the activities of these sectors; its variation impact is less than oil price changes.

6.2.4 Historical Decomposition of Oil Price Uncertainty

Using historical decomposition, Figures 6B.1-6 in the appendix show the historical contributions of oil price uncertainty shock to oil and gas, insurance, consumer goods, food beverages and tobacco, and banking sectors including the market uncertainties. Prior to the global financial crisis, the historical contribution of the food beverages and tobacco uncertainty and own shock, which were mostly below the trend line (negative), improved the oil price uncertainty shocks. The upward spike noted during the period was contributed mainly by oil and gas and exchange rate uncertainties. The deteriorating oil price uncertainty (upward push) during the global financial crisis is historically contributed by the oil and gas, banking, and own shock, which outweigh the contribution of the insurance sector. The negative contributions of oil price, oil and gas and banking sector uncertainty shocks kept oil price uncertainty below the trend line during the post crisis period. While the spikes witnessed during 2011 are attributed to the worsened exchange rate and banking sector uncertainties, insurance and own shock historically contributed significantly to dampen the oil price uncertainty during the 2014 – 2015 recession.

While the historical contribution of oil price and banking help dampen the uncertainty in exchange rate before the global financial crisis, oil price, oil and gas and banking, in no small measure, contributed to the worsened exchange rate uncertainty during the global financial crisis. The stability in the exchange rate prior to the global financial crisis was as a result of the negative or beneficial contribution of oil price. The pull witnessed within and after the crisis is accounted for by own shocks in spite of the lingering effect of oil and gas uncertainty contribution. Similarly, exchange rate uncertainty shock during the global recession of 2015 was pulled by the positive oil price and market uncertainties occasioned by global oil price decline. The stock market historically added to stability in exchange rate uncertainty, though moderately throughout the sample period. Own shocks and banking shocks contributed negatively and significantly to exchange rate dynamics during the estimation period.

A careful observation would reveal that historically the oil and gas sector activities both in the pre and post global financial crisis era are pulled by the banking, food beverages and tobacco and self-contributions. The banking sector contribution to the oil and gas is very pronounced throughout the sample period. Self-shocks and food beverages and tobacco significantly contributed to worsening oil and gas uncertainty in 2007 and during the global financial crisis. The banking sector uncertainty contribution, which worsened oil and gas prior to global financial crisis, immensely improved the sector uncertainty between 2013 and 2015 though these palatable effects were truncated by self-innovation. Stock market and exchange rate contributions were modest and generally offset by the contributions of other sectors. The historically contribution of the banking sector to innovations in the oil and gas confirms earlier findings in chapter five and parameter estimates earlier presented.

The historical contribution to insurance sector uncertainty by the various sectors' uncertainties shock is intuitive and elucidative; indicating that oil price shock, oil and gas, banking, insurance and exchange rate had dominant positive effects on insurance growth (Figure 6B.4 in the appendix). This closely tracked the growth turning points, especially in 2006 (aftermath of the banking consolidation exercise), 2009 (the global financial crises period) and 2014 (collapse of international oil price). As the global financial crises momentum waned, the effect of oil price historical contribution to insurance behaviour concomitantly dwindled until 2015 when a substantial effect was again noted and became more pronounced in 2015. This suggests significant influence on the behaviour of insurance by oil price uncertainty during this period. Own shock and banking shock contribution attain significant levels in 2013 as they jointly accounted for the moderation in insurance uncertainty. The spike witnessed during the global financial crises period was driven primarily by oil price, oil and gas and own shock.

The contribution to food beverages and tobacco in the pre and post financial global financial crisis show the dominance of own shock, with significant contributions by oil price, oil and gas, insurance and market sector shocks returns taking the lead. The contraction witnessed by food beverages and tobacco during the 2006 and 2007 was spurred mainly by negative oil price uncertainty shocks. Negative bank and insurance returns shock were pronounced from 2013 and accounted for the upward trend in food beverages and tobacco uncertainty. Consumer goods contributions were marginal and inconsequential as it lies mostly along the mean. Most of the deceleration was accounted for by negative oil price shock prior to the global crisis. The dampened growth of food beverages and tobacco during the global financial period was filliped principally by the positive oil price uncertainty complemented by the oil and gas and insurance uncertainties. The contribution of insurance, which was marginal, prior to the global crisis, improved significantly thereafter especially in 2013 and 2015.

An examination of Figure 6B.6, in the appendix, show a significantly modest historical contribution to consumer goods uncertainty shock by other sectors, confirming the minimal impulse response interaction between the sector and others. However, the oil price, banking, market and own shock influenced the consumer goods movements both in the pre and post global financial crises This is in consonance with the common general view in economic literature that rising oil prices slows growth historically as a result of higher production cost. This probably accounts for the huge contribution to the spike in consumer goods movement during the global financial crisis. Meanwhile, the spike witnessed in 2011 was mainly contributed but own shock, while in 2015, the positive contribution of oil price was neutralised by the negative insurance contribution. In terms of policy, economic managers have to monitor oil price movement vis-à-vis international developments if the sector has to play its role as the engine of growth. Spates of own shocks are noticed throughout the period while the banking shock markedly added to consumer goods uncertainties in 2013. Market contribution was meaningful only during the banking sector consolidation exercise of 2006.

Further evidence suggests that historically oil price uncertainty shock and oil and gas shocks exert dominant positive and negative influences on the behaviour of banking uncertainty, respectively. The contribution of own shock and insurance uncertainty equally made meaningful contribution to banking uncertainty throughout the sample period. Exchange rate contributed to improving banking uncertainty in 2011 but worsened it in 2015-2016. Market shocks impinge minimal positive effects that fizzle out over the forecast horizon while the worsening uncertainty during the global financial crises and in 2013 was contributed mainly by own shocks, oil price, insurance and oil and gas shocks. The other sectoral indicators of uncertainties contributed negatively to banking sector response, albeit marginally, hence minimal impacts were observed.

The estimate of the individual contribution of each sectors' structural shock to the movement in market uncertainty show that oil price significantly improved market uncertainty prior to the global financial crisis. The dampening market uncertainty during this period were contributed by own shock while banking shocks play modest role in the dampening of market uncertainty. Food beverages and tobacco made small positive contribution to market uncertainty, while the contributions of other sectors are thin throughout the forecast horizon.

Suffice to note that the outcome of historical decomposition largely mirror the parameter estimates, impulse response functions and forecast error variance decomposition earlier obtained and discussed in this chapter making the study results consistent. Over the sample period, the contribution of oil price, exchange rate, oil and gas and banking uncertainties remain significant for all the sectors, while the dynamic interactions were also consistent.

6.3 Sector-by-Sector SVAR Estimates

In the previous section, the effect of a one-off change in the structural innovations of oil price and exchange rate uncertainty on the five industry sectors and market were considered as a system. This procedure highlights the systematic components of the shock variables and uses the deviations to identify their effects on the sector returns uncertainties. Consequently the 8-variable SVAR model specification in section 4.1.2.3 is modified with the number of variables reduced to four namely: oil price, exchange rate, market and the uncertainty of the sector of interest in that order. The 4 x 4 model is, as in the previous section, is a recursive system and typically lower triangular with the assumption that variables ordered up are not influenced by those lower down. The ordering is guided by economic theory and institutional knowledge of the economy of interest. The model is exactly identified with 6 restrictions on matrix A as the other matrix is assumed to be an identity (Breitung, *et al*, 2004). The modified SVAR is specified as

$$e_t = \begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{oagu} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{oagu} \end{bmatrix} \qquad 6.1$$

The objective is driven by the need to take a closer investigation of the responses of the sector returns uncertainty to a one standard deviation structural change in oil price, exchange rate and market uncertainty shocks and compare the results with the system experiment model of the previous section.

Oil price uncertainty is included in the model to capture the anticipated effect interest rate and inflation rate on the sectors. To the extent that crude oil export constitutes the major singular earner of foreign reserves, uncertainty in its price is expected to impact negatively on the rates in the economy. The inclusion of exchange rate uncertainty is premised on the importance of the variable in the production processes of the sectors since intermediate raw materials, machinery and expertise is acquired with foreign exchange. It also serves as the channel for the pass through of international economic activities to prices and interest rate for the sectors.

Market uncertainty is included to control for other factors and sectors not captured in the model. The market nests all sectors in the market as well as reflects the performance of other key economic indicators in the economy. It is expected that sector uncertainties should track market behaviour. The last equation in the model represents the sector of interest and is assumed to respond to the structural innovations from oil price, exchange rate and market uncertainties but itself do not influence others contemporaneously. It is assumed that the sectors react quickly to all information. The model is estimated for each of the five sectors in the sample. Estimated structural parameters, the impulse response functions and forecast error variance decomposition are employed in the analysis.

Oil price is treated as an external variable which is not contemporaneously affected by other variables in the model. Exchange rate depends on oil price, reflecting the role of oil price in measuring anticipated inflation. The market is assumed to respond to changes in both oil price and exchange rate since it serves as channel through which these two external factors impulses infuse to domestic prices and interest rate. These assumptions are premised on the theoretical imperatives of the importance of oil prices as critical input in the production processes and that economic agents react decisively to any change in prices.

6.3.1 Empirical Results and Discussions

6.3.1.1 Short-Run Structural VAR Estimates

To implement the modified model, the same steps used in the previous model are followed using the uncertainty series as generated with a GARCH(1,1) process. Table 6.9 show the parameter estimates of the impact of oil price, exchange rate and market uncertainties on the five industry sectors.

Table 6.9 Structural Parameter Estimates of Contemporaneous Oil Price, Exchange Rate and Market Uncertainty Shocks on the Sectors Uncertainties

Oil and Gas

$$\hat{A}=\begin{bmatrix} 1 & & & \\ -0.026 & 1 & & \\ -0.096 & -0.362* & 1 & \\ -0.579 & -27.978 & 1.176 & 1 \end{bmatrix}\begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{oagu} \end{bmatrix}$$

Insurance

$$\hat{A}=\begin{bmatrix} 1 & & & \\ -0.012 & 1 & & \\ -0.291* & 0.102 & 1 & \\ -1.337* & -2.995* & 1.333* & 1 \end{bmatrix}\begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{insu} \end{bmatrix}$$

Food Beverages and Tobacco

$$\hat{A}=\begin{bmatrix} 1 & & & \\ 0.011 & 1 & & \\ -0.124* & -0.166 & 1 & \\ -0.520* & -1.402* & -0.762* & 1 \end{bmatrix}\begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{fbtu} \end{bmatrix}$$

Consumer Goods

$$\hat{A}=\begin{bmatrix} 1 & & & \\ 0.004 & 1 & & \\ -0.146* & -0.212 & 1 & \\ 6.204 & 19.907 & 50.854* & 1 \end{bmatrix}\begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{cogu} \end{bmatrix}$$

Banking

$$\hat{A}=\begin{bmatrix} 1 & & & \\ -0.024 & 1 & & \\ -0.315* & 0.445* & 1 & \\ -1.586* & -3.956* & -0.592 & 1 \end{bmatrix}\begin{bmatrix} e_t^{opru} \\ e_t^{exru} \\ e_t^{mktu} \\ e_t^{bnku} \end{bmatrix}$$

A cursory examination of the parameter estimates of the sectors highlight the similarities between the larger system models presented in Table 6.7 and the sector models, which are smaller in dimension. For instance, while oil price uncertainty shock in the larger model significantly affected insurance and banking sectors only, the sector representation extended the worsening effect to include food beverages and tobacco uncertainty by 1.34, 1.58 and 0.52 per cent, respectively. The highest impact is on the banking sector indicating the level of exposure of the sector to oil price innovations. This is closely followed by the insurance sector, ostensibly explained by the considerable similarities in the structure and activities of the two sectors (financial intermediaries).

The impact of the exchange rate uncertainty perfectly mimicked the oil price process in the smaller model both in terms of magnitude and direction. In contrast, however, exchange rate in the larger model, counterintuitively improve the consumer goods uncertainty significantly. This result suggests that the negative effect of exchange rate uncertainty was far outweighed by the positive from the interaction between the sector and other sectors in the economy or better still by factors not captured by the model.

Innovations in market uncertainty suggest beneficial effect on the insurance and consumer goods sectors while a positive effect was noted for the food beverages and tobacco sectors. The implication is that uncertainty in the market improves the outlook of the insurance and consumer goods sectors. The consumer goods outcome could be traced to panic buying that might accompany market uncertainty leading to upsurge in prices and eventual rise in the yields for stakeholders, at least in the short-term.

In summary, it has been shown that the sector by sector model succinctly highlighted the impact of oil price, exchange rate and market uncertainty shocks on the economy more than the larger system model. This finding emphatically supports earlier allusions that sector analyses unmask information concealed by larger models. The results also reveal that the insurance, food beverages and tobacco and banking sectors are the most affected by the innovations in oil price, exchange rate and market uncertainty shocks. Consumer goods is affected by market uncertainty while the impact on oil and gas is neutral. The outcome for the oil and gas sector is in tandem with the larger system model, which though was rightly signed but was not statistically significant.

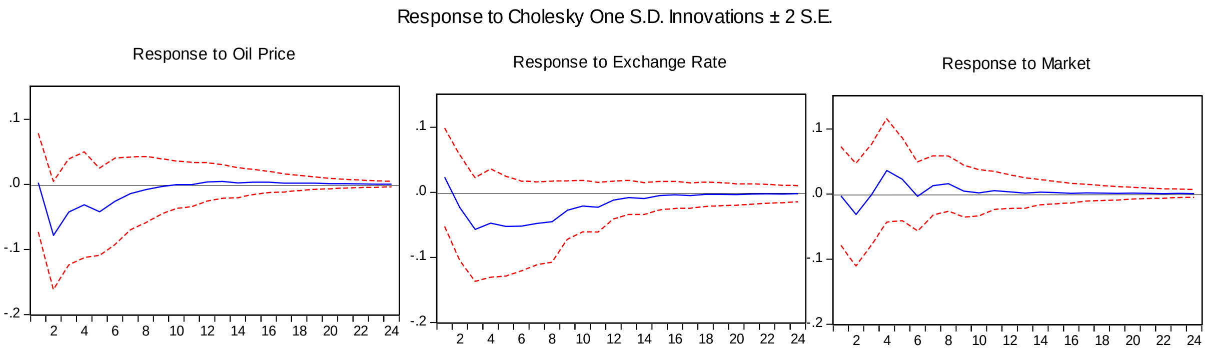
6.3.2 Sector-by-Sector Impulse Response Functions

Figure 6.2 illustrates the impulse response functions of the sector-by-sector estimates to the structural shocks in oil price, exchange rate and market uncertainties. It is theoretically expected that a shock from any of the three variables would lead to rise in the uncertainties of the various sectors, adding to their production cost and ultimately decline in output and share prices, all things being equal.

6.3.2.1 Oil and Gas

An unanticipated one per cent structural oil price uncertainty shock, reveals significant and immediate declines in the oil and gas sector uncertainty. This is consistent with the larger system estimate in the previous section. Market response is similar but more transitory as it reverted fast to positive in the first three months and meander around the mean from month ten. The response to exchange rate uncertainty was initially positive but immediately reverted to negative and remain so for the rest of the forecast horizon. The large negative response of oil and gas to oil price and exchange rate suggest improvement in the sector uncertainty rather than worsening it. This is explained by the apparent relationship and partnership between the sectors in the economy.

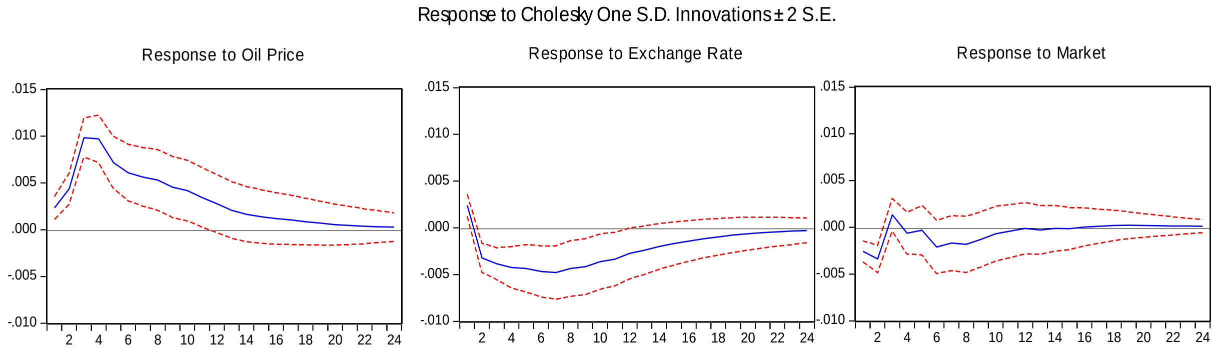
Figure 6.2a: Sector-by-Sector Impulse Response Function of Oil and Gas



6.3.2.2 Insurance

The response of insurance uncertainty to a standard deviation innovation in the three structural shocks offers useful information about the sector. While the response to oil price shock is large, significant and permanent over the period, the influence of exchange rate uncertainty initially worsen the sector uncertainty in the first month but reversed and remained permanently negative. In contrast the response to market, decreased from its negative trend to attain a steady state in month three. The positive achievement was short lived as it fell back to the negative region in month four.

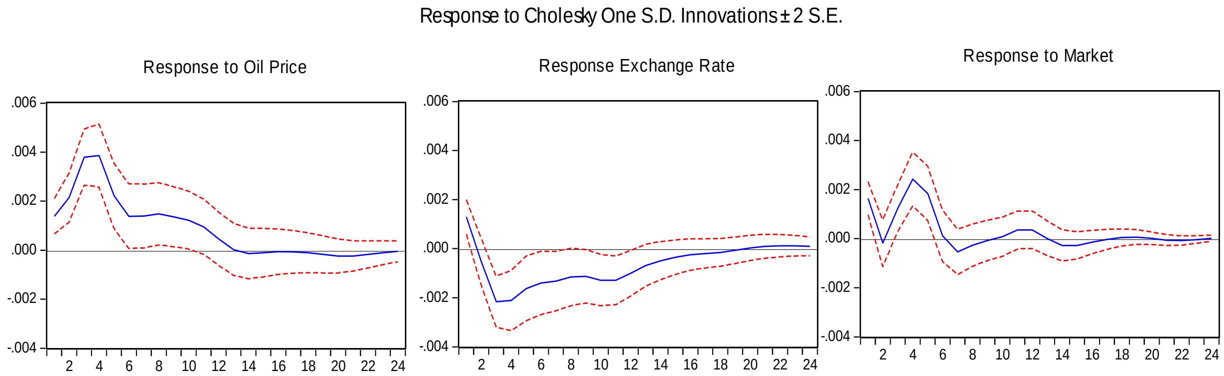
Figure 6.2b: Sector-by-Sector Impulse Response Function of Insurance



6.3.2.3 Food Beverages and Tobacco

In the Food Beverages and Tobacco sector, oil price and exchange rate uncertainty display similar statistically significant effect with the insurance sector uncertainty. The three structural shocks leads to significant increase in the sector uncertainty for the first two months for exchange rate and market but persisted positively for more than a year for the oil price change. Again exchange rate turned negative and remained so for about two years while market exhibited the same feature of winding around the mean before eventually dying out in the 17th month.

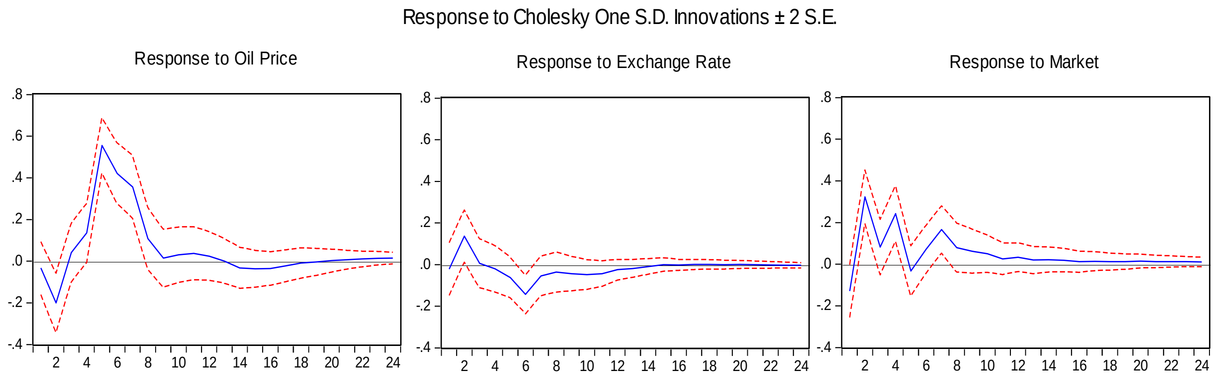
Figure 6.2c: Sector-by-Sector Impulse Response Function of Food Beverages and Tobacco.



