FINANCIAL DEVELOPMENT, ECONOMIC GROWTH AND STOCK MARKET VOLATILITY: EVIDENCE FROM NIGERIA AND SOUTH AFRICA

Thesis submitted for the degree of

Doctor of Philosophy

at the University of Leicester

By

UMAR BIDA NDAKO

BSc, MSc (Bayero University, Kano)

Department of Economics
University of Leicester

October 2010

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ABSTRACT

This thesis focuses on financial development, economic growth and market volatility in Nigeria and South Africa. For Nigeria, the thesis examines the long-run causality between financial development and economic growth. It uses three measures of financial development: financial development index measured using principal component analysis, bank credit to private sector, and liquid liabilities. For South Africa, the thesis evaluates the causal relationship between stock market development and economic growth. It uses both bank and stock market variables: bank credit to private sector, market capitalisation, turnover ratio, and value shares traded. The study applies Multivariate vector autoregressive (VAR) and Vector Error Correction Model (VECM). It further uses Generalised Impulse Response Function (GIRF) and Variance Decomposition (VDC). The results for Nigeria suggest the existence of unidirectional causality from economic growth to financial development using bank credit to private sector. While using liquid liabilities, it indicates bidirectional causality between financial development and economic growth. In the case of South Africa, the findings suggest the existence of bidirectional causality between financial development and economic growth using the banking system. However, when the stock market variables are used, the results indicate unidirectional causality from economic growth to stock market system. The thesis further examines the effect of financial liberalisation on the Nigerian and South African equity markets. It applies the Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) model and endogenous structural break tests. These are examined over pre- and post-liberalisation periods. The official liberalisation dummy is added to the augmented EGARCH model to capture the effect of financial liberalisation. The findings show that none of the estimated break dates coincides with the official liberalisation dates for the two countries. When structural breaks are taken into account, volatility tends to decline following financial liberalisation, and the effect of financial liberalisation on the stock markets is negative and statistically significant.

ACKNOWLEDGEMENTS

First, I would like to thank Allah (SWT) who has made it possible for me to complete this programme successfully and equally thank Him for His continued mercy and blessing.

I would like to sincerely thank my supervisor Professor Stephen G. Hall for his constructive comments, valuable suggestions and good guidance. I equally thank him for his kindness and necessary encouragement. I am extremely indebted to him as I have learnt so much from him. I would also thank members of my thesis committee, Professor Gianni De Fraja (Head of Department) and Dr. Martin Hoskins for their useful contribution.

My sincere appreciation goes to my mother, Malama Amina Muhammad and of course my late father, Alhaji Baba Muhammad who passed away before the completion of this programme may his soul rest in perfect peace amen. I would also like to thank my brothers and sisters for their continued support and prayers.

I would like to register special appreciation and heartfelt gratitude to my dearest wife, Maimuna for her tremendous support, sacrifice, and prayers. Also to our sweet and wonderful daughters, Firdausi and Ramlah: you are indeed the soul of the family.

My appreciation goes to some of my colleagues during the programme, Jonathan and family, Mumtaz, Kavita, Andrea, Sahar, Khaleed, Sergio, Dalia, Paul Mukabila and Grace. My appreciation also goes to all my friends, and colleagues at Bayero University, Kano.

My gratitude also goes to my part sponsor Bayero University, Kano for providing the opportunity for this programme. Also financial assistance from Niger state government is appreciated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter1

INTRODUCTION

1.1 Background to the Study

The relationship between financial development and economic growth has long been established both at theoretical and empirical levels.[1] However, the emergence of new theories of endogenous growth has indeed renewed interest in the potential role of financial systems in promoting economic growth and development. Greenwood and Jovanovic (1990), Pagano (1993) and King and Levine (1993) have all shown in their studies that financial development does have a positive impact on economic growth through investment, saving, productivity of capital and effective management of information.[2]

One of the contentious issues in the study of financial development and economic growth especially in time series studies is the direction of causality. Patrick (1966) explains that finance can lead to economic growth through what he terms the "supply-leading" hypothesis; and equally that economic growth can also stimulate financial development - he calls this the "demand following" hypothesis. Ever since the formulation of these hypotheses, empirical conclusions on the direction of causality between financial development and economic growth have remained inconclusive.

Evidence from cross-sectional studies, particularly the study by King and Levine (1993), indicates that financial development does not only have a positive impact on

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[1] See, for example, Goldsmith (1969), McKinnon (1973), Shaw (1973) King and Levine (1993a), and Patrick (1966).

[2] According to Levine (2004,p.6) "Financial development involves improvements in the (i) production of ex ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance, (iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services". These functions mentioned above according to him do impact on the decisions of savings, investment and economic growth.

economic growth but also serves as a good *"predictor of long-run growth over the next 10 to 30 years"* (p.719). However, results from time-series data contradict these findings. Demetriades and Hussein (1996) and Arestis and Demetriades (1997) identify the pattern of causality that varies across countries thereby showing the weaknesses inherent in cross-sectional methods of estimation which are based on averages of sample countries. Therefore, from their studies it is quite evident that carrying out an exclusive investigation on the relationship between financial development and economic growth for countries like Nigeria instead of a number of cross sectional countries provides greater advantage because findings from such a study easily reflect the prevailing economic conditions and institutional structures (Bell and Rousseau 2001, Arestis and Demetriades 1997). Chandavarkar (1992, p.134) also argues that the relationship between finance and growth "*merits systematic testing on a country wide basis over sufficiently long periods".*

In recent years there has been an increase in the application of multivariate VAR model to time-series studies on financial development and economic growth. Prominent among these include Luintel and Khan (1999), Chang and Caudill (2005), Liang and Teng (2006), Ang and Mckibbin (2007), Abu-Badr and Abu-Qarn (2008), Masih et al. (2009), Gries et al. (2009), and Wolde-Rafael (2009). This is because the endogenous growth models have explained that the interaction between financial development and growth often occurs through a number of channels for example through investment, productivity and savings. Therefore recent empirical works are now exploring some of these channels through the application of multivariate VAR methodology. However, this has still not resolved the issue of causality between financial development and economic growth. The first empirical chapter of this thesis follows this approach of multivariate VAR model for the case of Nigeria while controlling for trade openness and real interest rate.