6.3.2.4 Consumer Goods

A positive oil price shock to consumer goods uncertainty shows improvement in the sector uncertainty in the first two months but subsequently returned to equilibrium. Oil specific shocks leads to sustained positive effect over one year at a relatively higher speed. The effect of exchange rate shocks, on the other hand was not as pronounced as the oil price shocks as the positive impact lasted only for three months before reverting to and remaining in the negative region up to 14 months when it decayed completely. Market shocks similarly started with initial negative impact but turned and remain positive over the entire forecast period. Comparatively, these responses are larger and more pronounced in magnitude and direction when benchmarked against the impulse response of the larger model.

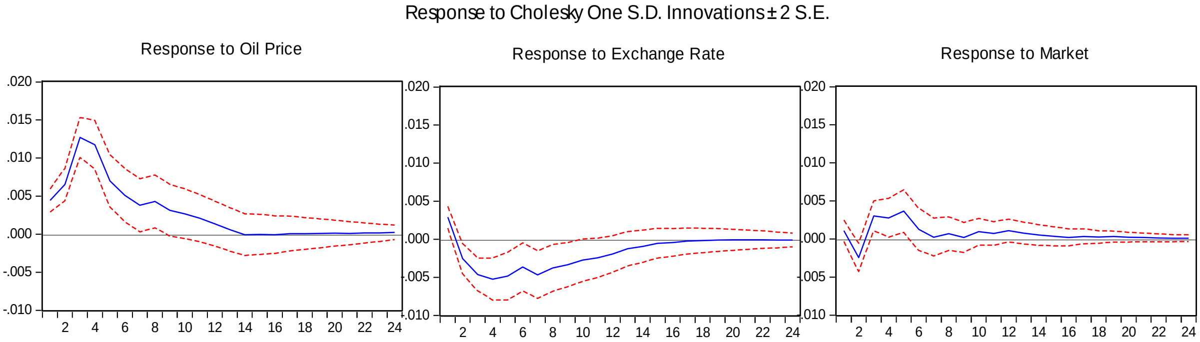
Figure 6.2d: Sector-by-Sector Impulse Response Function of Consumer Goods



6.3.2.5 Banking

Analysis of Figure 6.2e shows that the banking sector uncertainty response to oil price, exchange rate and market exhibit features contiguous to the consumer goods sector except that the impact of exchange rate is more prominent while the market effect is moderate and lied around the zero line from month seven. Oil Price uncertainty widened banking uncertainty for more than a year before attaining equilibrium and fizzled out in month 14. On the other hand, the improved posture of the sector to exchange rate shock persisted and decayed completely in month 17. While the oil price and market responses are inconsistent with the larger model, exchange rate results approximately mimic the larger model. Again the differences being accounted for by what could be regarded as the precision of the smaller models.

Figure 6.2e: Sector-by-Sector Impulse Response Function of Banking



6.3.3 Forecast Error Variance Decomposition

The variance decomposition result, as presented in appendix 6C, show that oil price uncertainty significantly accounted for about 31.3 per cent of the variation in the oil and gas sector uncertainty followed by market (23.8 per cent) after 10 months. The implication is that the oil and gas sector is more vulnerable to oil price shocks than other shocks. For the banking sector uncertainty, market uncertainty contributes the most variation followed by exchange rate and oil price, in that order. Market variation declined persistently from 27.1 per cent in month two to 8.9 per cent after ten months. Oil price shock contributes the least (3.3 per cent).

The contribution of market to insurance and food beverages and tobacco also led oil price and exchange rate at 22.4 and 17.2 per cent. This was followed by exchange rate (7.6 per cent) for insurance and oil price (12.2 per cent) for food beverages and tobacco. The variance decomposition of consumer goods shows that after 10 months, 12.5 per cent of the variation is accounted for by exchange rate uncertainty, while market and oil price explained 3.14 and 1.04 per cent, respectively.

In summary, the contribution of oil price was highest for oil and gas at 31.3 per cent variation, compared with 12.4 per cent recorded in the larger model in the previous section. This is followed by food beverages and tobacco at 12.2 per cent, while the lowest for consumer goods (1.0 per cent), consistent with the larger model. This implies that oil and gas is the most endogenous and consumer goods the most exogenous to oil price shocks. The variation explained by exchange rate was highest for consumer goods (12.5 per cent) followed by oil and gas (11.9 per cent), food beverages and tobacco (10.4 per cent) while banking is least. The variance error decomposition attributed to market shocks was 23.8 and 22.4 per cent for oil and gas and insurance sectors, respectively. The least is consumer goods at 3.1 per cent. This result is in tandem with the larger model which has 13.6 and 9.4 per cent variation for oil and gas and insurance sectors, respectively. The least contribution of 3.1 per cent agrees with the 1.4 per cent least explanation in the larger model, making the sector the most exogenous.

It could be inferred from the results that while congruence is observed for the direction of impact for both the small and large dimensional models, the magnitude vary significantly. The small model contributions are larger compared with the larger model, again highlighting the superior information content of sector by sector analysis over the large models.

6.4 Summary and Conclusion

This chapter investigates the effects of oil price uncertainty on sector stock returns uncertainties in Nigeria using the structural vector auto-regression (SVAR) framework. The impulse response function, variance decomposition and historical decomposition techniques were employed to examine the magnitude and direction of effects. This approach permits the evaluation of the dynamics between the five sectors and the overall market and pries more deeply in terms of the interrelationships. The variables and sample were chosen guided by economic theory and the availability of data.

Empirical results from the preliminary analyses, based on the Granger causality and cointegration tests, show that the variables in the system interact meaningfully and dynamically and exhibit elements of long-term relationships. The model was adjudged stable having satisfied stability condition of no unit root lying outside the unit circle. The short-run structural parameter estimates reveals that most of the coefficients were statistically significant and satisfy theoretical *apriori* expectations. Similarly, all sector stock returns uncertainties, except consumer goods, are rightly signed and significantly influenced by oil price uncertainty.

A perusal of the impulse response function show intuitive and informative insight about the impact of oil price innovation on the activities of the various sectors of the stock market over a 40 month forecast horizon. Treating oil price as exogenous, further evidence reveal that, except for consumer goods, all other sectors returns responses were positive. This implies that higher oil price uncertainty logically translates to higher equity returns uncertainty, suggesting higher risks in the market. This result is consistent with the findings of Falzon and Castilo (2013) and Arouri and Rault (2011). Equally significant was the finding that, aside from oil and gas sector returns, which show short-lived effect (10 months), the effect of oil price uncertainty on the uncertainties of all other sectors, was long-lasting, persisting over the entire estimation period. This, once again, demonstrate the pivotal role of oil price in explaining the volatility of equity returns in the stock market in Nigeria where oil resource is a critical factor for economic activities.

The forecast error variance decomposition shows that oil price uncertainty meaningfully contributed to explaining the variation in the sector returns uncertainties to as much as 57 per cent (banking), 55 per cent (insurance) and 52 per cent (market) at 24 month forecast horizon. Again this connotes the strength of oil price uncertainty in influencing the activities of the sample sectors in the stock market. This implies that movements in the sector indices are explained more by oil price returns uncertainty than other factors. The oil and gas sector returns was identified as the most endogenous with the least oil price returns contribution of 0.7 per cent of variation. It is important to highlight the fact that contributions to variations for all sectors stock returns peaked at period 8, after which they gradually weakened for the rest of the forecast horizon. This implies that the effect of oil price uncertainty dies off after 8 months.

Evidence from the examination of the historical decomposition show oil price and banking uncertainty shocks exerting significant contributions on the structural shocks of others especially before, during and after the global financial crises. The near neutral contribution to the consumer goods activities by the historical influence of other sectors in the model both in the pre and post global financial crisis was noted.

These results have various policy implications. From the perspective of policy, given the overwhelming dominance of oil price uncertainty on the activities of the sectors returns, there is need for the monetary authority to closely monitor oil price movement to ensure a stable and sound financial system. Secondly, the observed strong interlinkage within the market increases the systemic risks as the crystallisation of a sector risk can potentially upturn the entire market activities. More importantly, Nigeria is an import-dependent economy, which foreign reserve accretion depends on the direction of oil price, a critical determinant of exchange rate in the economy. Monitoring the meandering price of oil price, therefore, would send early warning signals to the monetary authority for the formulation of policy options to hedge against imminent systemic crisis that may be occasioned by oil price shocks. These results are also useful for portfolio management and diversification given the discovery of the sensitivities of the various sectors to oil price innovations.

Appendix 6

Figure 6A: Structural VAR Responses

Figure 6A.1: Impulse Responses to Positive Oil Price Uncertainty Shock

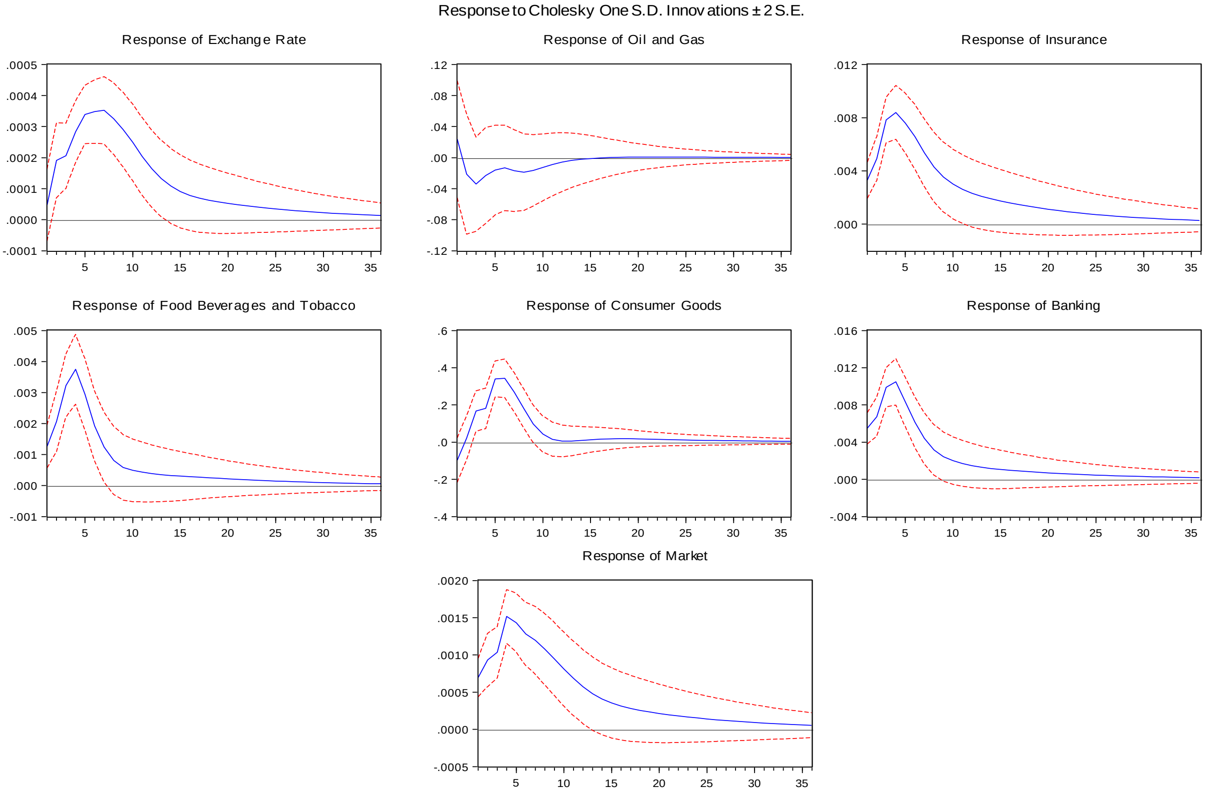


Figure 6A.2: Impulse Responses to Positive Exchange Rate Uncertainty Shock

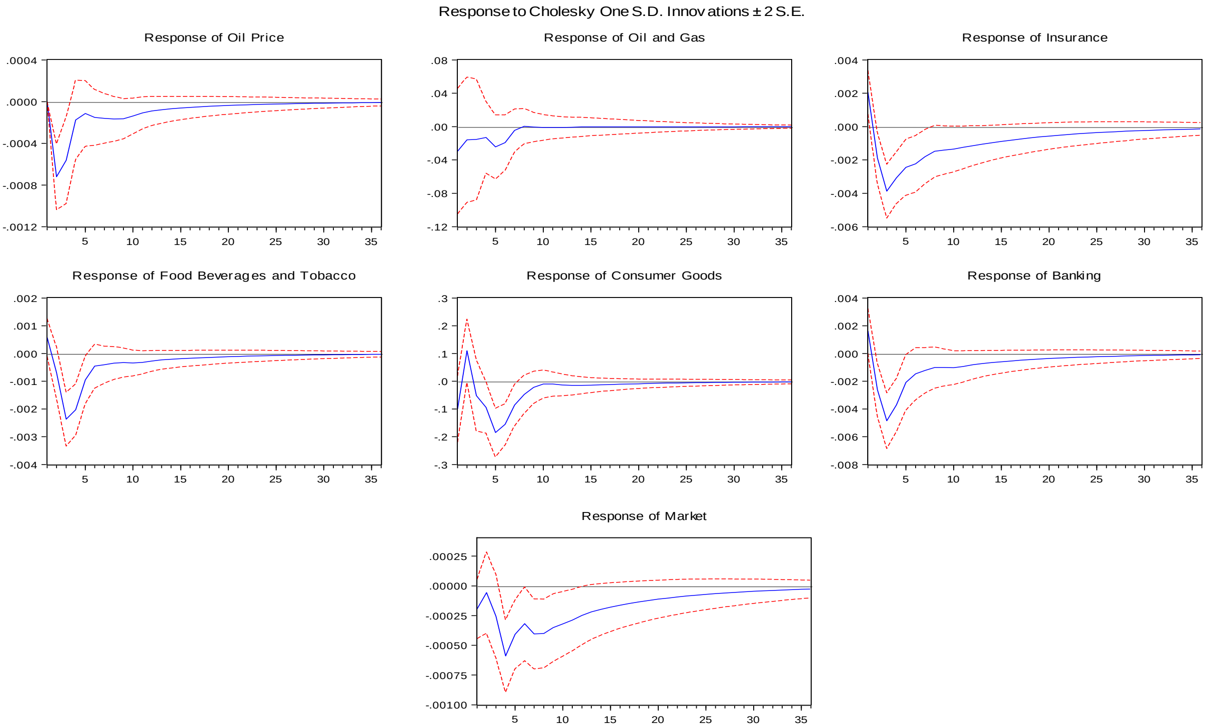


Figure 6A.3: Impulse Responses to Positive Oil and Gas Uncertainty Shock

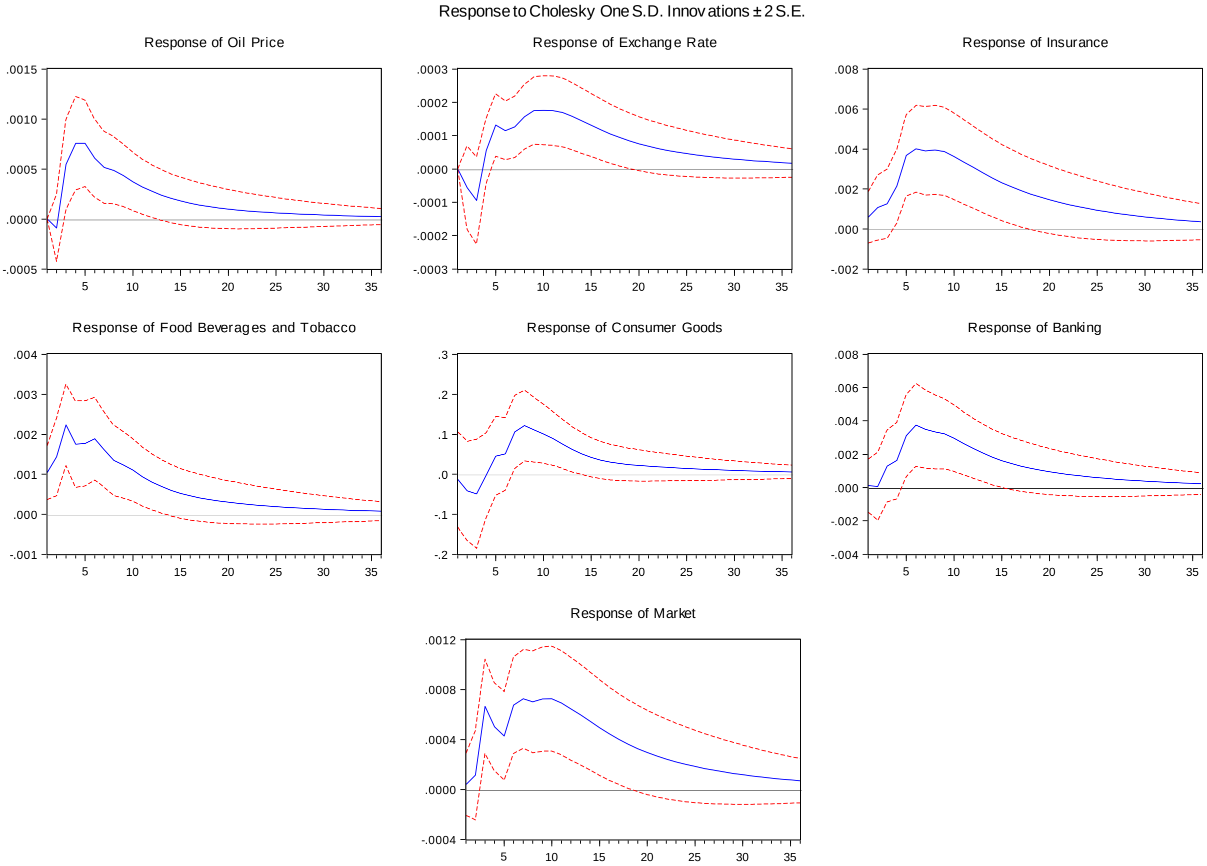


Figure 6A.4: Impulse Responses to Positive Insurance Uncertainty Shock

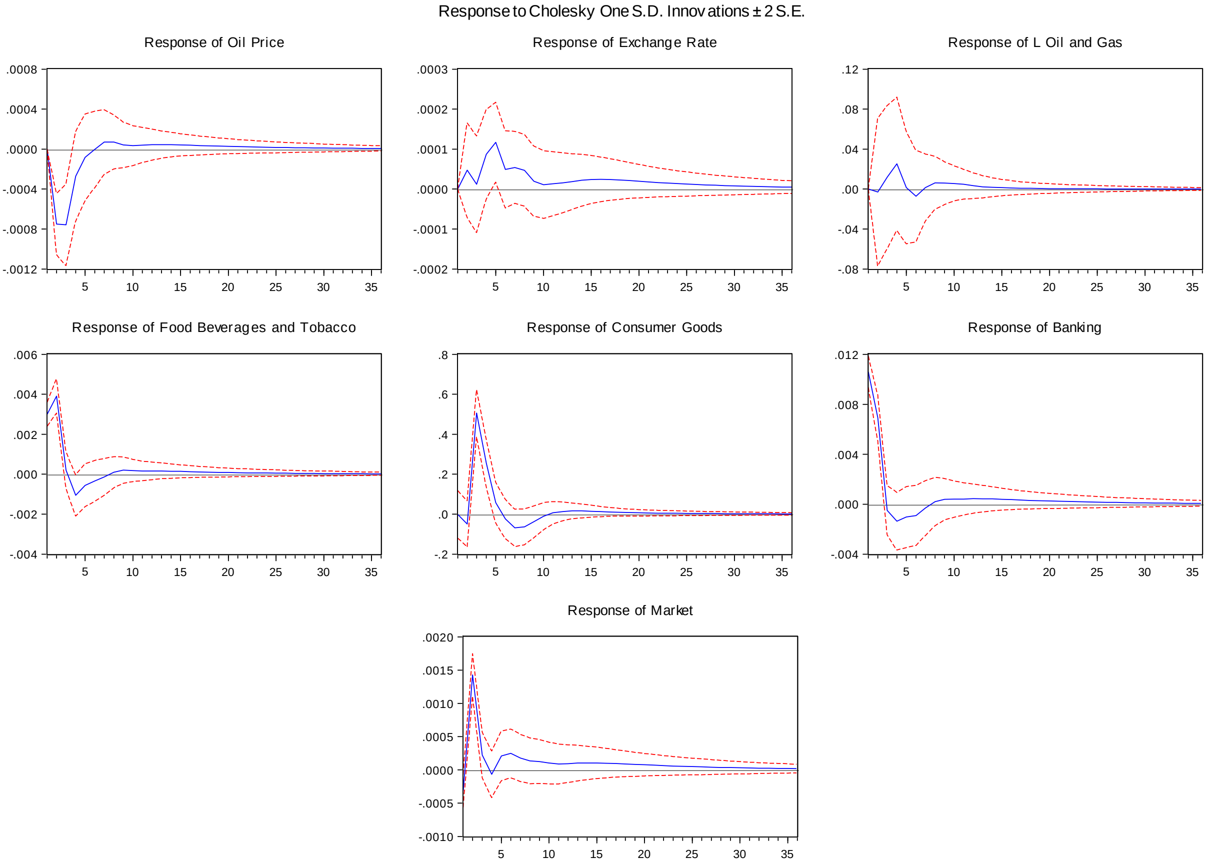


Figure 6A.5: Impulse Responses to Positive Food Beverages and Tobacco Uncertainty Shock