The increasing role of stock markets in economic development of the Sub-Saharan African particularly South Africa has now been recognised. South Africa is Africa's biggest economy and has-since the advent of democracy in the 1990s - embarked upon wide ranging financial reforms both in the banking sector and stock market system. This reform has resulted in South Africa's financial system being ranked 25th in the world in 2008 by World Economic Forum's first financial development index. It is even ahead of India, Brazil and Russia. It has also led to South Africa being included in the major global stock market indices. The IMF (2008) confirms that South Africa's financial system is "fundamentally sound" with a good legal framework and sound financial infrastructure supported by prudent macroeconomic management. The World Bank (2007) acknowledges this achievement by showing that the Johannesburg Stock Market is the fourth largest among the emerging markets.

The argument in the literature of financial structure has not been adequately resolved. Greenwood and Jovanovic (1990), Atje and Jovanovic (1993), Greenwood and Smith (1997), Morck and Nakuruma (1999), Allen and Gale (2000) and Capasso (2008) have all argued that the stock market does have a positive effect on the economic growth; while others like Stiglitz (1985) and Singh (1997) tend to favour the banks' role in the growth process. Meanwhile, Boyd and Prescott (1986), Boyd and Smith (1998) and Blackburn et al. (2005) have all shown that both stock markets and banks are necessary in promoting economic growth. Therefore, they consider stock markets as complementing banks rather than being substitutes.

From the empirical studies, different conclusions can also be found based on the different techniques. Rousseau and Wachtel (2000), Arestis et al. (2001), Beck and

Levine (2004), Dritsaki and Dritsaki-Bargiota (2005), Ang (2008), Singh (2008), Handa and Khan (2008), Christopoulos and Tsionas (2004), and Enisan and Olufisayo (2009) have all arrived at different conclusions. The inconclusive nature of these theoretical and empirical studies provides the basis for a further empirical investigation on the role of stock market development in economic growth. This is done for South Africa which forms the second empirical chapter of the thesis.

Nigeria and South Africa both liberalise their financial markets in 1995 and as expected, it has provided opportunities for foreign investors to actively participate in these markets which in turn increases the level of liquidity, saving and growth of these economies. However, experience has shown particularly from the South East Asia that these huge potentials are often characterised by high level of uncertainty. Meanwhile, both theoretical and empirical works offer different conclusions on the effects of market volatility following financial liberalisation. Kim and Singal (2000), Bekaert and Harvey (2000), Henry (2000), and Bekaert et al. (2003) have all argued that stock market liberalisation does have positive effects on the economy since it allows international risk sharing between domestic and foreign investors. It also reduces the equity cost of capital and encourages information efficiency. However, Singh (1997), Stiglitz (2000), Allen and Gale (2000) and others have argued that financial liberalisation increases the level of capital mobility which in turn increases the speculative activities and market volatility leading to crashes.

The 1997 Asian financial crisis ignited the debate on whether financial liberalisation increases market volatility and whether the high levels of volatility are due to presence of structural breaks. Several empirical studies have attempted to answer this question but the results still remain inconclusive. This can be seen in the work of Desantis and Imrohoroglu (1997), Kim and Singal (2000), Bekaert and Harvey (2000), Kassimatis

(2002), Jayasuriya (2005), and Kaminsky and Schmukler (2008). Also studies by Hamilton (1990, 1994), Lamoureux and Lastrapes (1990), Aggarwal et al. (1999), Sumsel (2000), Malik et al. (2005), and Cunado et al. (2006) have all shown that volatility could reduce or increase once structural breaks are taken in to account.

Study on financial liberalisation and stock market volatility has been mainly focused on South East Asia and Latin America economies.[3] There has not been much effort to examine the Sub-Saharan African stock markets following financial liberalisation. This study aims to fill this gap by applying exponential GARCH model (EGARCH) and endogenous structural break test to examine the effect of financial liberalisation on market volatility using South African and Nigerian equity markets.

This study therefore focuses on financial development, economic growth and market volatility in Nigeria and South Africa. It comprises three empirical chapters, the first of which focuses on Nigeria. This evaluates the long-run relationship between financial development and economic growth through theoretical restrictions on cointegrating vectors. The second empirical chapter uses both bank and stock market variables to examine the role of the stock market in economic development in South Africa. The third empirical chapter examines financial liberalisation, structural breaks and market volatility in Nigeria and South Africa.

1.2 The Nigerian and South African Banking and Stock Market Development

1.2.1 The Banking Sector

Banking in Nigeria started in 1892 with the establishment of the African Banking Corporation (Beck et al. 2005). Earliest banks were essentially foreign owned but in the 1930s, many indigenous banks were also established. The majority of these

[3] This can be found in the work of Aggarwal et al. (1999), Edwards (2003), Desantis and Imrohoroglu (1997), Nguyen (2008), and Wang and Theobald (2008) among others.

indigenous banks collapsed a few years after establishment, marking the first incidence of banks failure in Nigeria. The response of colonial government was the enactment of the 1952 Banking Ordinance, which marked the initial efforts at regulating the banking system in Nigeria.[4] In July 1959, the Central Bank of Nigeria (CBN) was established and empowered to regulate the Nigerian banking industry.

In the 1970s, the Nigerian banking industry was dominated by policies of financial repression and indigenisation. The repression policy included interest rate controls, selective credit guidelines and fixed exchange rate regimes. The indigenisation policy of the government was directed at nationalising all foreign owned banks in Nigeria.[5]

The challenges posed by financial repression and indigenisation policies necessitated the Federal Government's adoption of the Structural Adjustment programme (SAP) in 1986 as it had become very clear that the macroeconomic crisis could not be ameliorated without effecting a fundamental and comprehensive change in policy direction. In its various forms SAP has significantly influenced various indices of the Nigerian financial system such as interest rate structure, institutional development, reorganisation of money and capital markets operation, and non-deposit taking investment houses. Thus, financial liberalisation has been adopted to promote financial saving, reduce the distortions in investment decisions and induce more effective intermediation between savers and investors which in turn promote rapid economic growth (CBN 2004).

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[4] In the early 1950s, 21 bank failures were recorded and immediate response of the colonial government was the Banking Ordinance, which regulated the indigenous banks through supervision and examinations, and required reserve funds and provision of necessary assistance.

[5] The indigenisation policy was an attempt by the Nigerian government to reduce the role of foreign investment in the national economy by allowing its citizens to hold the majority shares in foreign companies. The policy derived its powers from the provisions of the Nigerian Enterprises Promotion Decree of 1972 and 1977. However, this decree was finally repealed in 1995.

The first operation of financial reform started with the deregulation of the interest rates in August 1987[6]; and later in the same year, conditions for licensing of new banks were relaxed which led to a phenomenal increase in the number of established banks in the country[7]. In 1988, the Federal Government established the Nigerian Deposit Insurance Corporation (NDIC) with the aim of providing safety and boosting public confidence in the banking system. In 1992, the Federal Government privatised government owned banks with equity interest in eight commercial banks and six merchant banks offered for sale.

Further reforms were taken by the CBN in July, 2004 to strengthen the banking system; hence a 13-point banking programme was enunciated. Some of the major elements of the programme included the requirement for Nigerian banks to increase their shareholders' funds to a minimum of N25 billion (about $200 million) by the end of December 2005; phased withdrawal of public sector funds; consolidation of banking institutions through mergers and acquisitions; and adoption of a risk-focused and rule-based regulatory framework.[8]

The South Africa banking system is the most developed in the continent of Africa and according to Abratt and Russell (1999), the Cape of Good Hope Bank was the first private commercial bank in South Africa, having been established in 1837.

[6] In 1987, market determined interest rates were introduced until 1991 when interest rates were recapped by the monetary authorities. After one year of control, interest rates were permitted once again to be determined by the market rates in 1992 and 1993. However, from1994 to 1998, interest rates ceiling were re-introduced and since the end of 1998, the rates now follow market rules.

[7] As the financial sector witnessed numerical growth, signs of financial sector unsoundness and fragility began to manifest. For example, there was an increase in the number of banks from 26 in 1980 to 120 in 1993, with the number of branches increasing from 740 in 1980 to 2,258 in 1993; however in the same year, the CBN declared eight banks as technically insolvent and took over the management of five of them.

[8] The reform had helped to reduce the number of banks in country from 89 to 25 through mergers and acquisitions. Since January, 2006, the banking sector has improved in terms of total assets and capitalisation. For detailed discussion, see Soludo (2006).

Other banks established in this period include the First Nation Bank and the Standard Bank of South Africa which were established in 1838 and 1900 respectively. Prior to the 1950s, the banking sector was mainly controlled by commercial banks; however, thereafter the banking system began to diversify its operations into insurance, and investment in manufacturing and commercial enterprises. The 1980s were characterised by political isolation and many foreign shareholders in South Africa disinvested their South African bank shareholdings due to political reason. For example, the Standard Chartered, Barclays, Amsterdam Rotterdam (ABN) and Algeme Bank Nederland (AMRO) all disinvested their bank holdings in South Africa (Falkena et al. 2001). Also, in the late 1980s, the building societies diversified their activities to commercial banks and general banking arms thereby increasingly challenging the big commercial banks in South Africa.[9]

The financial infrastructures in the 1980s were quite rudimentary and levels of transparency and accountability were very low. (Falkena et al. 2001, p.159). Therefore, in the 1970s and 1980s, the South Africa financial system was characterised by elements of financial repression; with fixed interest and exchange rates and selective control mechanisms.

Deregulation of the South African financial sector started to gain momentum in the 1990s particularly after the first post-apartheid election in 1994. Meanwhile as part of the reforms within the financial sector, the Financial Services Board (FSB) was established in 1990. It is an independent institution charged with the responsibility of effective supervision of non-banking financial institutions. In 1994, the first corporate governance rules were published by the King Commission and the National Payment

[9] The monetary authorities later came up with the deposit taking act of 1991 which formalised these overlapping functions.

Act of 1998 was introduced in order to bring South Africa financial settlement in line with international practice. Therefore, during this period of the 1990s, financial regulators and supervisors began to meet regularly and core principles of supervision for banks were also developed and adopted. Application of capital-adequacy measures and effective management control systems were becoming increasingly accepted.

According to the IMF (2008), commercial banks in South Africa are the dominant segment of the financial sector with assets of about 120% of GDP. The four biggest banks - the Amalgamated Bank of South Africa (ABSA), First Rand Bank, Ned Bank, and Standard Bank -account for about 85% of the total assets and have an international presence in Botswana, Mozambique, Namibia and Zimbabwe. The South Africa financial sector is also open to foreign financial institutions. For example, Barclays Bank became the main shareholder of ABSA in 2005 and in 2007 the Industrial and Commercial Bank of China (ICBC) acquired 20% stake in Standard Bank.

1.2.2 The Stock Market Development

The Nigerian Stock Exchange (NSE) is relatively young when compared with establishment of commercial banks. It started operations in mid-1961 with eight stocks and equities; there were also about seven UK firms quoted on NSE which had, at the same time, dual quotations on the London Stock Exchange. At the commencement of operations, the NSE started with 0.3 million shares worth N1.5 m in 334 deals and the value continued to grow steadily to N16.6m in 634 deals by 1970 (CBN 2004).

From the 1960s up to the late 1980s, trading at the NSE was dominated by government securities and this was partly explained by the implementation of the Nigerian Enterprises Promotion Decree of 1972 and 1977 which allowed a high level of public participation in the capital market. Also prior to the deregulation of the Nigerian capital market in 1995, the pricing of new issues was controlled by the SEC as against firms' preferences for a market determined pricing system (CBN 2004).