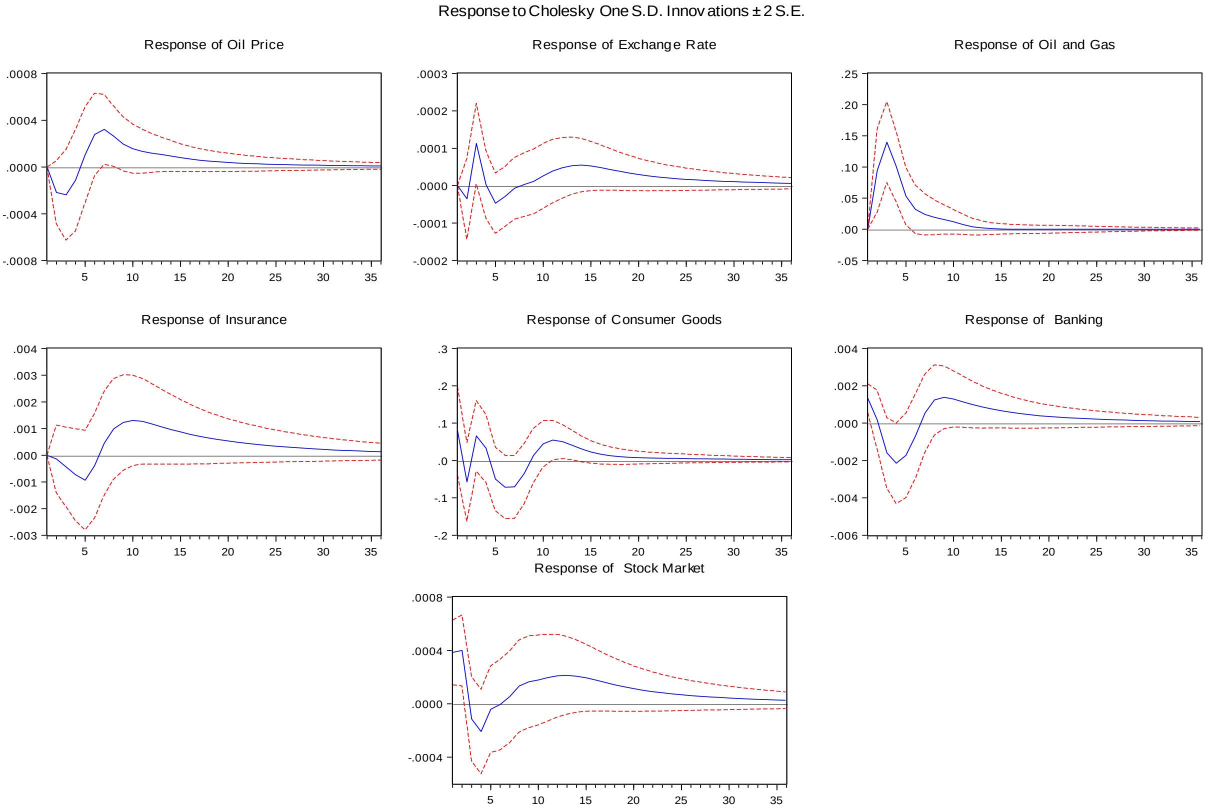


Figure 6A.6: Impulse Responses to Positive Consumer Goods Uncertainty Shock

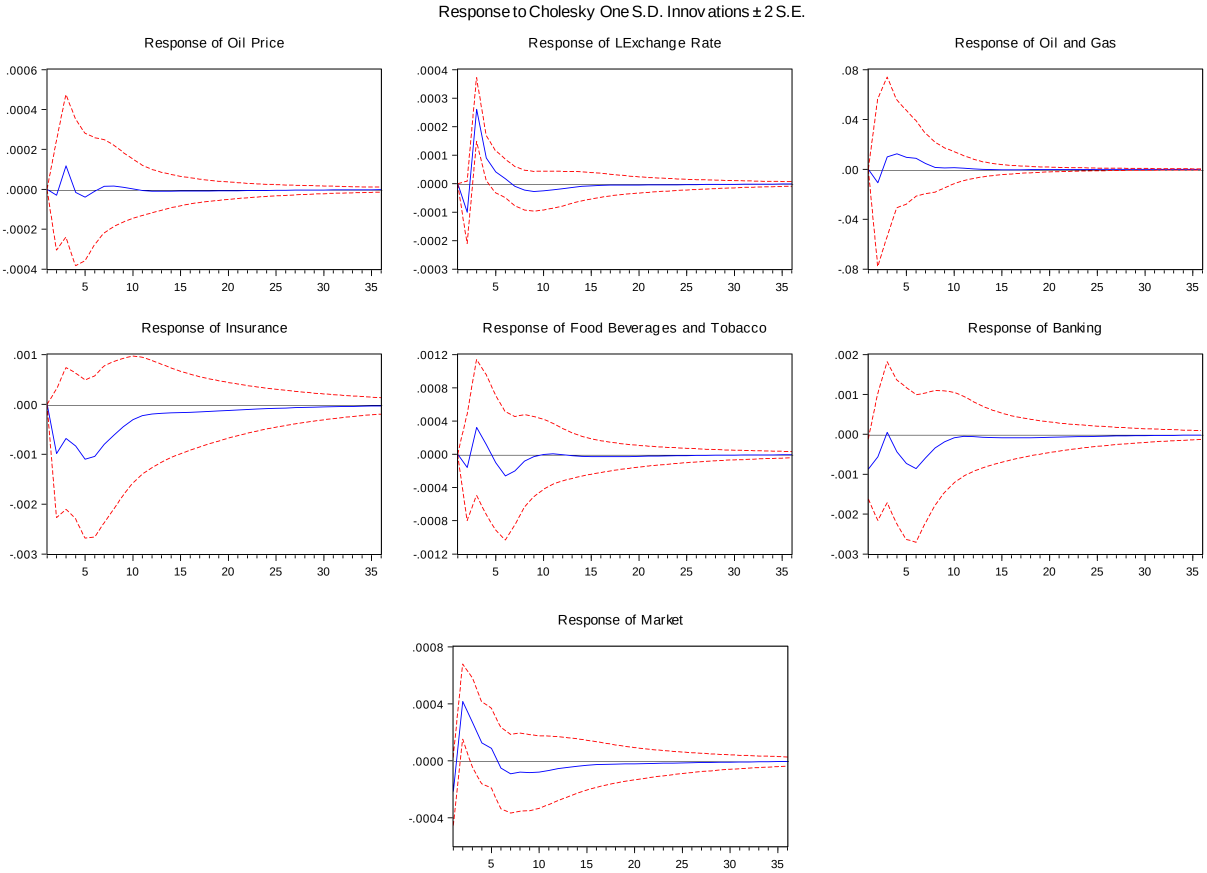


Figure 6A.7: Impulse Responses to Positive Banking Uncertainty Shock

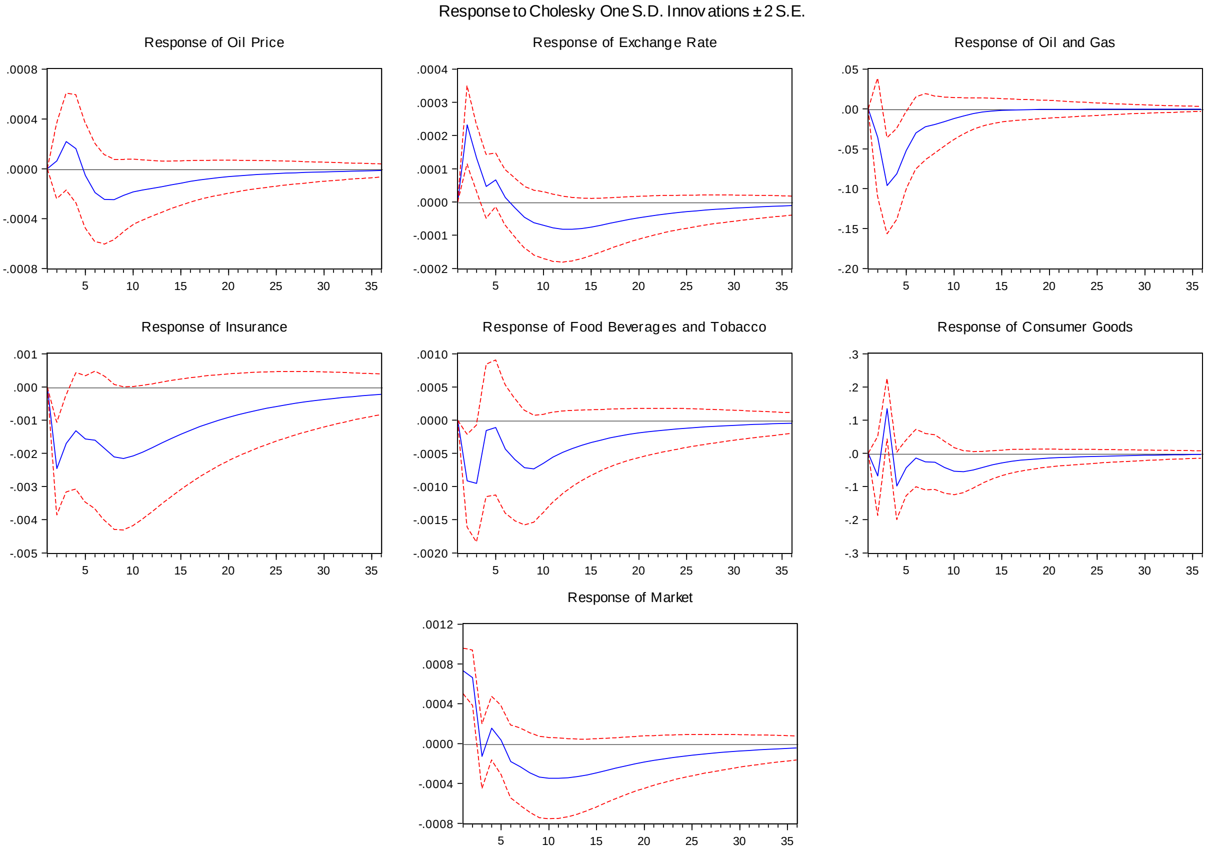
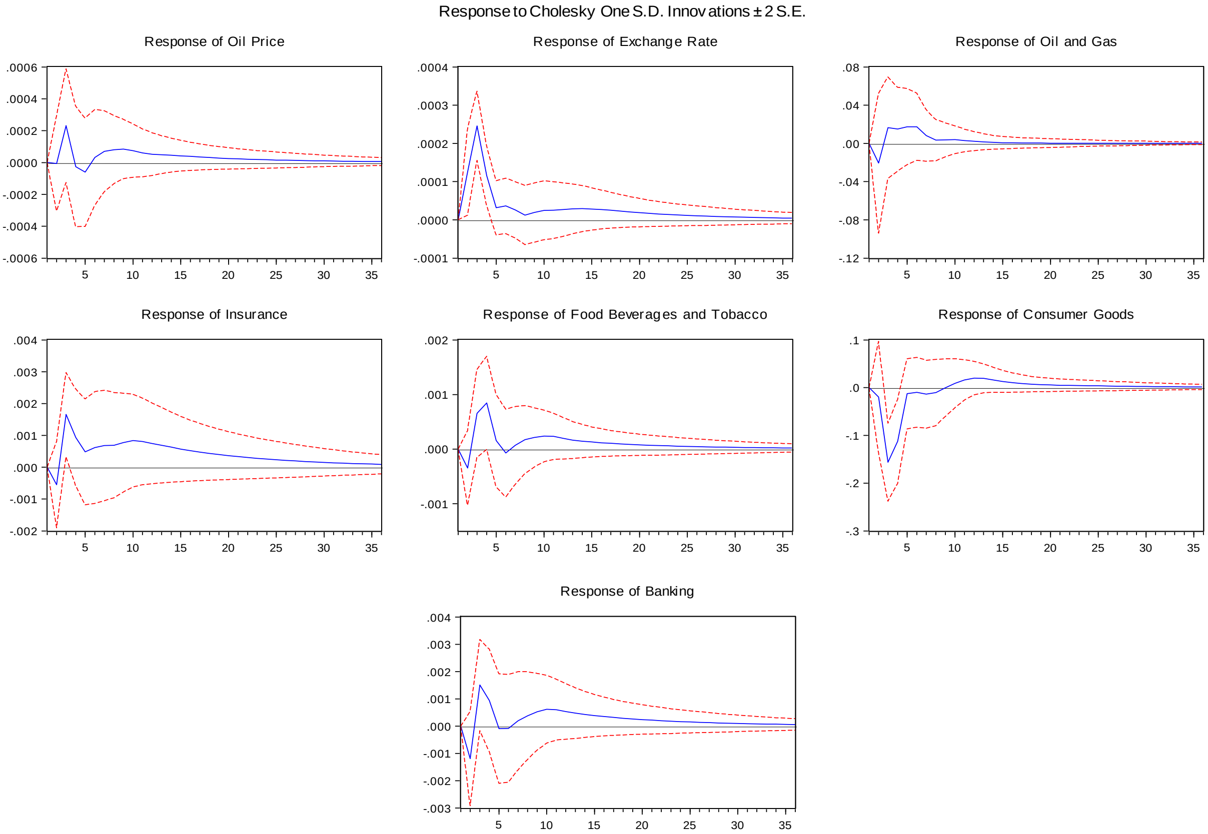