In 1995 the Federal Government liberalised the capital market with the abrogation of Laws that prevent foreign investors from participating in the domestic capital market. This includes: The Foreign Exchange (Monitoring and Miscellaneous Provision Decree No: 17, 1995; Nigerian Investment Promotion Commission Decree No: 16, 1995; Companies and Allied Matters Decree of 1990 and Securities and Investment Act (ISA) 45 of 1999[10]. These legislations have accorded Nigerians and foreign investors the same right, privileges and opportunities for investment in securities in the Nigerian capital markets. Other key measures include: The Central Security Clearing System (CSCS) which commenced operations in April 1997. It is a central depository for all the share certificates of quoted securities including new issues. The coming of the CSCS has made the trading on the NSE to be carried out on an Automated Trading System (ATS), which enable market order to be carried out in transaction days T+3 days (NSE 2009). Also in July 2002, the stock exchange introduced the e-business platform, which makes it possible for investors in the Exchange Market to access their CSCS database from the Exchange Website for the purpose of monitoring movement in their stock accounts.

In 2007, the SEC approved the establishment of the Investors Protection Fund (IPF) with the objective of compensating investors who suffer losses as a result of insolvency, bankruptcy or negligence on the part of a dealing member firm of a securities exchange. Also in 2007, to further deepen the market, the NSE launched new products, including mortgage-backed securities, asset-backed securities, derivatives and exchange- trade funds.

[10] The Decree No: 16 and 17 replaced the abrogated Nigerian Enterprises Promotion Decree of 1989 and Exchange Control Act of 1962 respectively. However, the Investment and Securities Act (ISA) 2007 repealed the ISA 45 of 1999 and subsequently those earlier decrees.

In 2008, the NSE crashed and suffered the heaviest loss in its history; although the global financial crisis partly contributed to this, the main source of the crisis could be traced to insider abuse, shares manipulation, margin loans scandals and other negative activities perpetuated by operators of the market. The stock market had less than N1trillion market capitalisation in 1999 but this jumped to N15.3 trillion in the first quarter of 2008, however, this amount plummeted to N7.53 trillion in the first week of November 2008 (NSE 2009).

The Johannesburg Stock Exchange (JSE) is the oldest stock exchange in Sub-Saharan Africa. It was established in 1887 and over the years has undergone a series of transformations and restructuring activities. More recently, it has developed other active markets like financial derivative markets and agricultural products markets.

Prior to 1994, the JSE was confronted with a lot of challenges including international economic sanctions, a rigid exchange control regime, thin trading and illiquidity, peculiar economic structures of companies and political instability. Although financial institutions' trading on the JSE increased significantly following the constant cash flow from insurance and pension funds over the years, investors constantly faced difficulties in achieving smooth and efficient trade in shares. All these challenges explain why - in the pre-1994 era - the JSE performed poorly when compared with other emerging markets. According to Falkena et al. (2001), there was a lack of competition on the JSE; and the market was heavily restricted in terms of single-capacity trading, fixed commission and no corporate membership, among others.

Following the first post-apartheid election in 1994 and the lifting of international economic sanctions on South Africa, in 1995 the JSE was restructured and liberalised in line with international financial standards.[11]

The open cry system where deals were conducted on telephones was replaced in 1996 by an automated trading system. The system allows traders to buy and sell shares by using the Centralised Automated System (ATS) and this helps to promote transparency and efficiency in daily transactions. In 1998, Shares Transaction Totally Electronic (STRATE) was introduced and commenced operations in 1999. This is an electronic clearing and settlement system that helps to solve problems associated with paper-based settlements. In 2001, the JSE merged with the South African Future Exchange (SAFEX) as part of the reform measures to consolidate its position in the global financial markets. In 2002, the London Stock Exchange (LSE) and the JSE entered into a strategic alliance where all shares were dematerialised and moved to the STRATE environment and guaranteed T+5 settlement for JSE main board trades. Also on 13 May 2002, JSE replaced its JET system with the securities Exchange Trading System of LSE. This has increased investors' confidence in the JSE; and helps in reducing thin trading and improving the market liquidity.

Another major change on the JSE was the launching of the Alternative Exchange (ALTx) in 2004. This was the first African alternative exchange: it provides opportunities for small and medium-sized companies with great potential to grow and covers all sectors of the economy. Also in 2007, the JSE launched currency derivatives which provide opportunities for market participants to hedge against currency risk, and diversify internationally as well as taking a view on the movement of the underlying exchange rates.

[11] The reforms of 1995 were termed the Big Bang because they brought about price competition, corporate membership and dual-capacity trading.

1.3 Objectives of the Thesis

This thesis focuses on financial development, growth and equity markets volatility in Nigeria and South Africa. It uses time series data and set to achieve the following:

(a) To examine the short-run dynamics and long-run causality between financial development and economic growth in Nigeria using annual data from 1961-2007;

(b) To evaluate causal relationship between stock market development and economic growth for South Africa using quarterly time series data from 1983:q1-2007:q4; and

(c) To study the effect of financial liberalisation on South African and Nigerian equity markets volatility using Exponential General Autoregressive conditional Heteroskedasticity (EGARCH) models; utilising both daily and monthly data.

1.4 Motivations

This thesis focuses on Nigeria and South Africa the two biggest economies in the Sub-Saharan Africa.[12] The two countries have over the years adopted various economic and financial reforms aimed at promoting economic growth and development.

It is evident from the background to the study of this thesis that the issue of causality between financial development and economic growth has remained inconclusive. This is both at the theoretical and empirical levels. It is also evident that studies on stock market volatility following financial liberalisation have not been adequately resolved. Therefore, different conclusions on these issues both at the

[12] While South Africa is the biggest economy in the continent, Nigeria is the second largest economy (World Bank, 2009) South Africa is in the southern part of continent, Nigeria is in the western part of the continent, it is most populous countries in Africa with a population of 151 million and accounting for 41% of the sub- Sahara African or region's GDP.

theoretical and empirical levels provide the background motivation for this study. This is because a further study on these issues using Nigerian and South African data would provide a clearer view that may help policy makers in planning decisions for these countries.

World Bank (2007) explains that although African financial system is confronted with a lot of challenges, it has been recording accelerating growth over the past years. It shows that the indicators of financial development have steadily increased and the real private sector has been growing at an accelerating rate in the past decades. This is an indication that financial development in Sub-Saharan Africa has potentials of promoting rapid economic growth. The thesis however focuses only on the two biggest economies in the sub-continent, Nigeria and South Africa. Therefore, the motivation and the reasons for the choice of the two countries are briefly examined below:

Figure 1.1 below presents the Nigerian financial system development. Figure 1 (A), depicts bank credit to private sector and it captures the amount of funds that is channelled by the banking sector to the productive sector of the economy. It shows that from 1960, the bank credit has been on the steady increase reaching over 20% of GDP in 1987, which coincides with the first deregulation of the Nigerian nominal interest rates. It, however, falls to 10% between 1988 and 1996 and later stabilises at 15% from 1998 to 2004. Bank deposit as percentage of GDP on the other hand, measures the size of money in the economy and this is presented in figure1 (B). It shows a steady increase from 10% in 1960 to 30% of GDP between 1980 and 1987. This trend later decline to the 1960 level of 10% but however rises again to over 20% of GDP from 1997 to 2004. According to the World Bank (2007), although both bank credit and bank deposit are measures of financial development, it is the former that captures the degree to which banks channel their funds to the productive sector of the economy and the later is central to the monetary policy of the economy. Therefore, the growth of this indicator (bank credit to private sector) although not stable, it does provides evidence that some funds are being channelled to the productive sector of the Nigerian economy and this may have positive impact on the economic growth. Therefore from the below figures, it shows that both measures of financial development have shown a positive trend. This indeed has provided the necessary motivation for the first empirical chapter to examine whether these positive trends have in the long-run made finance leads growth in Nigeria.

The stock market indicators are presented in figures 1C and 1D respectively. While figure 1C measures the size of the stock market, figure 1D indicates the level of liquidity in the market. It can be observed from figure 1C that market capitalisation is almost 0% in the 1980s during the pre-liberalisation period. However, in 1995, when the market was liberalised the capitalisation shows a steady rise from 20% in 2005 to over 50% in 2007. The sharp increase from 2005 to 2007 can be mainly attributed to the bank consolidation programme of the Central Bank of Nigeria (CBN) where banks were directed in 2004 to increase their capital base to about US$200milliom by December 2005 (World Bank, 2007). The market however plummeted in 2008 owing to the global financial crisis. During that period according to the CBN (2009), Nigeria stock market lost almost 70% of market capitalisation. The turnover ratio, which is shown in figure 1 D below, gives a similar upward trend. Starting from almost 0% per cent between 1988 and 1994 but begins to rise from 1996 with 10% to 30% in 2008. Figure1 (E) depicts the real interest rate for the Nigerian economy. It shows that for most of the periods under review the real interest rate has been negative. It was negative in 1970 and slightly above 0% between 1972 and 1973 and remained negative from 1974 to1982. However, a positive real interest rate of about 10% was recorded in 1990, after it was liberalised in 1987 but two years later it went down to negative between 1992 and 1996. A positive level was achieved in 2000 and remained stable onwards at slightly above 1%. This inconsistent level of the real interest rate has been partly attributed to several policy reversals by the Nigerian government of controlling and deregulating the nominal interest rates. World Bank (1989) and Fry (1997) have all indicated that a liberalised nominal interest rate does have positive productive effect on growth. Other studies on developing countries have however shown a contrasting view as their results indicate a negative effect on growth. This can be found in the work of Greene and Villanueva (1991), Warman and Thirlwall (1994) and Athukorala (1998). All this provides the motivation for the inclusion of real interest rate in the first empirical chapter to assess whether this channel has a positive relationship with economic growth and other determinants. This is more so since especially there has not been any study of finance and growth in Nigeria that includes this variable.

The choice of Nigeria for this study is due to the important role of the Nigerian economy in West Africa region and Africa in general. Nigeria is the most populous country in Africa (150 million people), the second biggest economy in the continent and the biggest in the West Africa sub-region contributing over 41% of GDP of the entire West Africa, (World Bank, 2009). World Bank (2006) also explains that it is only Nigeria and South Africa that have bank assets of over $10billion in the Sub-Saharan Africa and this mainly attributed to their years of financial reforms. Therefore, choice of Nigeria for this study is due to its dominant economic role in West Africa and its rich experience in financial sector reforms.

Figure 1.2 below shows the South African financial system and bank credit to private sector is presented in figure 2A. It has been on the steady increase from 50% of GDP in 1975 to 150% of GDP in 2005. There was however a sharp decline to 60% in

2008 which is partly due to the global financial crisis. This indicates that South Africa financial intermediaries have been over the period channelling enough resources to the productive sector of the economy. Bank deposit in figure 2B rather shows a steady and stable trend from about 60% in 1975 and decline to 50% between 1978 and 1997. It later rises above 60% in 2008.

Figures 2C and 2D are both market capitalisation and turnover ratio for Johannesburg Stock Exchange (JSE). The market capitalisation, which indicates the size of the market, has been on the increase from 2003 to 2007 having been relative stable from 1983q1 to 2003q1. The turnover ratio, which measures the market liquidity, indicates almost 0% in the most part of the 1980s. It however starts to increase immediately when the JSE was liberalised in 1995 and from this period the level of market trend has been on the increase. It is believed that this positive trend may provide some useful information on stock market relationship with economic growth. This further provides the motivation to see whether there is a causal relationship between stock market development and economic growth for South Africa.

Figure 2E is the real interest rate for South Africa. Unlike Nigeria, South African real interest rate is mostly characterised by positive rate as the negative period was only recorded from 1978 to 1980. This is an indication that the positive real interest rate in South Africa may have had positive impact on the average productivity of capital.