Figure 6A.8: Impulse Responses to Positive Market Uncertainty Shock



Source: Author's computation

Figure 6B: Historical Decomposition

Figure6B.1: Historical Decomposition of Oil Price Uncertainty

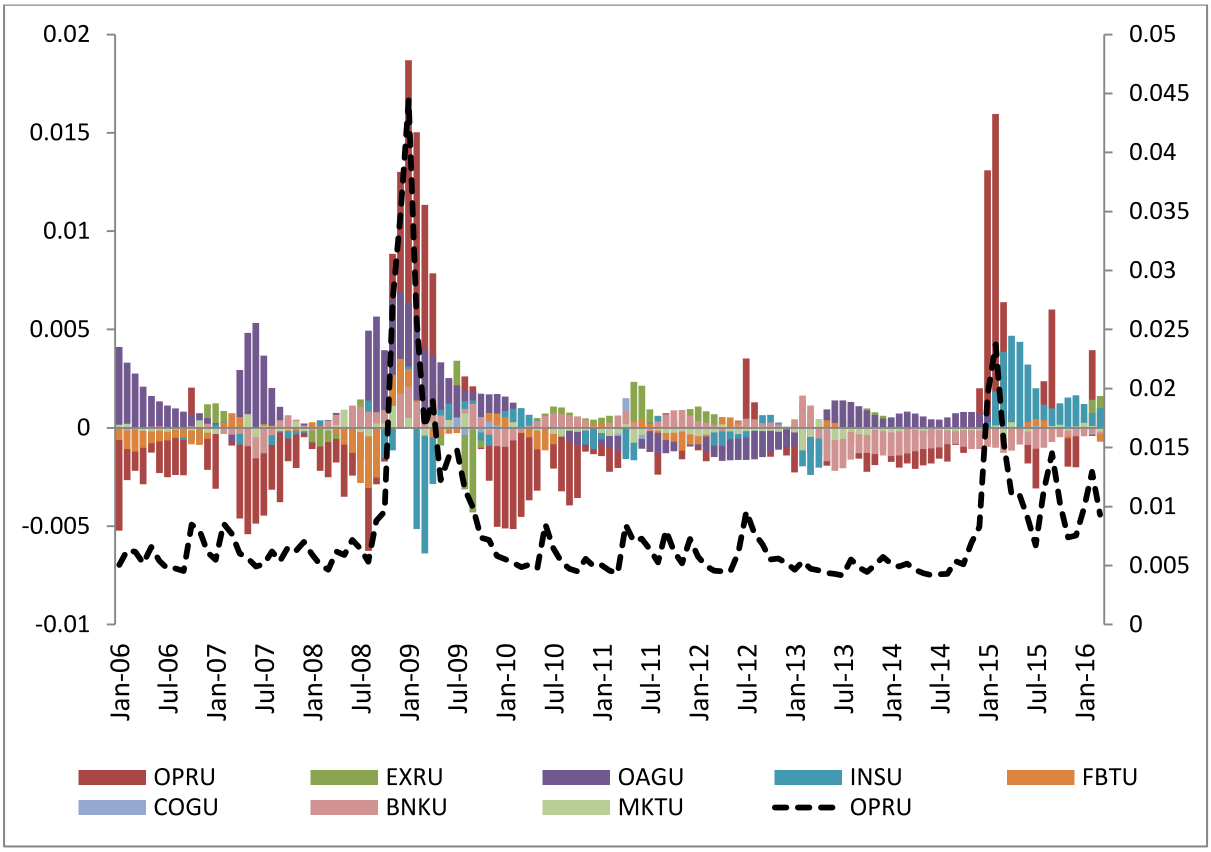


Figure 6B.2: Historical Decomposition of Exchange Rate Uncertainty

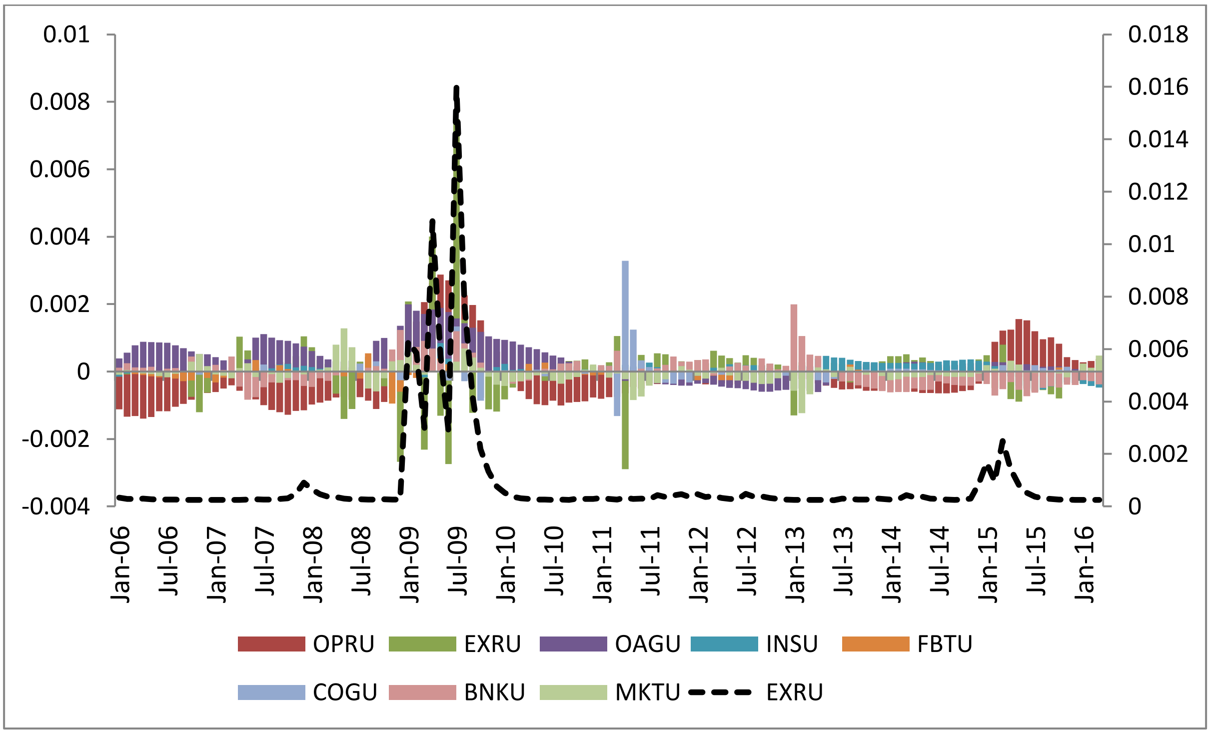


Figure 6B.3: Historical Decomposition of Oil and Gas Uncertainty

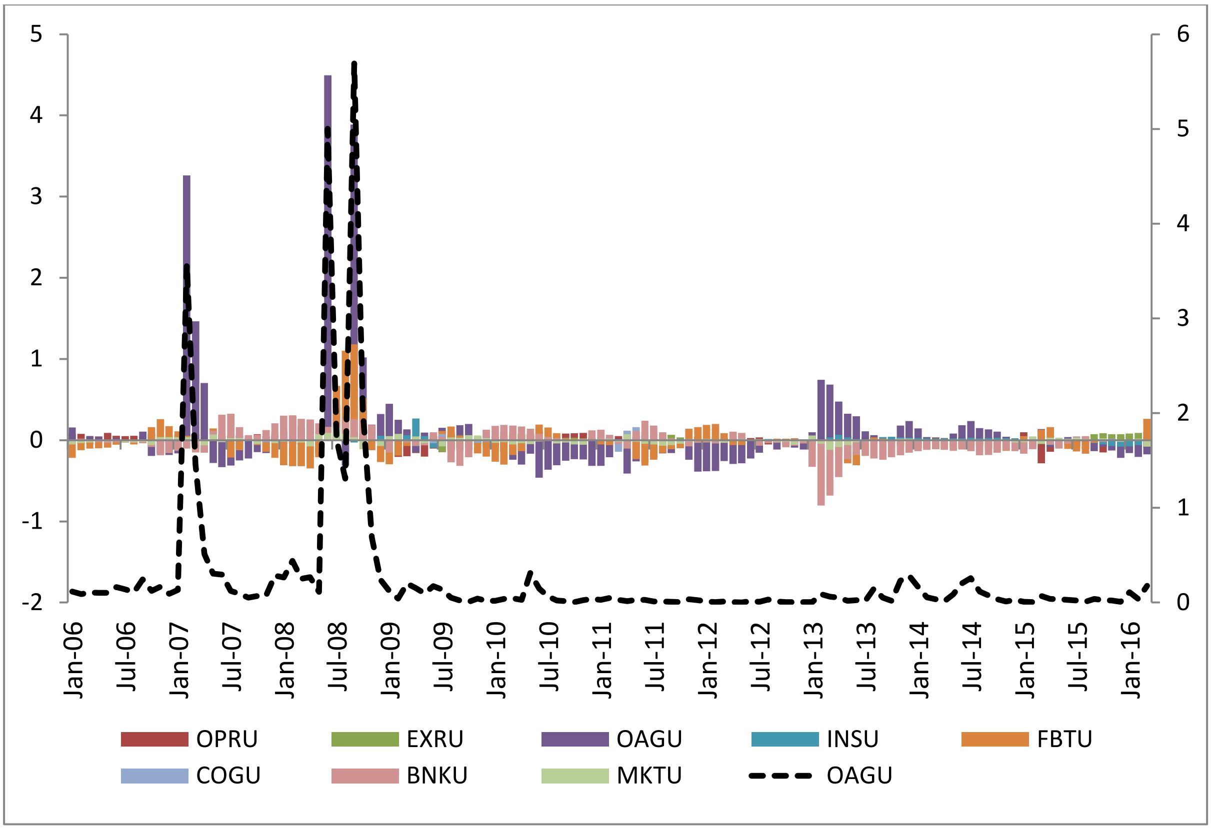


Figure 6B.4: Historical Decomposition of Insurance Uncertainty

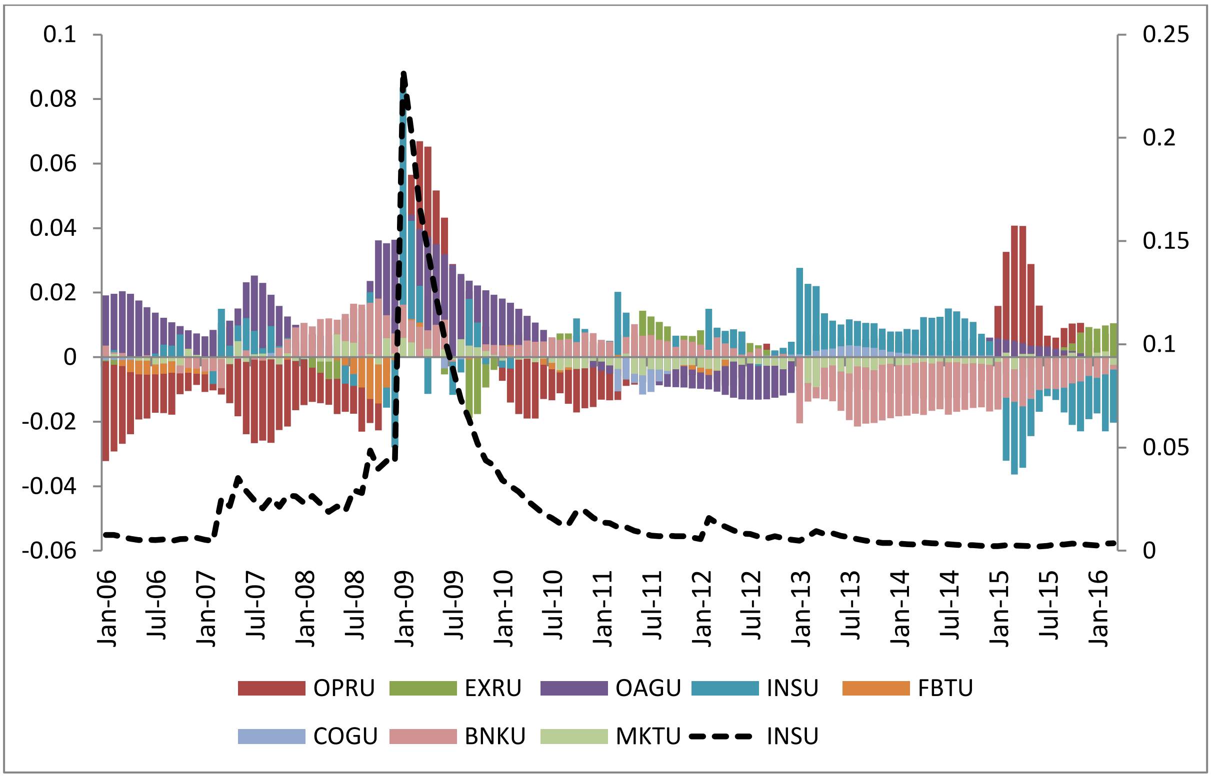


Figure 6B.5: Historical Decomposition of Food Beverages and Tobacco Uncertainty

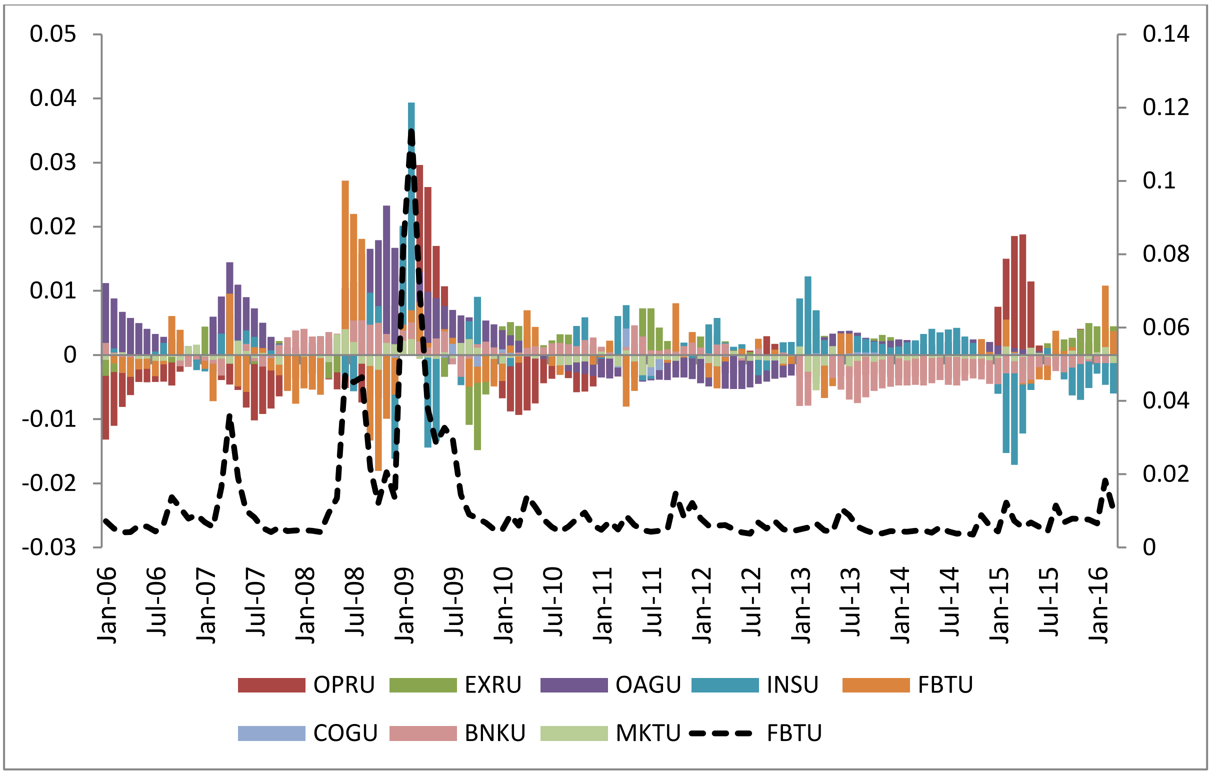


Figure 6B.6: Historical Decomposition of Consumer Goods Uncertainty

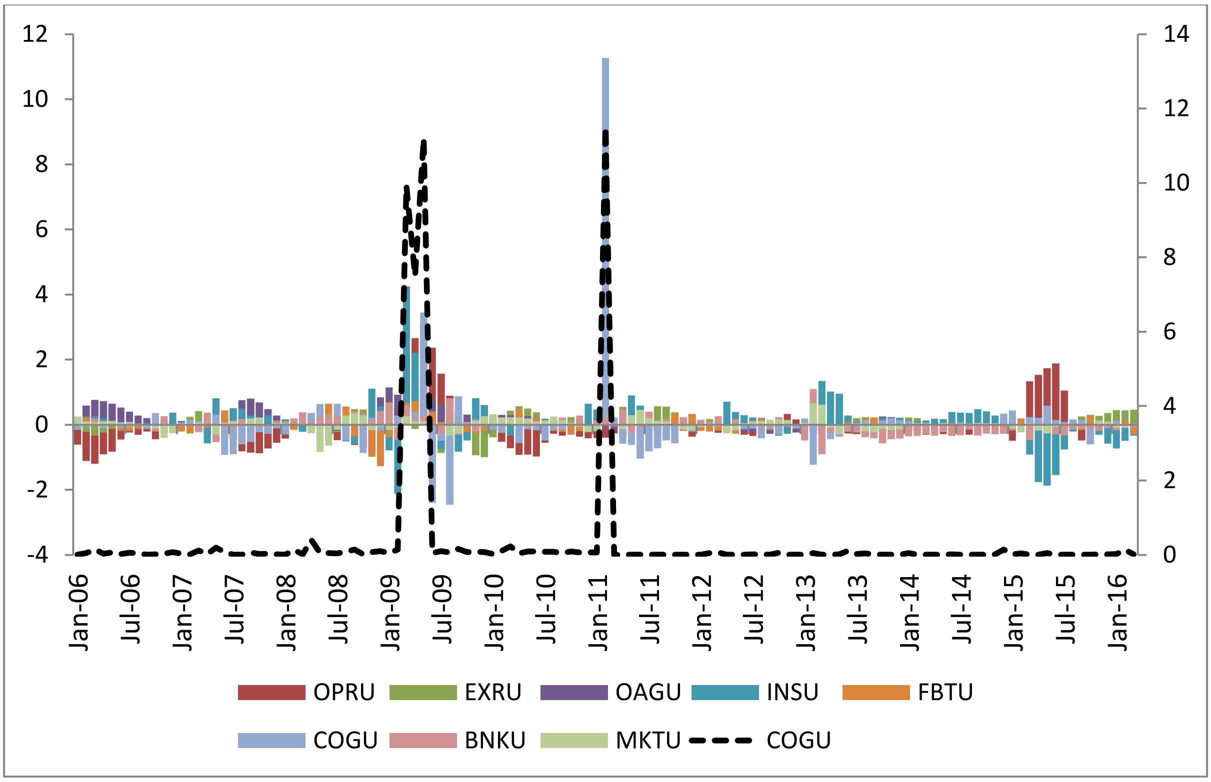


Figure 6B.7: Historical Decomposition of Banking Uncertainty

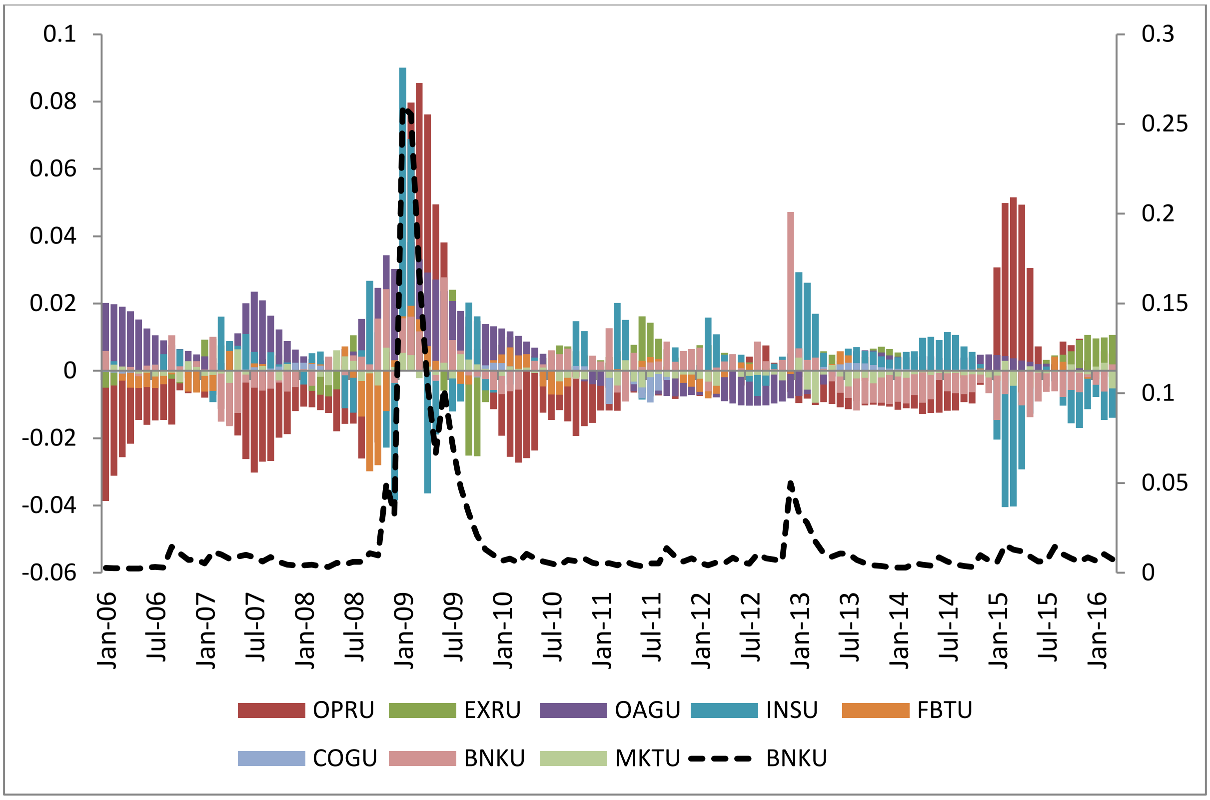
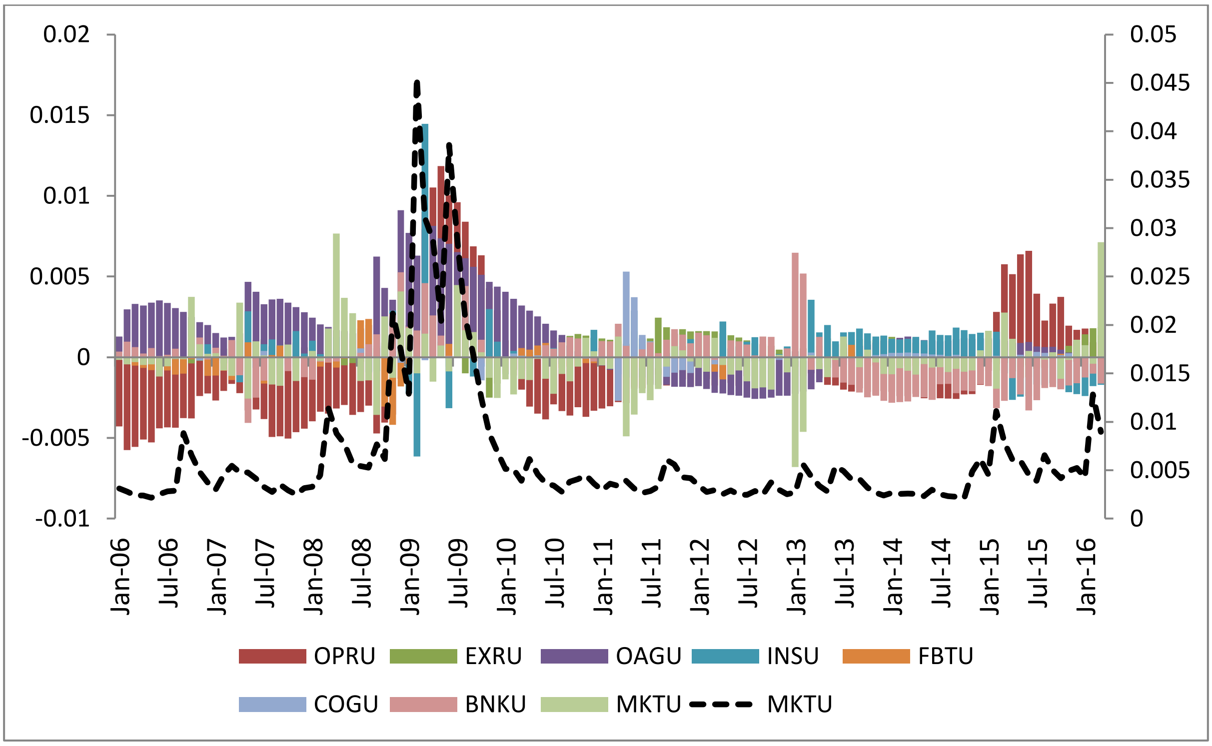


Figure 6B.8: Historical Decomposition Market Uncertainty



Source: Author's computation
Note: OPRU=Oil Price, EXRU- Exchange Rate, OAGU=oil and gas, INSU=insurance, FBTU= food beverages and tobacco, COGU= consumer goods, BNKU= banking and MKTU=market all share index uncertainties.