The choice of South Africa for the second empirical chapter is based on two reasons: The first and the main reason is the availability of data. South Africa has a long-period data (especially the quarterly observations) on stock market variables which is good for any meaningful time series work. This is lacking for other Sub-Saharan stock markets since the majority of them were established in the late 1980s and mid

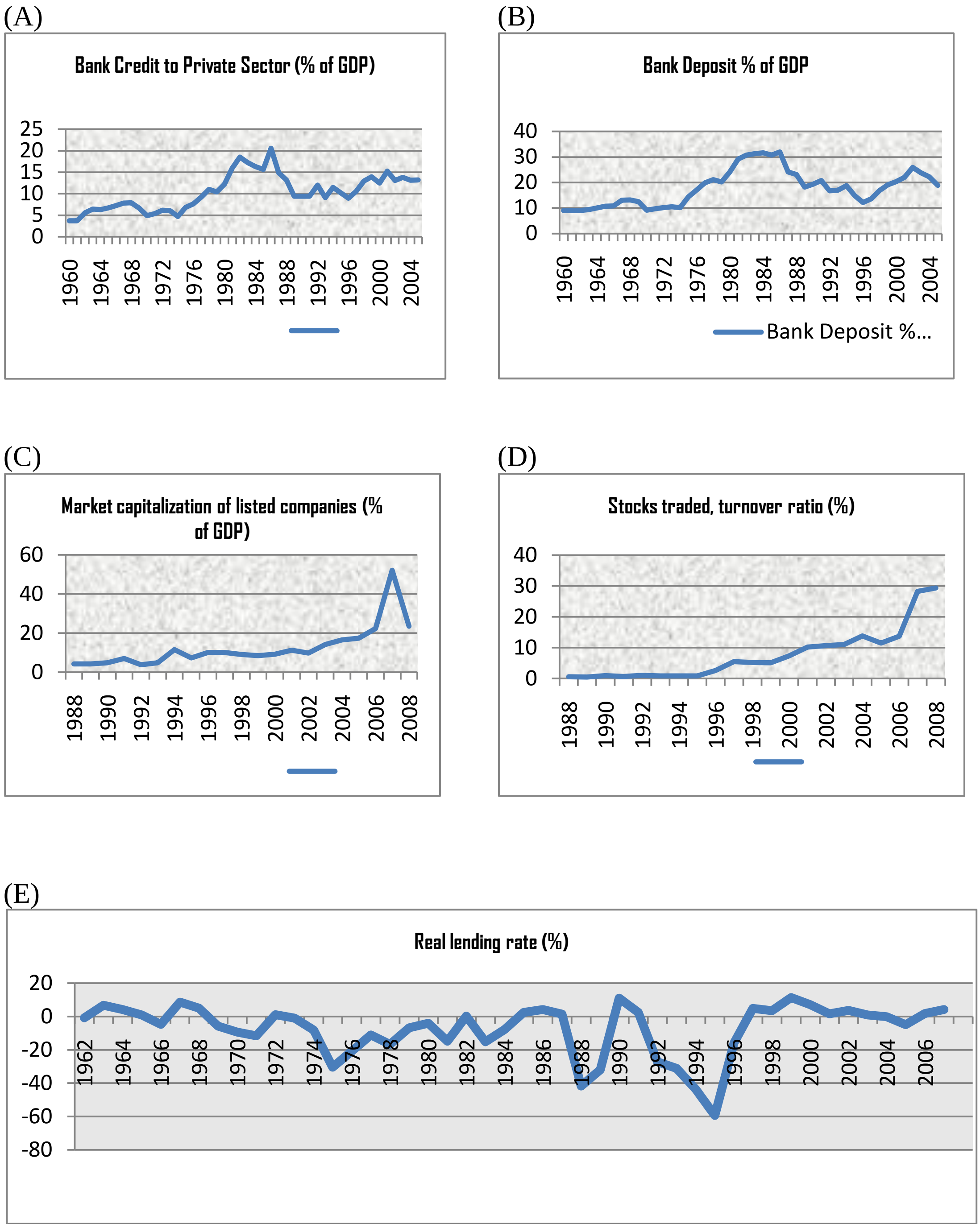
1990s. The second reason is that South Africa is the biggest economy in the continent of Africa and has a good record of financial policy reforms.

Table1.1 below shows the stock market development indicators for the Sub-Saharan Africa, 2008. From the table, it is clearly evident that the two dominant markets are South Africa and Nigeria. These two countries have the highest number of listed companies of 425 and 213 respectively. Others countries like Uganda, Tanzania and Swaziland are having 6, 7 and 7 listed companies respectively. It is also evident from the table that South Africa and Nigeria are the most liquid market as measured by turnover ratio. While South Africa's turnover ratio is by far the biggest with 60.61%; Nigerian market is second with 29.30 %. Other markets like Namibia and Botswana are having 2.84% and 3.09% respectively. This is a clear indication that many of the Sub-Saharan African markets are characterised by low liquidity and the consequence of this is low volume of trading as equally shown in the table above. While South Africa is by far the market with the highest value of trading in 2008 with 145.2%; Nigeria is second with 9.85 while countries like Namibia and Ghana are having 0.21% and 0.90% respectively.

Therefore for the third empirical chapter, we choose only South Africa and Nigeria for the obvious reasons that they are the most liquid markets and also the markets with the highest number of listed companies as shown from the table1.1 below. A highly liquid market makes it convenient for investors to buy and sell stock with relative ease. Foreign portfolio investors are particularly interested in the rate of liquidity in a market as it provides easy entry and exit. Also an increase in the number of listed companies increases the level of equity market deepening. This leads to increase in the required number of professionals for credible analyses, research, and information flows that are timely and accurate to enable investors allocate their financial assets efficiently and effectively.

Figures 1.3 and 1.4 present the daily and monthly stock returns as well as the daily and monthly conditional variances for both South Africa and Nigeria respectively. A close look at the stock returns of the two markets both for the daily and monthly returns clearly exhibit volatility clustering which indicates that news arrival for the two markets are serially correlated. Also based on the prior information, the conditional variances for the two markets both for the daily and monthly returns indicate high level of persistence. The two markets cover two periods: the pre-liberalisation and post-liberalisation periods both for the daily and monthly return series except for the Nigerian daily returns, which cover only post-liberalisation period due to lack of data for the pre-liberalisation period. The pre-liberalisation period is the period before the markets open up to foreign investors while post-liberalisation is after the markets become internationalised. Both countries liberalised their markets in 1995. Therefore, the motivation for the third empirical chapter comes from these figures where it becomes obvious to ask: Have these volatilities fell or increased after financial liberalisation? And whether once structural breaks are fully accounted for (as predicted by both theory and empirical works) will these volatilities decrease?

Figure 1.1: Nigerian Financial System Development



Source: World Development Indicators database, September (2009)

Figure1.2: South African Financial System Development

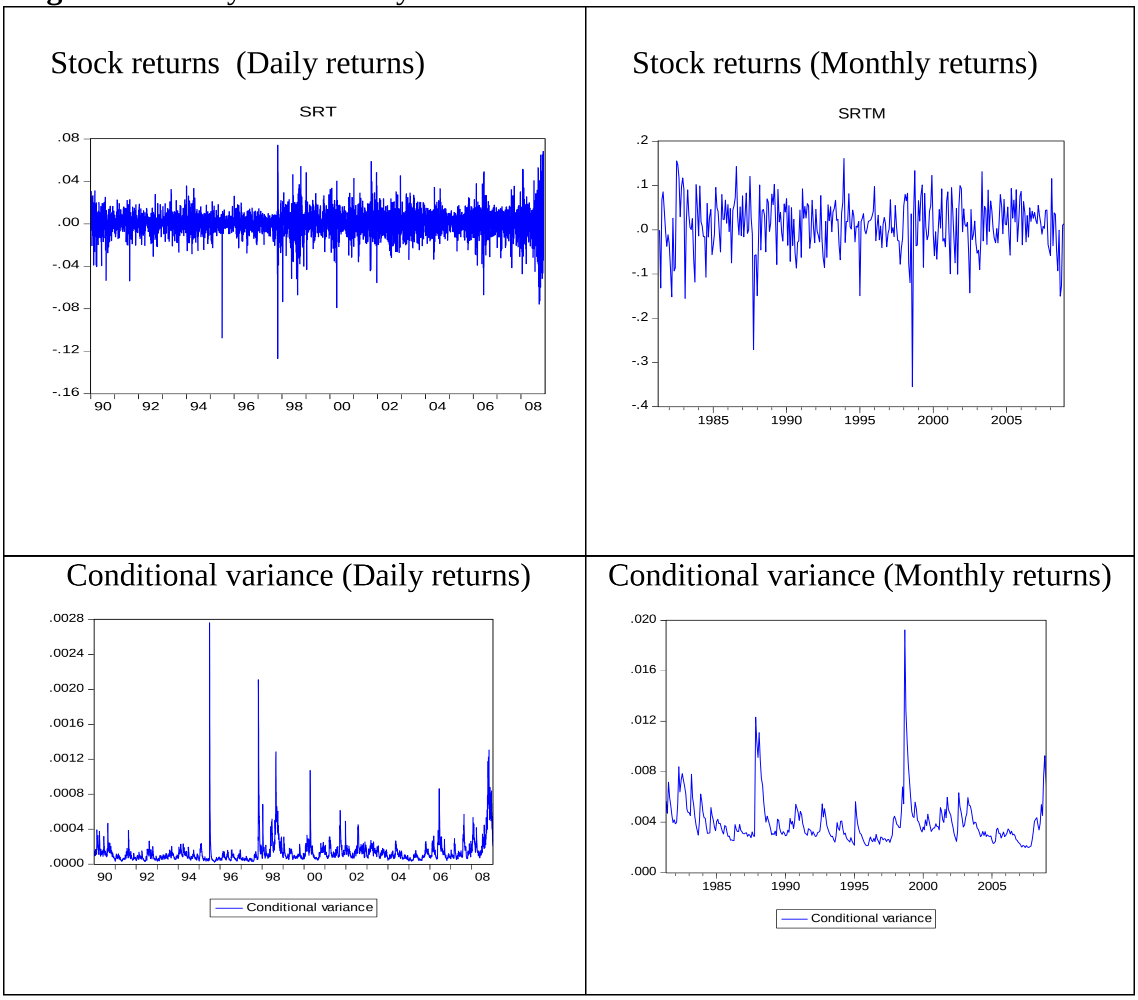
Sources: (1) World Development Indicators database, September 2009
(2) Johannesburg Stock Exchange (2009)

Table1.1: Sub-Saharan African stock markets (2008)

Country	Market cap% GDP	Value traded %GDP	Turnover ratio	Listed companies	Year of establishment
Botswana	26.5	1.07	3.05	19	1989
Cameroun	Na	Na	Na	2	2001
Cote d'Ivoire	30.2	1.34	4.08	38	1998
Ghana	20.4	0.90	5.19	35	1989
Kenya	35.9	4.73	11.8	53	1954
Malawi	41.4	1.40	3.92	14	1996
Mauritius	36.9	4.32	8.85	41	1988
Mozambique	Na	Na	Na	1	1999
Namibia	7.00	0.21	2.84	7	1992
Nigeria	24.04	9.63	29.30	213	1960
South Africa	177.7	145.2	60.61	425	1887
Swaziland	Na	Na	Na	7	1990
Tanzania	6.31	Na	Na	7	1998
Uganda	Na	Na	Na	6	1998
Zambia	Na	Na	Na	15	1994
Zimbabwe	Na	Na	Na	81	1896