Table 6A: Forecast Error Variance Decomposition

Period	OPR	EXR	OAG	INS	FBT	COG	BNK	SMK
Forecast Error Variance Decomposition of Oil Price								
1	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	89.914	4.591	0.072	4.964	0.416	0.008	0.036	0.003
4	81.874	4.888	4.939	6.816	0.658	0.085	0.435	0.306
6	77.844	4.624	9.277	6.226	1.048	0.085	0.595	0.301
8	74.796	4.643	11.208	5.947	1.826	0.083	1.156	0.341
10	73.066	4.719	12.402	5.778	2.065	0.081	1.498	0.389
Forecast Error Variance Decomposition of Exchange Rate								
1	0.292	99.708	0.000	0.000	0.000	0.000	0.000	0.000
2	4.348	85.988	0.354	0.249	0.141	1.135	6.024	1.761
4	13.061	63.627	1.222	0.801	1.129	6.961	5.954	7.244
6	25.607	52.056	2.945	1.678	1.093	5.669	5.036	5.916
8	33.821	44.811	4.649	1.679	0.918	4.779	4.346	4.996
10	36.933	40.599	7.060	1.512	0.852	4.299	4.271	4.474
Forecast Error Variance Decomposition of Oil and Gas								
1	0.174	0.267	99.557	0.000	0.000	0.000	0.000	0.000
2	0.281	0.309	96.456	0.003	2.440	0.032	0.357	0.118
4	0.640	0.359	85.412	0.189	9.060	0.087	4.036	0.217
6	0.709	0.560	83.868	0.191	9.531	0.122	4.674	0.343
8	0.843	0.559	83.453	0.197	9.639	0.126	4.822	0.357
10	0.936	0.557	83.224	0.211	9.689	0.127	4.892	0.363
Forecast Error Variance Decomposition of Insurance								
1	9.815	3.825	0.307	86.053	0.000	0.000	0.000	0.000
2	20.186	4.468	0.856	70.262	0.0121	0.557	3.483	0.174
4	47.326	9.118	2.174	36.415	0.214	0.606	3.033	1.114
6	53.189	8.554	7.389	25.611	0.354	0.878	3.119	0.902
8	52.638	8.103	11.364	21.634	0.495	0.912	3.939	0.916
10	50.489	7.845	14.413	19.567	0.924	0.863	4.882	1.016
Forecast Error Variance Decomposition of Food Beverages and Tobacco								
1	5.617	1.184	3.8037	31.779	57.616	0.000	0.000	0.000
2	10.105	1.396	5.384	41.881	39.544	0.043	1.437	0.208
4	29.143	10.112	10.742	24.447	22.502	0.136	1.699	1.218
6	34.131	9.307	14.305	20.691	18.778	0.176	1.575	1.038
8	33.598	8.923	16.677	19.388	18.096	0.200	2.121	0.996
10	32.696	8.734	17.981	18.678	17.957	0.193	2.728	1.032
Forecast Error Variance Decomposition of Consumer Goods								
1	1.134	1.215581	0.020	0.001	0.765	96.865	0.000	0.000
2	1.1594	2.598706	0.226	0.284	1.128	94.011	0.546	0.046
4	5.366	2.553830	0.329	24.565	1.138	60.739	2.466	2.843
6	18.577	5.624755	0.547	20.030	1.3794	49.421	2.114	2.306
8	22.724	5.646743	1.942	18.705	1.601	45.268	1.999	2.114
10	22.803	5.542932	3.113	18.342	1.682	44.242	2.207	2.067

Period	OPR	EXR	OAG	INS	FBT	COG	BNK	SMK
Forecast Error Variance Decomposition of Banking								
1	16.806	1.476	0.0067	62.593	0.9983	0.422	17.697	0.000
2	26.762	3.352	0.006	56.714	0.645	0.382	11.631	0.508
4	51.979	8.556	0.791	29.777	1.645	0.234	6.174	0.842
6	56.655	7.699	4.072	23.809	1.802	0.370	4.923	0.668
8	55.963	7.404	6.839	21.881	1.899	0.402	4.974	0.637
10	54.327	7.282	8.898	20.788	2.252	0.387	5.379	0.687
Forecast Error Variance Decomposition of Market								
1	11.978	0.934	0.039	2.495	3.645	1.161	13.224	66.524
2	16.931	0.512	0.184	26.750	3.840	2.743	12.181	36.859
4	36.202	3.476	5.435	16.777	2.781	2.357	7.759	25.211
6	47.150	4.042	7.556	12.861	2.044	1.782	5.861	18.703
8	49.945	4.744	10.751	10.645	1.748	1.511	5.385	15.270
10	49.768	5.037	13.569	9.402	1.760	1.374	5.632	13.457
Cholesky Ordering: Oil Price, Exchange Rate ,Oil and Gas, Insurance, Food Beverages and Tobacco, Consumer Goods , Banking Market								

Source: Author's computation

Note: OPR=Oil Price, OAG=oil and gas, INS=insurance, FBT= food beverages and tobacco, COG= consumer goods, BNK= banking and MKT=market all share index.

Table 6B: Structural VAR Parameter Estimates

Structural VAR Estimates. Structural VAR is just-identified

	Coefficient	Std. Error	z-Statistic	Prob.
Oil and Gas				
C(1)	-0.026380	0.024284	-1.086331	0.2773
C(2)	-0.096322	0.073401	-1.312260	0.1894
C(3)	-0.579024	16.37515	-0.035360	0.9718
C(4)	-0.362429	0.200540	-1.807268	0.0707
C(5)	-27.97841	44.88989	-0.623267	0.5331
C(6)	1.176176	14.78352	0.079560	0.9366
Insurance				
C(1)	-0.011997	0.021732	-0.552047	0.5809
C(2)	-0.290731	0.054333	-5.350938	0.0000
C(3)	-1.337498	0.247613	-5.401570	0.0000
C(4)	0.102358	0.166191	0.615905	0.5380
C(5)	-2.995102	0.714135	-4.194031	0.0000
C(6)	1.332888	0.285598	4.667011	0.0000
Food Beverages and Tobacco				
C(1)	0.011362	0.024361	0.466418	0.6409
C(2)	-0.124408	0.062172	-2.001041	0.0454
C(3)	-0.520093	0.142623	-3.646636	0.0003
C(4)	-0.166057	0.169681	-0.978642	0.3278
C(5)	-1.402693	0.386664	-3.627680	0.0003
C(6)	-0.762421	0.151262	-5.040414	0.0000
Consumer Goods				
C(1)	0.004212	0.019193	0.219474	0.8263
C(2)	-0.146043	0.069021	-2.115926	0.0344
C(3)	6.203817	25.99534	0.238651	0.8114
C(4)	-0.212427	0.239192	-0.888100	0.3745
C(5)	19.90714	89.36333	0.222766	0.8237
C(6)	50.85411	24.80854	2.049863	0.0404
Banking				
C(1)	-0.023831	0.022012	-1.082618	0.2790
C(2)	-0.314538	0.052120	-6.034923	0.0000
C(3)	-1.586541	0.320877	-4.944393	0.0000
C(4)	0.444596	0.157092	2.830155	0.0047
C(5)	-3.955884	0.913295	-4.331441	0.0000
C(6)	-0.591728	0.380048	-1.556981	0.1195

Source: Author's computation

Table 6C: Forecast Error Variance Decomposition of the Sectors

Sector	Period.	Oil Price	Exchange Rate	Market
	1	0.000000	0.000000	0.000000
	2	0.499348	0.182022	0.184690
Oil and Gas	4	4.273095	1.364898	2.178721
	6	20.69740	2.284808	6.387239
	8	28.35661	7.116579	16.14673
	10	31.26935	11.90340	23.76881
	1	0.000000	0.000000	0.000000
	2	1.823054	2.414384	27.14484
Banking	4	2.538869	4.361573	15.59919
	6	3.246336	4.165042	12.35737
	8	3.277361	5.924807	10.13223
	10	3.260697	5.131764	8.854882
	1	0.000000	0.000000	79.30154
	2	1.769267	0.462477	63.24472
Insurance	4	1.843609	3.067518	30.74700
	6	1.768992	2.863314	25.72585
	8	2.110200	6.841346	23.29741
	10	2.354632	7.588945	22.35318
	1	0.000000	0.000000	0.000000
	2	0.901322	0.008204	18.16340
Food	4	1.486736	0.829717	11.88252
Beverages	6	4.756568	1.557905	13.91711
and	8	11.90503	7.796335	15.39340
Tobacco	10	12.24539	10.39857	17.17598
	1	0.000000	0.000000	0.000000
	2	0.193053	0.109206	1.004553
Consumer	4	0.362262	11.86036	4.827838
Goods	6	0.420208	17.58489	3.592000
	8	0.750296	14.70835	3.027527
	10	1.038622	12.48316	3.142326

Cholesky Ordering: Oil Price Exchange Rate Market

Source: Author's computation

CHAPTER SEVEN

OIL PRICE UNCERTAINTY SHOCKS AND OUTPUT GROWTH IN NIGERIA

7.0 Introduction

Having established the significant influence of oil price uncertainty on stock market returns in the last chapter and that sector returns are not exclusive function of oil price innovation but also of other macroeconomic aggregates, it follows that changes in any of these macro indicators could affect cash flows and interest rates in the economy. This chapter extends the analysis of the effect of oil price uncertainty beyond the stock market to include the macroeconomy with specific interest on output, a measure of economic growth. It is from this perspective that this chapter approaches the investigation since innovations in all of the indicators in the economy are nested in the output level. The analysis consider the direct effect of oil price uncertainty on all the selected macroeconomic growth indicators bearing in mind that their relationship would eventually impinge on sector returns indices (cash flows).

The structure of the chapter is in sync with the previous chapter in terms of preliminary estimations and the framework. The model is modified to include private sector credit, which is the quantum of credit advanced by the commercial banks for private sector investment, and used here to measure the popular "crowding out effect" hypothesis in the literature. The argument here is that since the private sector and government lay claims to net domestic credit, an increase in credit to the private sector implies a decline to government credit and vice versa. Hence a negative credit to the private sector connotes "crowding out" effect and a positive movement indicate "crowding in" effect for the private sector credit. The index of industrial production is included also to proxy for real economic activities since GDP series are only available at quarterly frequency and for a very short period. Both series are sourced from the CBN database.

The estimation period spans from January 1997 to March 2016 using oil price uncertainty, exchange rate, credit to the private sector, interest rate, inflation rate, stock market and index of industrial production. The prime lending rate, which is the rate at which banks extends credit to the private sector in the economy is used to represent interest rate. All other variables are as defined in chapter four.

7.1 Preliminary Estimates

7.1.1 Unit Root Tests

The test for the stationarity of the series in the structural VAR was conducted using the standard tests prevalent in the literature, namely the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). These tests procedures, which are similar, differ mainly in the statement of the null hypothesis. Generally, while the ADF test exhibit high propensity for not rejecting the null hypothesis (that the series has a unit root); the PP test differs principally in the treatment of serial correlation and heteroscedasticity in the errors. The KPSS complements both the ADF and PP tests as it tests for the unit root with the stationary null hypotheses. In addition, the number of lagged difference terms of the dependent variable sufficient to remove serial correlation in the residual has to be determined. The result of the unit root tests, using optimal lag length determined by the Schwarz Information Criterion (SIC) are presented in Table 7.1. Tests were conducted with a constant and intercept for all series. The test is performed on the uncertainty series for oil price and log returns for all other series.

The Table shows that for all variables, the null hypothesis of the presence of a unit root at 1.0 per cent is clearly rejected at levels. This suggests stationarity of the series when the deterministic term is constant with time trend.

Table 7.1: Results of Unit Root Tests

		ADF test-stat	PP test-stat	KPSS LM-test	Order of integration
Oil Price Uncertainty		-4.519* (0.0002)	-4.653* (0.0011)	0.056	I(0)
Exchange Rate		-10.523* (0.0000)	-10.183* (0.0000)	0.073	I(0)
Credit to private sector		-20.973* (0.0000)	-21.370* (0.0000)	0.074	I(0)
Interest Rate		-15.260* (0.0000)	-15.268 (0.0000)	0.124	I(0)
Inflation Rate		-12.054*(0.0000)	-11.770* (0.0000)	0.034	I(0)
Market All Share Index		-13.171* (0.0000)	-13.336* (0.0000)	0.089	I(0)
Index of Industrial Production		-3.286* (0.071)	-7.908* (0.0000)	0.43	1(0)
Critical Values	(1%)	-3.9988		0.216	
	(5%)	-2.4296		0.146	
	(10%)	-3.1383		0.119	

Source: Author's computation
Note: ADF = Augmented Dickey-Fuller test, PP = Phillips-Perron test, and KPSS = Kwiatkowski-Phillips-Schmidt-Shin test,
**, represents rejection of the null hypothesis at 1%. Test conducted with Trend and intercept.*

The satisfaction of the stationarity assumption implies robust impulse response functions as no asymptotic efficiency (wider error band) is lost since the series are not differenced (Kilian, 2009 and Kilian and Park, 2009). This denotes a stable long-run relationship (cointegrated) among the variables in the model and that at least one factor drives the relationship towards a convergence.

7.1.2 Descriptive Statistics

The descriptive statistics of the variables in the model for oil price uncertainty and growth indicators for the period January 1997 to March 2016 is presented in Table 7.2. The result identifies stock market index as the leading volatile series, followed by credit to the private sector and index of industrial production, respectively, as measured by the degree of dispersion (standard deviation).

Table 7.2: Descriptive Statistics

	Mean	Median	Std Dev.	Skewness	Kurtosis	Jarque-Bera
Oil Price Uncertainty	0.007	0.006	0.003	3.097	16.029	1986.14 (0.000)
Exchange Rate	0.004	0.000	0.018	2.745	15.627	1809.25 (0.000)
Credit to Private sector	0.018	0.016	0.067	0.678	62.030	33265.93 (0.000)
Interest Rate	0.001	0.0004	0.030	0.161	8.375	276.66 (0.000)
Inflation Rate	0.009	0.008	0.015	0.367	5.596	69.468 (0.000)
Market All Share Index	0.005	0.0002	0.069	-0.475	8.326	279.28 (0.000)
Index of Industrial Production	0.001	0.001	0.052	0.253	7.759	218.563 (0.000)

Source: Author's computation
Note: Probability values in parenthesis

This observation is a true reflection of the market that has been identified as the major channel for international economic influence. While credit to the private sector exhibited the highest mean and median, interest rate and index of industrial production show lowest mean. The distributional properties represented by the skewness and kurtosis statistic, supported by the Jarque-Bera statistic, suggest the rejection of the null hypothesis, indicating the non-normality for all the variables, except oil price and exchange rate. This assertion is confirmed by the associated Jarque Bera *p-value* that is equal to zero. With the kurtosis, far exceeding the threshold of three for all of the variables, a leptokurtic distribution is denoted, implying the prevalence of extreme values across the economy. The measure of skewness equally exhibits fat tails indicating the probability of positive returns.

7.1.3 Conditional Variance Equations

Table 7.3 presents the test of the null hypothesis of no GARCH effect against the alternative that the disturbance terms follow a GARCH process. The estimated conditional covariance and the implied coefficients clearly rejected the null hypothesis at 5.0 per cent significance level, indicating that the parameters satisfy the GARCH conditions.

The implied meaning is that the variance is influenced by the contemporaneous volatility of the various indices, making GARCH(1,1) the suitable method for generating the conditional variances. This conclusion is in tandem with the residual diagnostics, which show that the GARCH models of the conditional means and variances adequately describe the joint distribution of the disturbances. The Ljung-Box Q test (used to determine if the observation time is random and independent, else autocorrelation), Ljung-Box Q test for squared returns and the ARCH-LM test (used to assess the significance of ARCH effect), with 34 lags, suggest strong presence of serial correlation in the oil price data.

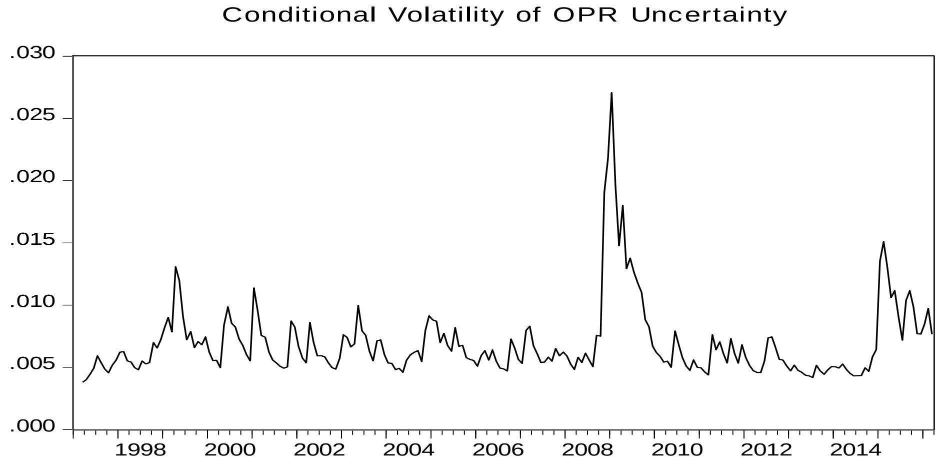
Table 7.3: Conditional Variance Equation for Oil Price Uncertainty: GARCH(1,1) Estimates

Variable	Coefficient	Std Error	z-Statistic	Probability
Mean Equation				
C	0.0053	0.0320	0.1665	0.8677
LOPR(-1)	1.000	0.0083	120.5074	0.0000
Variance Equation				
C	0.0018	0.0012	1.5738	0.1155
RESID(-1)^2	0.2084	0.0778	2.6791	0.0074
GARCH(-1)	0.5375	0.2064	2.6035	0.0092
Diagnostics				
Q-Statistic	37.65			0.394
Q^2-Statistc	36.69			0.437
ARCH-LM Test	0.613			0.434

7.1.4 Graphical Plot of Conditional Volatility

The graphical plot of the conditional volatility for oil price is presented in Figure 7.1. Evidence from the plot shows the pronounced impact of the global financial crisis (2008–2010). Episodes of short-lived spikes over the sample period, especially in 1999 and the later segment of the sample (2014-2015) are very evident.

Figure 7.1: Plot of Conditional Volatility



Source: Author's computation

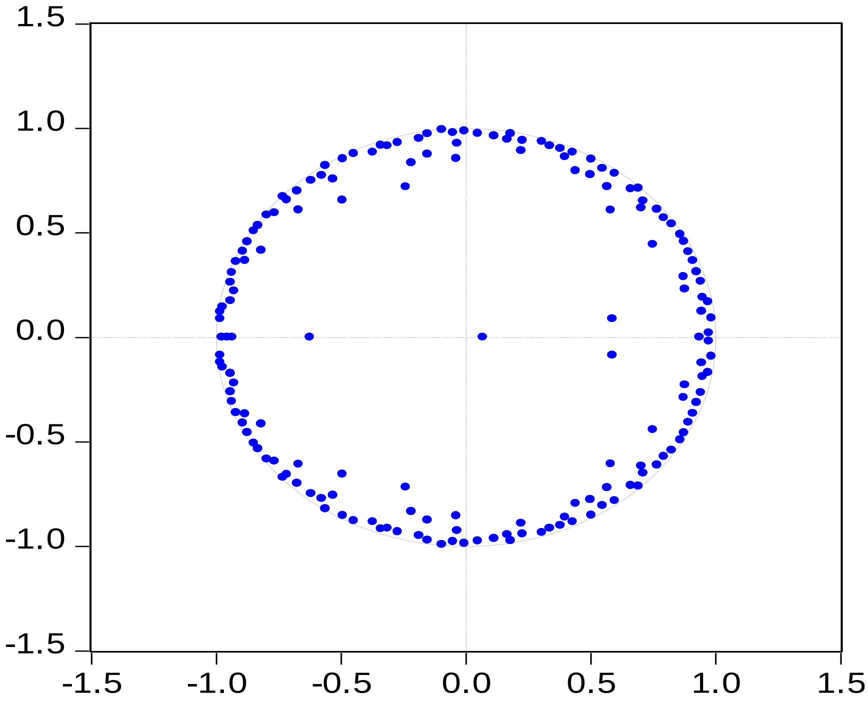
As economies get intertwined through globalisation and financial integration, impulses from the global financial crisis filter through erratic oil prices to aggregate economic indicators in the economy. One of such major impact was on the stock market, which declined precipitously from a landmark ₦13.0

trillion market capitalisation in 2008 to ₦4.9 trillion in 2009. This was in response to the sharp fall in oil price from US$110 per barrel to about US$40 per barrel during the same period.

7.1.5 VAR Stability Test

The test for stability shows that the model is characteristically invertible and has an infinite order vector moving average representation. Stability in the model is a prerequisite for a robust and economically meaningful impulse response function and forecast error variance decomposition. Variables in the SVAR are expected to be covariance stationary (implying their independence of time). Lutkepohl (2005) and Hamilton (1994) show that if the modulus of each of the eigenvalues of a matrix is strictly less than one, the estimated VAR is stable. Hence, Figure 7.2 satisfies this stability condition as the modulus of the estimated VAR, with a lag specification of 24, is less than one, with no root lying outside the unit circle.

Figure 7.2: Inverse Roots of AR Characteristic Polynomial



Source: Author's computation

7.2 Regression Results and Discussions

7.2.1 Short-Run SVAR Parameter Estimates

The contemporaneous estimate of the structural factorisation of the impact of oil price uncertainty on different macroeconomic indicators is shown in Table 7.5. As stated earlier, the specified model is exactly identified given that the number of restrictions imposed is 21. The impact of oil price uncertainty shocks is analysed from the perspective of small open economy.

Evidence from the structural parameter estimate indicates satisfaction of the *apriori* expectation and statistical significance for most of the coefficients within a given month. This observation is consistent with the findings of Paramanik and Kamaiah (2014) in their analysis of the Indian economy. A cursory examination of the Table shows that oil price uncertainty shock significantly depreciates exchange rate returns by 3.4 per cent.

Table 7.4: Estimation of Contemporaneous Oil Price Shock Structural Parameters

Equation	Coefficient	Estimate	Std Error	Prob
Exchange Rate	a_{21}	**-3.38***	0.65	0.0000
Credit to the Private Sector	a_{31}	**-11.36***	2.29	0.0000
	a_{32}	**0.96***	0.23	0.0000
Interest Rate	a_{41}	-1.73	1.54	0.2614
	a_{42}	-0.03	0.15	0.8235
	a_{43}	**-0.08*****	0.04	0.0660
Inflation Rate	a_{51}	0.28	0.61	0.6510
	a_{52}	**-0.14****	0.06	0.0228
	a_{53}	**0.06***	0.02	0.0005
	a_{54}	**-0.06****	0.03	0.0213
Stock Market Index	a_{61}	**19.52***	3.42	0.0000
	a_{62}	-0.19	0.34	0.5751
	a_{63}	-0.16	0.10	0.1187
	a_{64}	**0.31****	0.16	0.0509
	a_{65}	**1.05***	0.39	0.0071
Output	a_{71}	**0.83***	0.27	0.0024
	a_{72}	-0.01	0.04	0.5969
	a_{73}	**-0.02***	0.01	0.0018
	a_{74}	**-0.03****	0.01	0.0172
	a_{75}	**0.09***	0.03	0.0023
	a_{76}	**0.03***	0.01	0.0000

Source: Author's computation

Note: *, ** and *** denotes statistical significance at 1% , 5% and 10% level, respectively

The result meets the theoretical *apriori* expectations especially for a small open oil-exporting economy that depend heavily on crude oil receipts for its foreign exchange, the price and production of which it has no control over (see Table 7.4). With the exchange rate movement inextricably tied to the reserve position of the country, that is in turn dependent on oil price, uncertainty about oil price naturally translates to exchange rate gyrations as government credibility and creditworthiness dwindles in the face of depleting reserves. The result is usually the massive capital reversal as investments migrate to less risky and higher returns economies.

Though the response of credit to the private sector to innovations in oil price uncertainty is significant, it is however, not rightly signed. Theoretically it is expected that uncertainty in oil price should dry up credit lines rather than expand it as banks postpone credit delivery decisions pending a more clement and less risky investment climate. Meanwhile, the observed expansion in credit could be argued from the perspective of increased demand for credit by economic agents to finance the importation of intermediate and finished goods in the face of exchange rate depreciation. There is an observed contraction of stock market, and by extension, economic activities, arising from unanticipated oil price shocks. This is theoretically consistent and statistically significant with the stock market being hit the most (19.5 per cent). The lack of significance on interest rate and inflation rate is an indication that they are affected indirectly through either credit to the private sector or exchange rate.

The dynamics in the system further elicits useful insights about the interactions in the economy. Exchange rate depreciation is observed to exert positive influence on inflation rate (0.14 per cent) but a negative immediate effect on private sector credit. The depreciation in exchange rate serve as an incentive for currency speculation as agents hedge against losses by converting domestic currency to foreign currency related assets. This drives up domestic prices as imported goods become more costly, in the face of low domestic production especially for import dependent economies like Nigeria. The costly imports trigger higher demand for money, thereby pushing up interest rates in the economy. Credit to the private sector decelerates by 0.96 per cent, affirming the impact of crowding out effect as stakeholders shift portfolio to less risky and high yielding government instruments. The reduced credit to the private sector, coupled with increased interest rates and inflation cumulatively contracts stock market and output growth in Nigeria.

A one standard deviation increase in credit to the private sector uncertainty contributes significantly to reining in inflationary pressures and spur output growth by 0.02 per cent. The evidence of counterintuitive response of interest rate to private sector credit confirms the impact of structural rigidities such as poor power supply and weak infrastructural facilities that inhibit the seamless transmission of monetary policy impulses and the stickiness of interest rate. Hence the continuous increase in interest rate in the face of increased credit to the private sector.

A positive structural change in interest rate positively stimulates output growth even as it drives domestic prices up by 0.06 per cent and slows market returns by about 0.3 per cent. The rise in interest rate boosts capital inflow, making available long-term funds for economic growth. Similarly, inflation rate is found to cause stock market and output growth to slow by approximately 1.05 per cent and 0.09 per cent, respectively. These findings are in sync with traditional economic intuition as inflationary trend has been recognised as a fundamental deterrent for growth, though a generally accepted tolerable level is necessary. The impact of stock market returns on output growth, though statistically significant, is counterintuitive as it is one of the major metrics for measuring the level of economic activities in the economy.

Consistent with economic theory, oil price uncertainty and inflationary pressures are found to depress output in Nigeria, while increases in exchange rate, interest rate and credit to the private sector expands output performance. Again this underscores the critical role of the market in promoting and engendering growth and development. Having identified and estimated the structural model, the effects of the shocks ε_t are investigated through an impulse response function analysis, which according to Breitung *et al.* (2004) contain more information than the structural parameter estimates.

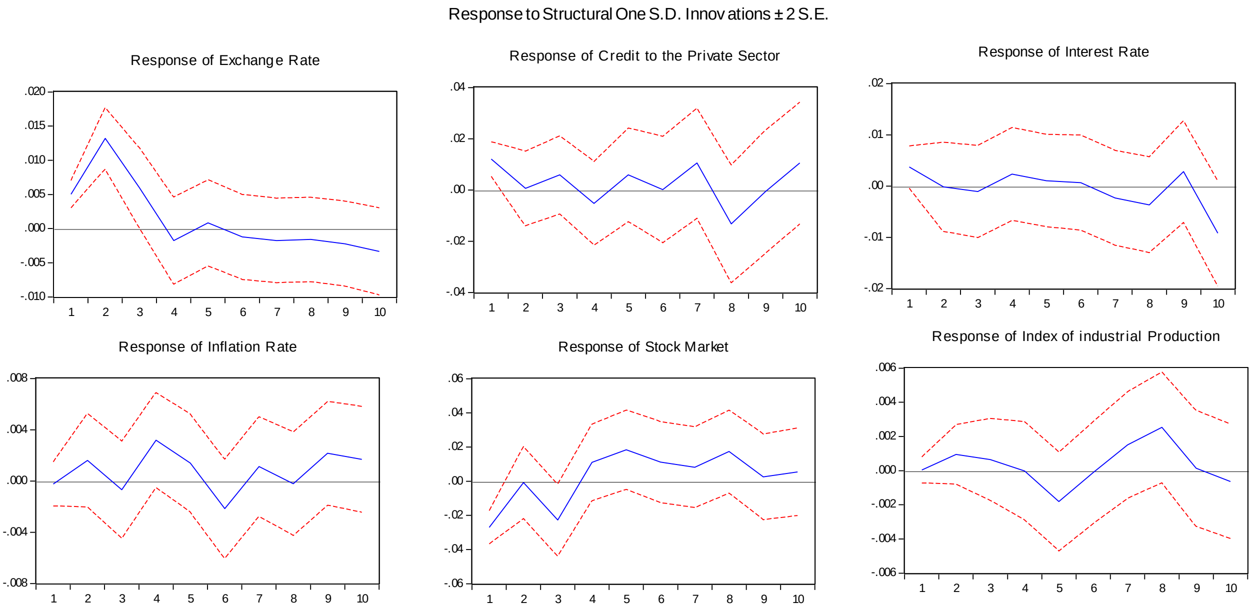
7.2.2 Impulse Response Function

This section presents the impulse response function employed to measure the responsiveness of each of the dependent variables in the SVAR to a one-time innovation from other variables (shocks to error term). It decomposes the total variance of a time series into the percentages attributable to each structural break and help to identify sources of business cycles as well as importance of such economic fluctuations. The SVAR residuals are necessarily orthogonalised so as to appropriately display the pattern of the shock in the system. In an SVAR, it is the imposition of restriction on parameters that accord the shocks an economic interpretation.

In line with the objective of this thesis, this section focuses on the dynamic responses in the system variables namely: exchange rate, credit to the private sector, interest rate, inflation rate, stock market returns and output to structural shock in oil price uncertainty over a 10 month horizon. Oil price uncertainty shock is treated in the system as contemporaneously exogenous as stated in earlier sections. Figure 7.3 shows the contemporaneous responses of the variables to a one standard error shock in oil price uncertainty. Evidence from the estimates indicates significant impact, again confirming the dominance of oil price on Nigeria's fiscal space.

Evidence from Figure 7.3 shows output, proxied by the index of industrial production, responding positively to innovation in oil price uncertainty shock in the first four months, when it achieved a steady state. That output remained positive in the first four months suggest the lag period within which oil price uncertainty impulses transmit to the production sector. Being a small open oil-exporting economy, output growth is expected to contract in response to oil price shocks. However, the observed positive outcome connotes the inability of production processes to respond contemporaneously to oil price movement, since it takes longer duration and huge cost to adjust to new prices. This informs investors' reluctance to effect change as they expect prices to revert in the very near future. The development could also be attributed to investors' preference for reasons such as the huge market, cheap labour and locational advantage in the region, in spite of the absence of congenial investment environment, requisite economic and legal infrastructure and other impediments to doing business. Output is, thus, found to be countercyclical to oil price shocks.

Figure 7.3: Response to oil price uncertainty shock



There is evidence of price puzzle as the positive interest rate response was associated with a short-memory negative inflation rate in the first month when it achieved a steady state. Ideally, these two are supposed to trend in the same direction. The price level and interest rate responses show strong signs of mean reversion, remaining around the mean for most of the estimation horizon. Sims (1992) attributes the development to omitted variable bias, which suggests that factors, not captured by the model, could be influencing inflation rate.

Exchange rate depreciated in response to a one standard deviation shock in oil price uncertainty, measured by the increase in the value of local currency vis-a-vis foreign currencies. Conventionally, central banks stabilises exchange rate by increasing interest rate under a tight policy stance. This implies a withdrawal of funds from the system, reduction in the credit creating ability of banks and, thus, moderates the appetite for the demand for foreign currency. The effective conduct of these actions, over a period of time, would lead ultimately to exchange rate smoothening and eventual appreciation of the currency for the rest of the forecast horizon. Consequently, the existence of exchange rate puzzle was noted as the upward adjustment of interest rate depreciates, rather than appreciate the exchange rate, in the first four months.

While output witnessed growth for four consecutive months in response to a one standard deviation shock in oil price uncertainty, stock market return was generally negative during the four months. The downturn in market returns is plausibly explained by the depreciating exchange rate, a critical determinant of capital inflow for small open economies that are essentially oil dependent. Since foreign investors are wary of the safety and value of their assets and investments, a depreciating and unstable exchange rate hurts portfolio investment, resulting in low patronage and capital outflow. This assertion is confirmed with the appreciation of the exchange rate after four months coinciding with improvements of activities at the market. Rising from the lowest ebb in month three, stock returns improves thereafter to achieve equilibrium and remained positive for the rest of the forecast horizon.

7.2.3 Forecast Error Variance Decomposition

The forecast error variance decomposition (FEVD) measures the proportion of the forecast error for a variable that is explained by other variables in the model (Kilian, 2009). Inferences from FEVD aid the understanding of the inherent idiosyncrasies and dynamic links among the variables jointly analysed in the model. According to Bernanke (1986), Blanchard and Quah (1989) and Shapiro and Watson (1988), the FEVD shows how different structural innovations at different horizons influence the behaviour of a variable in the system.

Since FEVD explains the proportion of variance due to its own shock and those of other variables, it follows that if a shock fails to explain any forecast variance error of another variable at all forecast horizons, the sequence could be said to be exogenous. On the other hand, if the shock explains all of the forecast error variance of another variable, the sequence is considered endogenous. Empirically, it is a common phenomenon for a variable to explain almost all of its forecast error variance at short horizon and smaller proportions at longer horizons. Table 7.5 reports the percentage contribution of oil price uncertainty shock to other variables in the model.

Table 7.5: Percentage Contribution of Oil Price Uncertainty

	Percentage Contribution of Oil Price Uncertainty to:						
Time Horizon	Oil Price Uncertainty	EXR	CPS	INT	INF	MKT	IIP
t+1	100.00	11.56	6.03	1.58	0.04	13.90	0.01
t+2	85.78	48.43	4.93	1.33	1.38	13.16	1.51
t+3	80.34	44.26	5.10	1.30	1.57	18.43	1.34
t+4	69.13	42.69	4.67	1.73	6.14	18.07	1.21
t+5	63.09	42.19	4.09	1.68	6.42	20.21	3.90
t+6	60.93	41.03	3.71	1.68	8.01	20.84	3.26
t+7	58.66	40.53	4.58	2.02	7.88	20.34	4.48
t+8	57.33	39.94	5.96	2.73	7.74	22.50	7.86
t+9	54.66	38.88	5.83	2.99	9.21	20.92	7.73
t+10	53.71	38.75	6.88	7.42	9.30	20.55	7.86

Source: Extract from Table 7B in the Appendix.
Note: EXR=exchange rate; CPS=credit to the private sector; INT= interest rate; MKT= market all share index; and IIP=index of industrial production.

Inferences from the Table show that the percentage contribution of structural shocks from oil price uncertainty in the variation of other variables in the model is quite negligible in the first month. The highest contributions of 100 and 13.9 per cent is recorded for own shock and market returns, respectively, followed by exchange rate (11.6 per cent), while the least contribution of 0.01 per cent was reported for output growth. However, the gradual increase in the explanatory power of oil shocks to other variables was simultaneously followed by continuous decay to own shock over time. Analysis of the results suggests improved and meaningful explanation of the forecast error variance of all the variables after a time horizon of 10 months by the structural shock from oil price uncertainty. This finding is consistent with the evidence by Wang, *et al.* (2013), which found the dominance of oil price uncertainty on the activities of oil-exporting economy of Australia.

After 10 months, the percentage contribution of structural shocks in oil price uncertainty to own variation decayed from 100 per cent in period one to 53.7 per cent in the tenth period. This implies that about 46.3 per cent variation in oil price uncertainty is jointly explained by factors other than itself in the system. This is theoretically plausible as the dynamics in the system allows all variables to affect each other in the long-run. It confirms arguments in the literature by Kilian (2014) that endogenous economic fundamentals also affected trends in oil price.

A cursory examination of Table 7.6 reveals exchange rate and stock market as the most exposed (endogenous) to oil price uncertainty shocks as it accounted for 38.8 and 20.6 per cent of the forecast error variance decomposition, respectively. This finding reflect the fundamentals in the economy as the volatility in exchange rate and stock returns during the global financial crises and the economic slowdown that commenced from mid-2014 are entirely ascribed to oil price fluctuations. During the global financial crisis, for instance, the stock market lost about 45 per cent of market capitalisation, while the decline in oil price to about US$28 per barrel in 2014/2015 depreciated the domestic currency substantially. On the other hand, the result show that credit to the private sector is the least exposed (exogenous) to oil price uncertainty innovation at 6.9 per cent. This implies that 93.1 per cent variation in private sector credit is accounted for by factors other than oil price shocks. It is also noted that, over 10 month's horizon, 9.3, 7.9 and 7.4 per cent of the variation in inflation, output growth and interest rate are driven by oil price structural shocks, respectively.

In summary, the result show that the fraction of variation of the variables explained by oil price uncertainty after 10 months horizon was highest for exchange rate and least for credit to the private sector, assumed as the most endogenous and exogenous to oil price uncertainty shocks, respectively. The dynamics in the system further revealed the exposure of each of the variables to uncertainties in other variables. This indicates that structural factors other than oil price uncertainties shocks accounts for the variation in most of the variable uncertainties, highlighting the flash points for policy design and direction in order to avoid systemic risks. The analysis also exposed the existing interlinkages among the variables in the model indicating the sensitivity of each variation to other variables in the system.

7.3 Summary and Conclusion

In this chapter of the thesis, the effect of oil price uncertainty shock on key macroeconomic variables is examined, with a view to ascertaining its contribution to economic growth using monthly data and a structural VAR framework. The structural parameter estimates, coupled with the impulse response function and variance decomposition analysis indicated that oil price uncertainty is strongly correlated with and contributes meaningfully to economic growth. Oil price uncertainty coefficients were found to significantly and statistically affect most variables in the model and largely dictated the magnitude and direction of economic growth as evidenced by the impulse response functions. In terms of contribution to variation in the uncertainty of other factors in the model, oil price uncertainty demonstrated strong explanatory power especially for exchange rate and output. It was equally shown that credit to the private sector is the most exogenous of the variables in the model, while interactions in the model reveal significant dependence and exposure to each other's activities.

Using monthly series covering the pre and post global financial crisis period, these results provides new and very instructive evidence for economic managers, investors and financial market participants. For the monetary authority, the study has shown that the primary channel of oil price uncertainty transmission to the economy is the exchange rate channel. This requires the intermittent and appropriately sequenced intervention in the foreign exchange market to ensure a stable exchange rate is accorded utmost priority given the import-dependent nature of the economy. This evidence is consistent with the growing body of literature on the importance of exchange rate especially for import-dependent and commodity-exporting countries. A larger proportion of oil price uncertainty shocks filters into the economy through this channel.

The analysis also has direct implication with respect to the level of interdependence among the variables in the model. There is need for proper monitoring of inflation rate, interest rate and credit to the private sector, all of which are stimulants to economic activities. The contribution of each variable to the variation in the uncertainties of others in the system is an indication that negative outcomes could easily be transmitted to other sectors, resulting in systemic risks. The result is also very informative for portfolio managers as the stock market is identified as the second most important channel for the transmission of oil price uncertainty impulses into the economy. This serves as a guide to investors on the appropriate portfolio strategies to adopt in order to diversify risks associated with oil price uncertainty shocks and hedge their investments against losses.

Appendix 7A

Figure 7A.1: Impulse Responses to Exchange Rate Shock

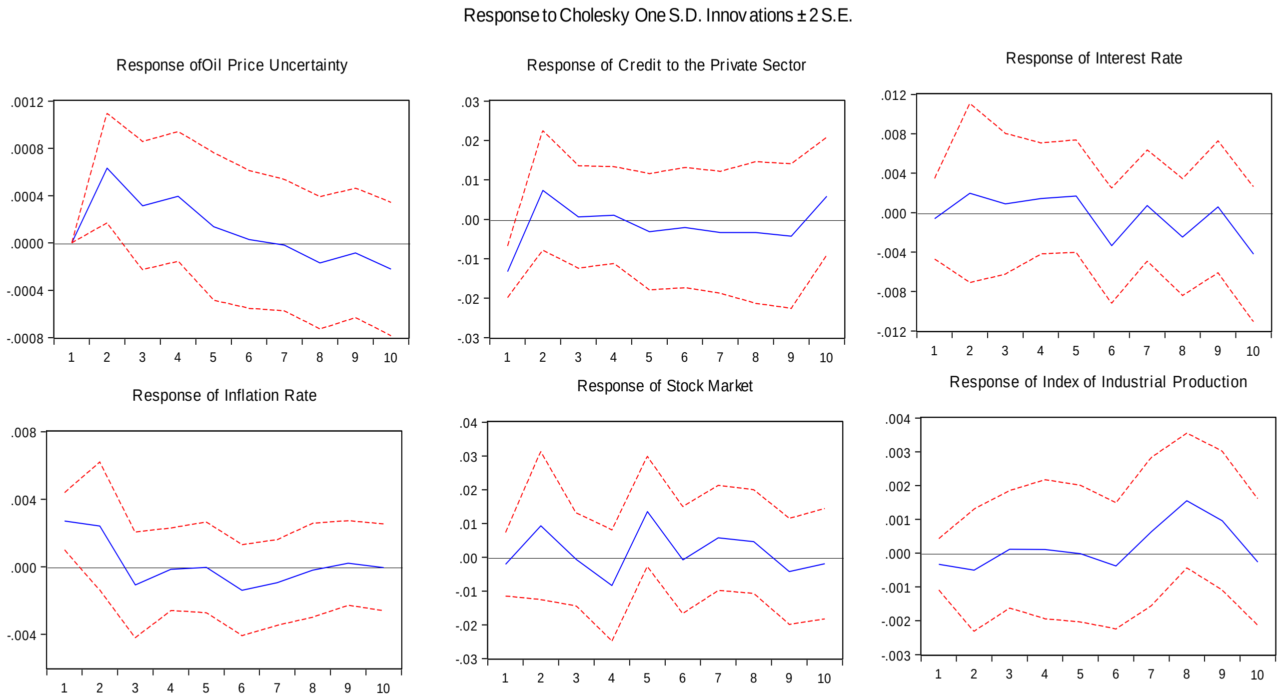


Figure 7A.2: Impulse Responses to Credit to the Private Sector Shock

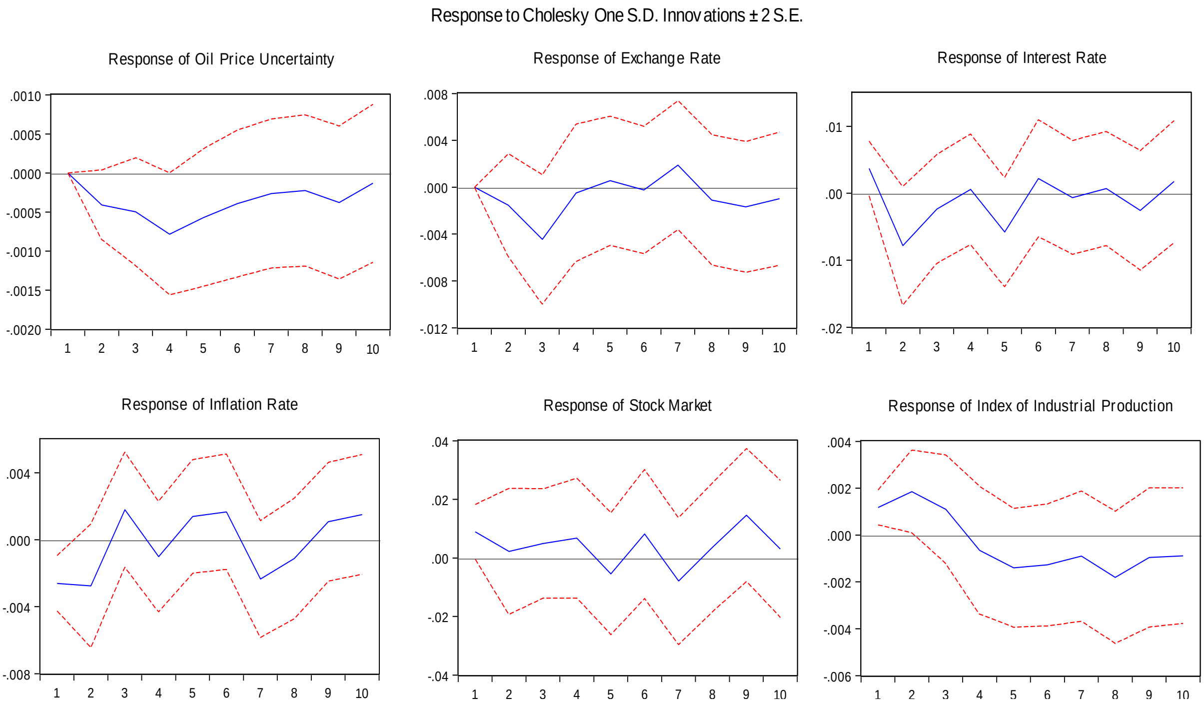


Figure 7A.3: Impulse Responses to Interest Rate Shock

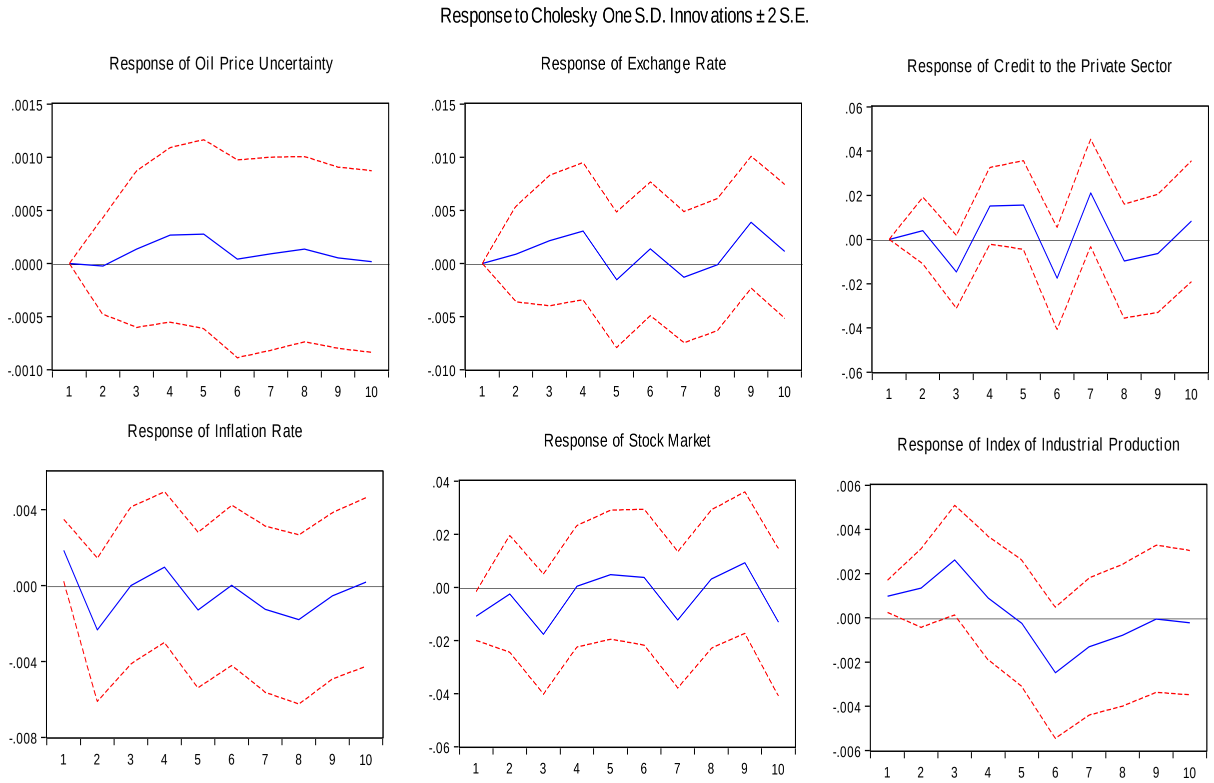


Figure 7A.4: Impulse Responses to Inflation Rate Shock

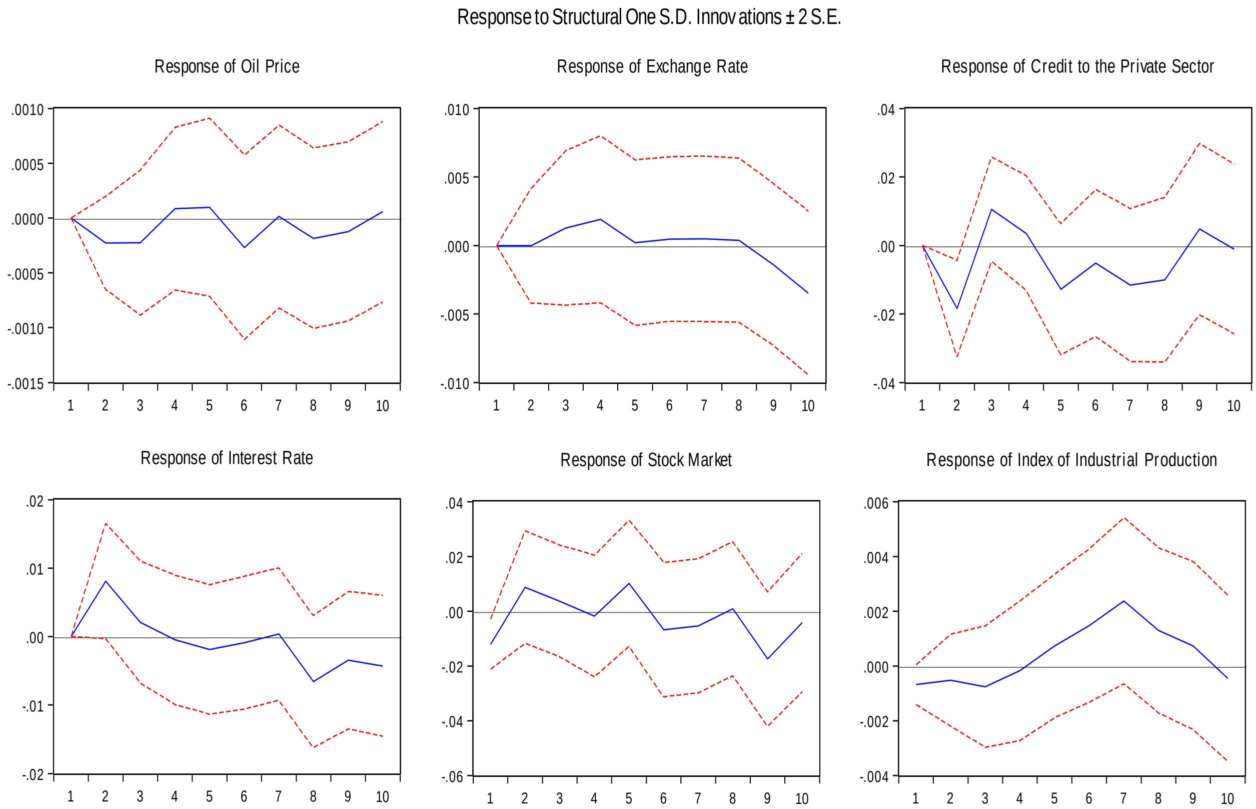


Figure 7A.5: Impulse Responses to Stock Market Shock

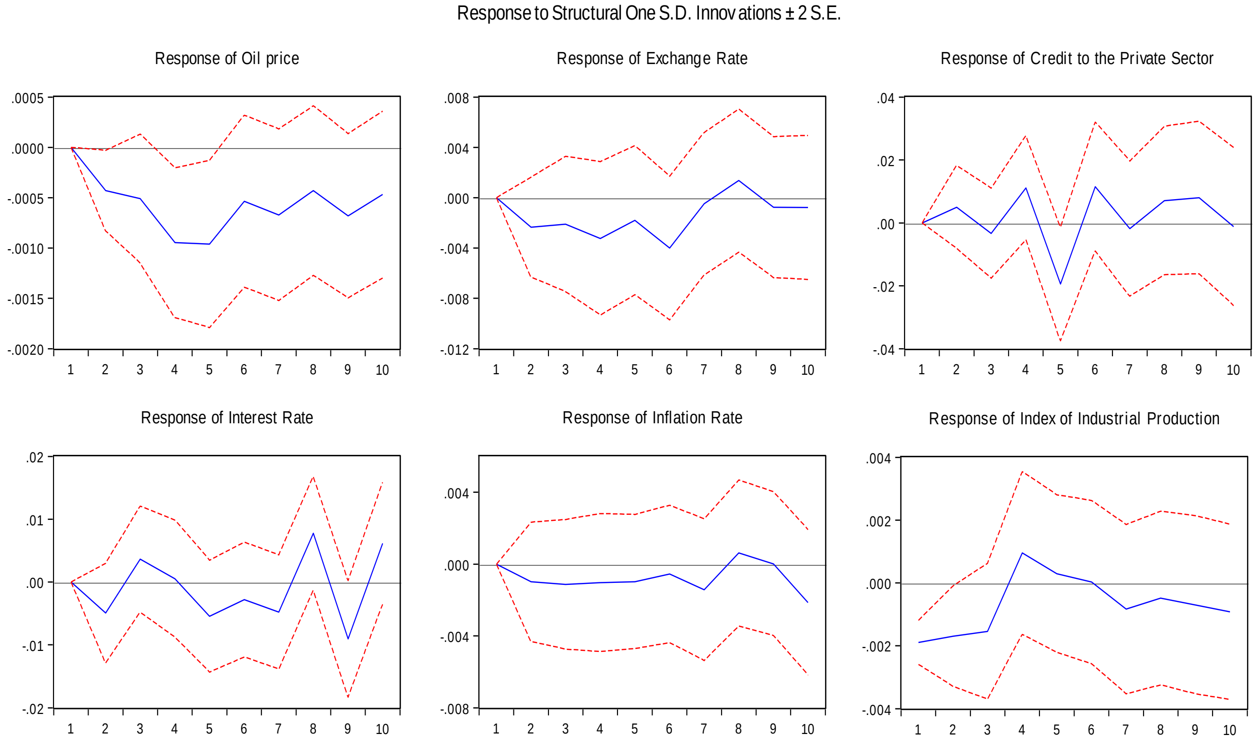
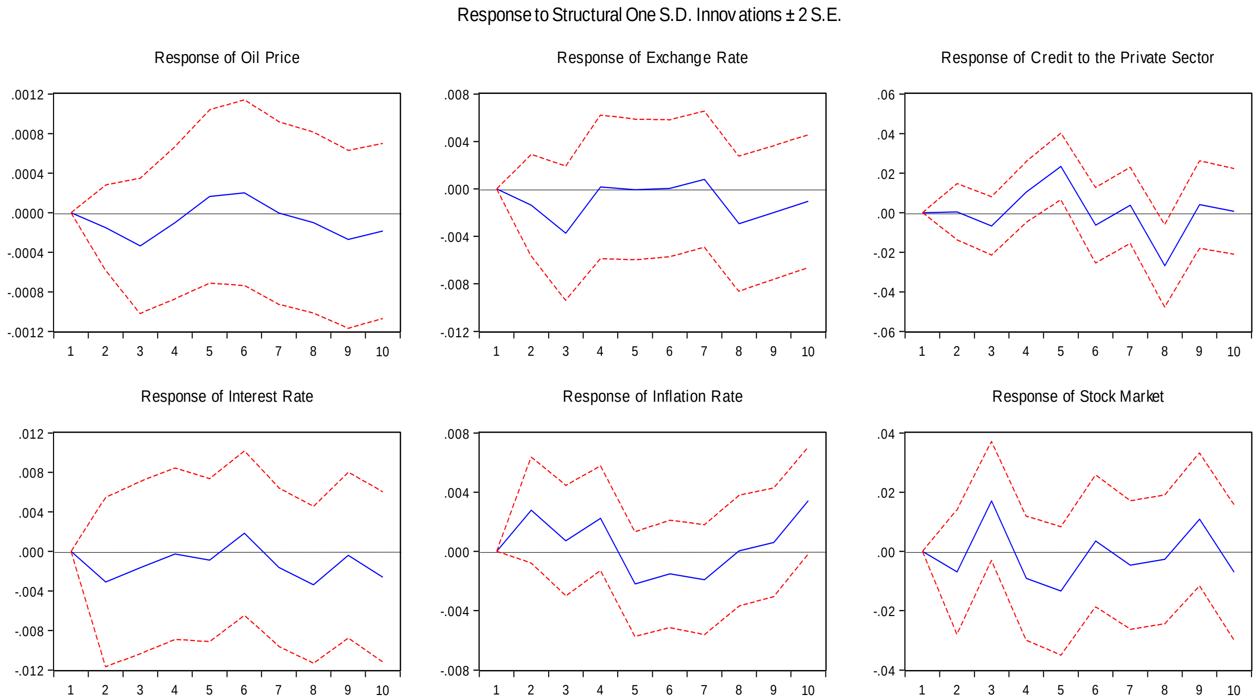


Figure 7A.6: Impulse Responses to Index of Industrial Production Shock



Source: Author's computation

Table 7A: Forecast Error Variance Decomposition

Period	OPR	EXR	CPS	PLR	CPI	MKT	IIP
Variance Decomposition of Oil Price Uncertainty							
2	85.75860	6.888489	2.875160	0.011061	0.887881	3.178455	0.400352
4	69.13269	5.990765	9.428273	0.821433	1.004884	12.27846	1.343496
6	60.93447	4.963841	11.11205	1.224256	1.409357	18.78594	1.570082
8	57.33120	4.869862	11.28841	1.331775	1.564706	22.06469	1.549359
10	53.71085	4.887173	11.53937	1.257587	1.573636	24.89520	2.136185
Variance Decomposition of Exchange Rate							
2	48.43305	49.00399	0.578639	0.185116	0.000122	1.338228	0.460852
4	42.68809	43.17453	4.052884	2.612671	0.945398	3.676168	2.850266
6	41.03256	41.37138	3.920922	3.221171	0.944224	6.794210	2.715528
8	39.94401	40.34731	4.503224	3.348326	0.957236	6.803824	4.096066
10	38.75097	37.31279	4.666299	5.456824	2.974383	6.366860	4.471870
Variance Decomposition of Credit to the Private Sector							
2	4.936507	7.767106	74.44255	0.534866	11.47439	0.839598	0.004983
4	4.675963	5.199700	62.23889	10.38188	10.40787	3.599900	3.495793
6	3.713828	3.751727	45.57889	15.45932	9.970952	10.21780	11.30748
8	5.961478	3.020321	38.74686	17.51183	9.998674	8.147830	16.61301
10	6.877710	3.444684	37.52549	17.87045	9.787924	8.476544	16.01719
Variance Decomposition of Interest Rate							
2	1.331187	0.405546	7.233779	81.42559	6.329816	2.347867	0.926215
4	1.732261	0.594050	6.817374	80.71603	5.920074	3.176524	1.043687
6	1.675195	1.596339	9.050286	75.03451	5.664631	5.720441	1.258599
8	2.734008	1.852406	8.041301	66.84867	7.894636	10.57842	2.050566
10	7.422144	2.541598	7.225424	57.00852	8.254779	15.45502	2.092516
Variance Decomposition of Inflation Rate							
2	1.378047	6.950903	7.594986	4.735541	74.71456	0.517192	4.108767
4	6.144643	6.651744	8.655441	4.599867	66.22246	1.539399	6.186452
6	8.007535	6.552173	9.419400	4.670101	61.24611	1.845851	8.258824
8	7.743562	6.285694	11.03383	5.999612	57.53076	2.563734	8.842811
10	9.297459	5.585651	10.88951	5.423896	53.29931	3.754649	11.74952
Variance Decomposition of Market							
2	13.16162	1.645866	1.511096	2.247113	4.037882	76.52727	0.869147
4	18.07139	2.155504	2.029635	5.821775	3.184142	63.16866	5.568895
6	20.84256	3.960044	2.844041	5.437060	4.451686	55.48928	6.975328
8	22.50229	4.111677	3.326673	6.529109	4.302076	52.66289	6.565286
10	20.55439	3.898111	5.037947	8.249771	6.844980	47.98284	7.431970
Variance Decomposition of Index of Industrial Production							
2	1.510552	0.606240	8.068820	4.586123	1.254902	10.82975	73.14362
4	1.208869	0.354372	5.911316	9.464720	1.243837	8.921675	72.89521
6	3.264425	0.375840	7.098072	11.68367	2.864678	6.926594	67.78673
8	7.860512	1.987389	8.381522	11.18187	6.733325	6.360668	57.49472
10	7.864109	2.493282	9.094296	10.86912	6.953595	6.929268	55.79634

Factorisation: Structural

Source: Author's computation EIGHT

CHAPTER EIGHT

SUMMARY AND CONCLUSIONS

8.0 Introduction

As outlined in the introduction, the major objective of this thesis is to provide insight on how uncertainty in oil price shocks drives individual sector stock returns uncertainties and output in the small open oil-exporting economy of Nigeria. Three themes evolved from this objective namely: i) sector stock sensitivity to oil price change in Nigeria, ii) effects of oil price uncertainty shock on sector stock returns uncertainty shocks in a small open oil-exporting economy, and iii) oil price uncertainty shocks and output growth in Nigeria. Two methodologies were adopted in the estimation process namely: the multifactor regression model for the first research theme and the structural VAR for the other two themes. Five sector stock returns including oil and gas, banking, insurance, food beverages and tobacco and consumer goods comprise the sample sectors. Varying degrees of sector sensitivities to oil price innovations are discovered while some sector stocks returns apparently not directly affected by oil price shocks are found sensitive to oil price indirectly.

In the first research theme, three models are estimated to measure the degree of sensitivity and persistence of the effect of oil price shock on the activities and performance of the five selected industry sectors. In the second and third research themes, structural parameters, impulse response function and forecast error variance decomposition are used to measure the influence of oil price uncertainty on the uncertainties of the sector indices and output growth. In this concluding chapter, the findings of these research themes are summarised and their implication for policy contextualised. In addition, the thesis major contributions and possible areas of further research interest are some other highlights of the chapter.

8.1 Major Findings

8.1.1 Findings from Chapter Five

Major findings arising from the three multifactor regression models estimated in chapter 5 are as follows:

8.1.1.1 Key findings from model 1

- The banking and oil and gas sector stock returns show significant and positive sensitivity to oil price returns, consistent with *apriori* expectations, implying increased stakeholders' returns as oil price increases. While the effect on consumer goods sector return is inverse and not significant to oil price returns, market returns coefficient show high sensitivity that is in excess of unity across sectors. This suggests individual sector risk exposure that is proportionately higher than market risk.

- Market-wide sector stock returns sensitivity to exchange rate depreciation is negative and statistically significant, suggesting the weakening prospects of sectors' performance and the degree of exposure to exchange rate risk.

- Inflation exerts market-wide pressure on all the sectors. Three of the sectors namely banking, insurance and oil and gas satisfied the theoretically expected inverse signs and are significantly vulnerable to inflation risk with evidence of a more than one-on-one risk exposure. This accentuates the role of prices in the returns of sector stocks. The consumer goods and food beverages and tobacco demonstrated significant positive sensitivity to inflationary movements, consistent with the findings of Fama (1981).

- Interest rate is observed to be highly exogenous as only the banking and consumer goods sectors show significant relationship. This suggests a weak transmission mechanism of monetary policy actions, and possibly less potent and effective monetary policy instruments.

- The negative coefficient of the global crisis dummy for banking, insurance and oil and gas sectors are consistent with economic literature that postulates increases in the cost of production during depressions or financial crisis periods. Though the coefficient for food beverages and tobacco and consumer goods sector are significant, they are, however, not rightly signed.

8.1.1.2 Key findings from model 2

- Stock market, exchange rate, interest rate and inflation rate returns shocks exert significant sector-wide effect with most of the coefficients satisfying the theoretical expectation, albeit a few exceptions, and significantly exceeding unity.

- Non-linear oil price measures of net oil price increase and net oil price decrease confirms evidence of asymmetric effects of oil price uncertainty for Nigeria. This suggests that the effects of oil price increase differs markedly in magnitude from oil price decline, implying that a decrease in oil price does not necessarily translate to a simultaneous decrease in the cost of production nor increased stock returns. These findings are in agreement with observations in extant literature (Arouri and Nguyen (2010).

- Contrary to apriori expectations, net oil price decline dampens stock returns across sectors, although only the insurance and oil and gas sector returns are statistically significant. This indicates excess spending on imports, and high production cost occasioned by structural rigidities, weak legal and economic infrastructure and poor power supply.

- Net oil price increase reveal sector-wide positive effect, except for food beverages and tobacco returns. The implication is that some sectors are less affected by or better still benefit from oil price rise, in line with the findings of Agusman and Deriantino (2008) for Indonesia but in contrast with Hasan and Ratti (2012) for Australia.

- The banking, food beverages and tobacco and oil and gas sectors uncertainties remain positively and significantly influenced by oil price returns with the coefficient of oil and gas sector taking the lead.

- Estimated coefficient of the banking, insurance and food beverages and tobacco sector stock returns are found to be riskier than market returns risk as they all exceeded unity.

- In line with economic theory, exchange rate depreciation significantly dampens sector stock returns, except for food beverage and tobacco. The negative sign suggests revenue and cash flow decline following depreciation and underscore the prevalence of exchange rate risk in the economy.

- Evidence from the price (inflation) equation is mixed as it worsens the banking, insurance and consumer goods sector returns uncertainty but positively affected other sector returns. The coefficients of four sector stocks exceeded unity, demonstrating the relatively high exposure of these sectors to inflation risk that is greater than one.

- Interest rate was noted to significantly worsen the returns of all the sectors in the model except food beverage and tobacco. This highlights the efficacy of the monetary policy transmission mechanism and affirms the critical role of interest rate factor in the model. The result is, however, in contrast with model 1 result that had only two sectors being significantly affected.

8.1.1.3 Key findings from model 3

- Market returns and oil price changes showed no significant contemporaneous lagged effect on the individual sector returns, suggesting the existence of an inefficient market system.

- Lagged dependencies to oil price were exhibited between months two and twelve for banking and oil and gas sectors, suggesting that the effect of oil price change manifest only after two months and could last through twelve months.

- Meanwhile, the effect on insurance and food beverages and tobacco sector returns concentrates between months three and six, while consumer goods sector exhibited lagged dependencies to oil price change at six, eight and twelve months, respectively.

8.1.2 Findings from Chapter Six.

The key findings from chapter 6 are as follows:

- The parameter estimates indicate that increases in oil price uncertainty shocks positively and significantly influence the uncertainty of all sector stock returns contemporaneously, except food beverages and tobacco. This supports the hypothesis that increased oil price uncertainty induces increase in stock returns uncertainties, thereby slowing economic growth and investment in Nigeria, especially as the sectors are pro-cyclical and are highly dependent on oil.

- The magnitude and direction of impulse responses confirm the positive posture of oil price uncertainty shock on the uncertainties of all sector stock returns, suggesting a weakening outlook for the various sectors, except consumer goods. This implies the improvement in the activities and returns of the consumer goods sector returns as against the expected contraction.

- A structural innovation in insurance significantly worsens the uncertainty of the banking, food beverages and tobacco, consumer goods sector and the stock market returns momentarily, with the sectors achieving steady state within the first three months on the average.

- Oil and gas, consumer goods, banking and stock market returns weakened in response to a structural shock in food beverages and tobacco uncertainty. It was noted that activities in the insurance sector received a sharp contemporaneous boost, while consumer goods oscillate around the mean in the first ten months. The highest impact is on oil and gas and the market sectors.

- All the industry sectors uncertainty including oil price and exchange rate response to one standard structural shock in consumer goods returns uncertainty is negative. The implication is that a positive shock from this sector improves other sectors' activities. The negative effect was more pronounced for the market stock returns.

- The banking sector returns uncertainty shocks counterintuitively reduces the uncertainties in the oil and gas, insurance, consumer goods, and food beverages and tobacco. The influence is more on the insurance sector confirming the strong correlation between the banking and insurance sectors that stemmed from the emergence of "financial supermarkets" occasioned by the universal banking scheme and filliped by the 2004/2005 banking sector consolidation exercise.

Forecast Error Variance Decomposition

- Oil price uncertainty meaningfully contributed to explaining the forecast error variance of the sampled sector stock returns. This validates the assertion of the dominance of oil price uncertainty on the activities of oil-exporting economy of Nigeria, consistent with the findings of Wang, *et al.* (2013) where oil price shocks explain 20 – 30 per cent of variation in stock market returns.

- The contribution of oil price uncertainty to FEVD of oil and gas stock uncertainty returns is negligible. The sector is intuitively identified as the most exogenous (0.9 per cent) to oil price uncertainty shocks followed by consumer goods (22.8 per cent).

- The fraction of variance in food beverages and tobacco contributed by the various sectors are insurance (18.7 per cent), oil and gas (17.9 per cent) and own share (17.9 per cent). Oil and gas and insurance sectors returns contribution to variation in the banking sector uncertainty forecast is 8.9 and 20.8 per cent, respectively. Contributors to the market uncertainty variance are oil and gas (13.6 per cent) and own shock (13.5 per cent).

- Oil price innovation exerts significant influence across the various sectors of the market, implying that movements in the market returns are explained more by oil price uncertainty than other factors.

- The forecast error variance decomposition show that oil price uncertainty meaningfully contributed to explaining the variation in the sector returns uncertainty to as much as 54.3 per cent (banking), 50.5 per cent (insurance) and 49.8 per cent (market) at 10 month forecasting period. This implies that movements in the sector indices are explained more by oil price returns uncertainty than other factors.

Historical Decomposition of Oil Price Uncertainty

- The positive historical decomposition of the shocks to oil price uncertainty was mainly contributed by oil and gas and exchange rate. On the other hand, the negative contributions of oil price and banking sector uncertainty shocks kept oil price uncertainty below the trend line during the post crisis period.

- Oil price historically contributed to the stability in the exchange rate uncertainty prior to the global financial crisis, complemented by the market contribution. During the global recession of 2015, exchange rate was pulled by the positive oil price and market uncertainties occasioned by global oil price decline. Own shocks and banking shocks contributed negatively and significantly to exchange rate dynamics during the estimation period.

- The banking sector contribution to the oil and gas is very pronounced throughout the sample period, worsening the sector uncertainty prior to the global financial crisis but improving it thereafter. The contributions of the stock market and exchange rate were modest and generally offset by the contributions of other sectors.

- The historical contribution to insurance sector uncertainty indicates that oil price shock, oil and gas, banking, insurance and exchange rate had dominant positive effects on insurance growth. The effect of oil price historical contribution to insurance behaviour was again noted and became more pronounced in 2015. The spike witnessed during the global financial crises period was driven primarily by oil price, oil and gas and own shock.

- The contribution to food beverages and tobacco by all other sectors shows that historical decomposition both in the pre and post financial global financial crisis was significant, with the banking sector taking the lead. Most of the deceleration was accounted for by oil price shock prior to the global crisis except in 1999, when it assumed the positive lead.

- The effect of uncertainty on the performance of the market was persistently positive with market uncertainty shock accounting for a higher proportion of it. This was followed by the positive contribution of oil and gas, which accounted for most of the weak performance of the market especially during the pre-global financial crisis era.

- Equally significant is the contribution of oil price uncertainty on the uncertainties by all other sectors, which is long-lasting and persisting over the entire estimation period. This, once again, affirms the pivotal role of oil price in explaining the volatility of equity returns in the stock market in Nigeria. Each sector contributes significantly to the structural variation of others before, during and after the global financial crises.

8.1.3 Findings from Chapter Seven

The major findings arising from chapter 7 are as follows:

- Evidence from the structural parameter estimate show oil price uncertainty shock significantly depreciating the exchange rate leading to massive capital outflow resulting in the shrinking of government credibility and creditworthiness. This is consistent with theory especially for small open oil-exporting economies such as Nigeria.

- Uptick in interest rate exacerbates pressure on domestic prices as the pass-through from oil price uncertainty to stock market and output is significant and satisfies the standard negative theoretical expectations. There is an observed connection between interest rate and credit to the private sector, given the downward moderation in interest rate as credit to the private sector increases.

- The impact of stock market returns on output growth, though statistically significant, is counterintuitive. Consistent with economic theory, oil price uncertainty depresses output. Equally, a shock to the stock market reduces output, again underscoring the critical role of the market in spurring and engendering growth and development.

Impulse Response Function

- Evidence from estimates indicates significant impact of oil price on output growth. Output positively responds to innovation in oil price uncertainty shock, and takes approximately four months to transmit to the real sector. This is in contrast to the expectation of small open oil-exporting economy as output growth is expected to contract in response to positive shock in oil price.

- There is evidence of price puzzle given that positive interest rate response is associated with a short-memory decline in inflation rate. There exist also exchange rate puzzle as the upward adjustment of interest rate depreciates, rather than appreciate the exchange rate. In other words, exchange rate depreciated in response to oil price uncertainty shock. Similarly, oil price uncertainty shock weakens stock market returns, explained plausibly by the depreciating exchange rate, a critical determinant of capital flows for small open economies that are essentially oil dependent.

Forecast Error Variance Decomposition.

- In terms of contribution to variation in other factors in the model, oil price uncertainty demonstrated strong explanatory power especially for exchange rate and output. It was equally shown that credit to the private sector is the most exogenous (least affected) of the variables in the model while interactions in the model reveal significant dependence and exposure to each other's activities. This suggests the existence of spill over effect indicating the impact of oil prices on sectors not directly dependent on it but which trading partners are oil-intensive in their processes.

- The percentage variation in oil price uncertainty jointly explained by other factors in the system after a time horizon of 10 months is quite substantial, confirming arguments in the literature by Kilian (2014) and Riman, *et al.* (2014) that oil price trajectory is also influenced by endogenous economic fundamentals.

- Exchange rate and stock market are the most exposed (endogenous) to oil price uncertainty shocks as it accounted for 38.8 and 20.6 per cent of the forecast error variance decomposition, respectively.

- The fraction of variation explained by oil price uncertainty after 10 months horizon was least for credit to the private sector. Evidence indicates that structural factors, other than oil price uncertainties shocks, accounts for the variation in most of the variable, highlighting the flash points for policy design and direction in order to avoid systemic risks.

These findings are germane to researchers, market regulators, participants and other stakeholders. For instance, the evidence of different sensitivities to oil price returns is a tenable guide to risk diversification across sectors. This enables investors to rebalance and adjust portfolio more efficiently.

8.2 Key Policy Implications and Recommendations

Arising from the analyses of results are the following key policy implications.

- From the perspective of policy, given the overwhelming dominance of oil price uncertainty on sector activities, there is need for the monetary authority to closely monitor oil price movement and conceive policies that would largely eliminate or immune the system from oil price shocks. This would not only ensure a stable and sound financial system but also serve as guide in the adjustment of rates in response to oil price propagations.

- Nigeria is an import-dependent economy, where exchange rate is strongly determined by the level of external reserve, which in turn is dependent on the level of crude oil production level and the prevailing price. Monitoring the meandering price of oil would send early warning signals to the monetary authority for the formulation and implementation of policy options to hedge against any imminent systemic crisis that may be occasioned by oil price or production shocks. These metrics are also useful for portfolio management and diversification given the discovery of the sensitivities of the various sectors to oil price innovations.

- Exchange rate depreciation was noted, in all models, to exert considerable negative influence on the economy and the various segments of the stock market. The ready reason for this has been the extreme dependence of the economy on crude oil export for its foreign exchange earnings in addition to high imports that hugely deplete external reserves, deteriorate investor confidence and credit worthiness and, by extension, weaken the exchange rate.

- Given the sensitivity of exchange rate, the need for stable and consistent exchange rate management policies and framework cannot be over emphasised as frequent policy changes could be inimical to investment and output growth. Consequently, interventions at the foreign exchange market must be properly sequenced and timely to assuage the fear of supply shortages and discourage speculative activities. In addition, there is the need for committed effort at diversifying the export base of the economy so as to move away from the single to multiple streams of foreign exchange earnings to dampen the pressure on exchange rate in the economy.

- The observed evidence of significant impact of the interest rate in the estimations serve as an indication of the apparent efficacy of monetary policy transmission mechanism. This calls for the strengthening of monetary policy instruments given the challenges monetary authorities are passing through in the formulation and implementation of monetary policy globally. It has been shown severally that the efficacy of the conventional monetary policy tools is fast waning under the complex and challenging economic environment. The need for a rethink of monetary policy strategy becomes imperative.

- Though the high interest rate has often been touted as an incentive for capital inflow but its counterproductive effect on domestic investment (crowding out private sector credit) might, by far, outweigh the supposed advantages. Consequently, the Banks's intervention initiatives in infrastructure development should be sustained as this would go a long way to bridging the gap and free up credit lines for investors. Interventions in infrastructure provisions would also go a long way to easing the interest rate and inflationary pressures as the upward stickiness of interest rate is often attributed to structural rigidities.

- The observation of the banking and oil and gas sectors sensitivity to oil price changes among the sample sectors suggest calls for deliberate policies to strengthen the energy and financial sectors, especially as they constitute the major players at the Exchange. The banking sector accounts for more than half of the market capitalisation constituting it a serious risk to the economy should the investing public confidence in the system wane.

- Aggregate demand in the macroeconomic literature is assumed to be primarily driven by domestic prices, and curbing inflationary pressures, to a large extent, implies stabilising the economy, which is the primary mandate of every monetary authority globally. Inflation rate in the estimates is found to highly influence the activities of various sectors with significantly high coefficients. Since the weight of the food component constitute more than half of the consumer price index basket in Nigeria, sustained interventions in the agriculture sector would help rein in prices. This would also imply stable exchange rate as import volume reduces while interest rate is made more responsive to policy than structural issues. With credit flowing to the rural areas, not only will agriculture growth be enhanced as more of the population is employed by it, but the financial inclusion and cashless policies of the Bank would naturally be funnelled into the overall national growth objective. However, there is the need for regular evaluation and appraisal of these interventions initiatives to ascertain the achievements and relevance vis-à-vis set targets and objectives.

- The contribution of each variable to the variation in the uncertainties of others in the system indicates the interconnectedness in the system implying that sector negative outcome can easily be transmitted to other sectors resulting in systemic risks. This result is very informative for economic managers as the stock market is identified as one of the important channels for the transmission of oil price uncertainty impulses into the economy. It also serves as a guide to investors on the appropriate portfolio strategies to adopt in order to diversify risks associated with oil price uncertainty shocks and hedge against investments losses. This means that while priority should be accorded systemically risky sectors, this must not be to the exclusion of other sectors.

8.3 Thesis Major Contributions

- This section appraises the contributions of the thesis and the techniques of estimation beginning with the multifactor regression model employed in the analysis of the sensitivity of sector returns to oil price and some selected macroeconomic indicators in chapter 5. This method has been employed by McSweeney and Worthington (2008) for Australian industry stock returns, Gogineni (2008), Augusman and Deriantino (2008) for Indonesia and Arouri and Nguyen (2010) for Europe. Though this thesis may not categorically claim being the first user of the technique for Nigeria, the author, however, is not privy to any study that has applied it to the Nigerian economy at sector level. Modifying the framework to estimate three different models elicit similar results as obtained in other climes, albeit with some exceptions. However, owing largely to differences in economic fundamentals, results obtained actually, though not consistent with what obtained in previous studies, reflect the fundamentals of the economy studied.

- The response of the variables of interest mimics and captures the major turning points and regimes as well as highlights the impact of policies. The impact of the dummy capturing the global financial crises and the net oil price increase and decreases reveal much about the economy responses to external movements in oil price. The asymmetric effect demonstrated is in line with similar studies for other countries. The measure of oil price persistence is very insightful indicating that the impact of oil price change is suppressed for two months before the impulses are manifest in the activities of the various sectors. For sectors such as banking and oil and gas, the impact lingers on for the rest of the forecast horizon, indicating the persistence of the lagged oil dependence in the sector.

- Equally important is the effect of oil price returns on such indicators as exchange rate, interest rate and inflation rate as well as interrelationships among the variables. This model, which serves as the baseline model provides the benchmark upon which the framework adopted in chapters 6 and 7 are premised and compared.

In chapters 6 and 7, the structural vector autoregressive (SVAR) model is applied to further investigate the effect of oil price returns uncertainty shock on the uncertainty returns of the five sectors of the study sample. In chapter 6, an 8-variable SVAR model was estimated to investigate the effect of oil price and exchange rate uncertainties on the uncertainties of oil and gas, insurance, banking, food beverages and tobacco, consumer goods and stock market returns. The outcome from the structural parameter coefficients are instructive and confirm the domineering influence of oil price returns in the economy as observed in chapter 5. The interrelationships between variables in the model were clearly noted. The impulse response and forecast variance decomposition further reveal the critical role of oil price uncertainty in explaining the variation of sector returns uncertainties at reasonably high degrees.

The historical decomposition results corroborate earlier claims especially the impact of the global financial crises on the pattern of the uncertainties of the various sector returns. The results obtained by this approach are consistent with results of previous researchers and reflect the peculiarities of the economy of focus. The results confirms the various degrees of exposure of the sectors to oil price uncertainties as asserted by Arouri and Nguyen (2008), which argue that in analysis such as this, the heterogeneous feature of the various sectors should be taken into consideration. The implication is that imposing a one-size-fit-all analysis, which is the aggregate approach, would mask some salient features of the market and monetary policy might not be able to address sector-specific needs and challenges.

In chapter 7, the SVAR approach was modified to include selected macroeconomic variables such as credit to the private sector and index of industrial production, a proxy for output. The intuition is anchored on the assertion that oil price uncertainty is influential in the outcome of other macroeconomic variables that contribute to the activities at the stock exchange. This is intended to provide additional information and insights as to the underlying behaviour and response of the economy to oil price uncertainty and the identification of the drivers for energy demand. Consequently, interest rate, exchange rate and inflation rate were included in the model to capture the monetary, external and real sectors of the economy, respectively. This aggregate approach to analysis is meant to provide a platform for result comparison with previous researches conducted in this area for the economy and to also serve as take-off points for further research with other econometric modelling approaches.

The results reveal exchange rate returns as being more sensitive to oil price uncertainty with associated effects on interest rate and domestic prices. This cumulatively put the credibility and creditworthiness of the economy at stake as investors divest to other economies with less risk and higher returns for their assets. The response of stock market returns and index of industrial production satisfy theoretical expectations as they both declined as oil price uncertainty worsened.

The characteristics of the impulse response functions and variance decomposition for the estimates in chapter 7 were not markedly different from chapter 6 confirming the consistency of sector outcomes with aggregate performance. Oil price uncertainty strongly explained the variation of the variables in the model lending credence to the dominance of the oil price uncertainty on Nigeria's fiscal space in line with the findings of Wang, *et al.* (2013). The results further reveals the dynamics within the system as each factor was significantly influenced by other sectors in the model indicating the exposure of the variables to each other.

A significant contribution of the thesis also lies in the adoption of index of industrial production, a higher frequency representation for output growth, unlike previous studies that used GDP growth at either annual or quarterly frequency. The monthly frequency data adequately tracks developments and provide insights for policy formulation. Using monthly series covering the pre and post global financial crisis period, these results provided new and very instructive evidence for economic managers, investors and financial market participants. For the monetary authority, the study has shown that the primary channel of oil price uncertainty transmission to the economy is the exchange rate channel. This implies intermittent intervention in the foreign exchange market to ensure a stable exchange rate, given the import dependent nature of the economy. This evidence is consistent with the growing body of literature on the importance of exchange rate especially for commodity-dependent and commodity-exporting countries. A larger proportion of oil price uncertainty shocks filters into the economy through this channel.

8.4 Areas for Further Research

Research is an on-going venture and following from the findings and subsequent recommendations, the following are the identified areas for further research. First, given that exchange rate has been shown to be very influential in the Nigerian economy as demonstrated in the various models, it is imperative to investigate the contribution of exchange rate uncertainty on the activities of the economy both at industry and aggregate levels. This is to inform monetary authority about the need to possibly shift from monetary targeting to exchange rate targeting to achieve the desired overall l economic growth and development objectives.

Secondly, there is need to expand the sample size of the industry returns as more data is made available to enhance the representativeness of the market for more effective policy oriented results. This is a limitation to the present study as the sample size of five industry sectors was selected based on the availability of data. As the stock exchange continues to introduce more indices, there is the need to expand the sample size to capture the new introductions. In addition, given that market data is of high frequency, it would be apt for a study to attempt examining the effect of oil price uncertainty on the various sector returns in Nigeria using weekly or daily data. It could also be curious to extend the scope of this study to cover beyond 2016 when the economy would have rebounded from the recession to ascertain the role of oil price uncertainty in the recession so witnessed.

Finally premised on the established effect of world market risk and exchange rate risk in the literature within the international asset pricing model framework, it might form an interesting research to re-estimate the models with the inclusion of world market return and foreign interest rate. This is based on the argument that Nigerian stock returns are exposed to the world market risk through its integration to the regional and world stock market. In that regard, an investigation to assess whether oil price is an integral business component in the West Africa and sub-Saharan region sectoral indices would be considered appropriate. The introduction of new methodologies such as the dynamic conditional correlation models that allow for covariance analyses between variables in the system could be a viable exploration.

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