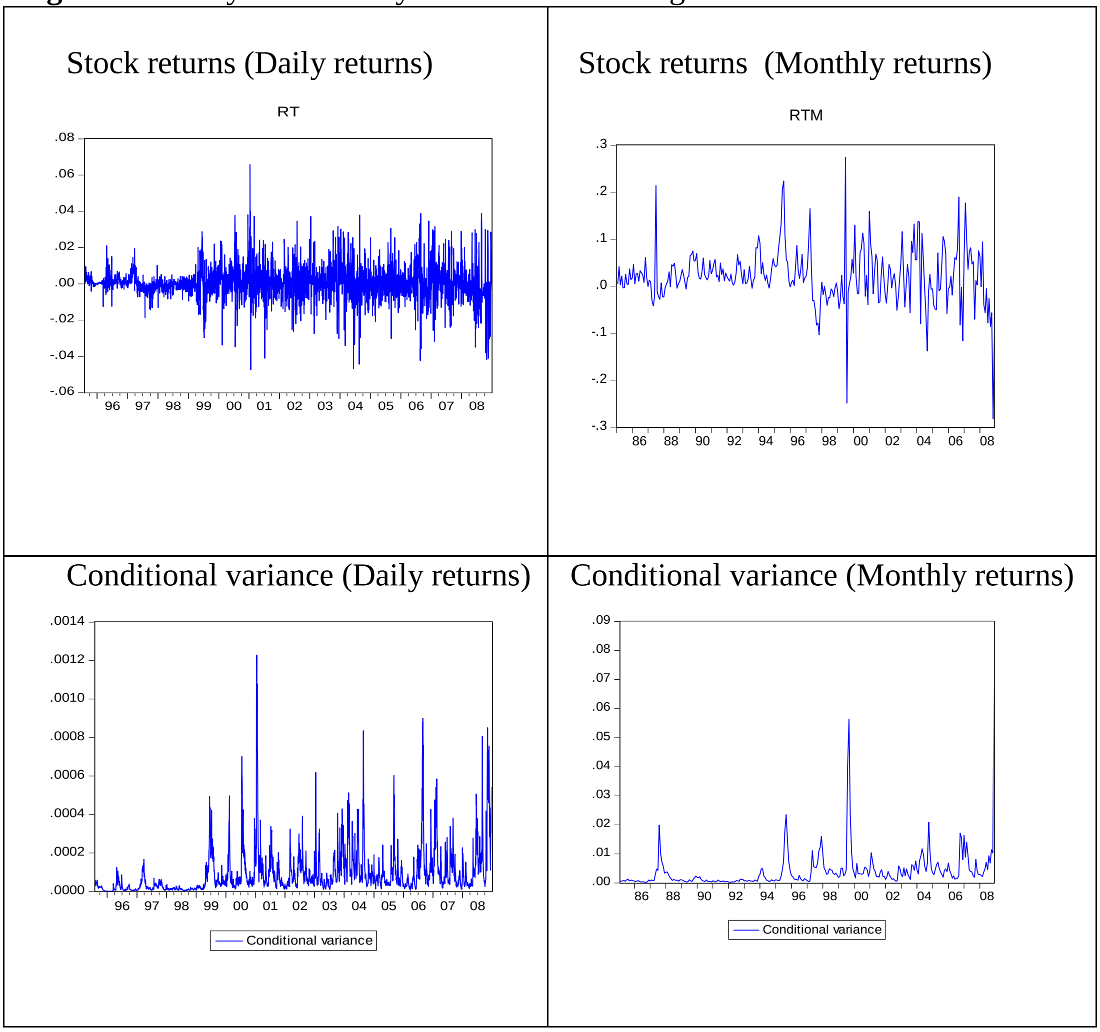
World Development Indicators (April, 2010)

Figure 1.3 Daily and monthly stock returns for South Africa



Source: Datastream International (2008)

Figure 1.4: Daily and monthly stock returns for Nigeria



Source: Datastream International (2008)

1.5 Plan of the Thesis

The thesis consists of six chapters: An introductory chapter, literature review and theoretical framework, three empirical chapters, and a concluding chapter.

Chapter one focuses on the introduction of the thesis. It comprises the general background to the study and a brief outline of the Nigerian and South African banking and stock markets. It also presents the objectives of the study, motivations for the study, and plan of the thesis. Chapter two presents the theoretical framework and empirical literature review for the three empirical chapters

Chapter three is the first empirical chapter of this thesis. It uses multivariate autoregression (VAR) to examine the long-run causality between financial development and economic growth. One important contribution of this chapter to the study of finance and growth in Sub- Saharan African is the application of a theoretical test of identifying restrictions in cointegrating vectors following Pesaran and Shin's (2002) framework. Chapter four is the second empirical chapter and it applies the Vector Error Correction Model (VECM), impulse responses and variance decomposition methods to South African quarterly data (1983q1 to 2007q4). The chapter utilises both bank and stock market variables following the theoretical model of Boyd and Smith (1998). Three types of causality tests are used to examine the relationship between financial development (represented by both bank and stock market variables) and economic growth. These are: short-run Granger causality, weak exogeneity and strong exogeneity respectively. The study also performs generalised impulse response function and variance decompositions which are analysed both at the VAR and at the cointegrated levels. Chapter five is the last empirical chapter of the thesis and it examines the effects of financial liberalisation on stock market volatility in Nigerian and South African equity markets using EGARCH models respectively. It uses both daily and monthly data for the two countries. The objective is to build a good time series model and test for the effects of financial liberalisation on stock market volatility. It applies the structural break test of Bai and Perron (2003), the ordinary least square method, and the cumulative sum of the square method, the CUSUM-type test of Inclan and Tiao (1994) and Sanso et al. (2004) respectively. One important contribution of this thesis is the consideration of the structural break tests both in the stock returns and in the conditional variance. This is a departure from previous studies that consider breaks in unconditional variance of stock return only. The study further adds the liberalisation dummy using official liberalisation dates to assess the overall effect of financial liberalisation. News Impact Curves are also estimated from the EGARCH parameters using both daily and monthly data. Chapter six summarises and concludes the main finding of the thesis, discusses the contribution of the thesis and offer suggestions for future research.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This chapter provides a review of theoretical framework and empirical literature. It essentially consists of two parts: The first part is the theoretical framework while the second part provides a review of empirical literature for the three empirical chapters of the thesis.

2.1 Theoretical Framework

2.1.1 Financial Development and Economic Growth

Schumpeter (1911) explains that a well developed financial system can facilitate technological innovation and economic growth through the provision of financial services and resources to investors who are ready to invest in new products.

The above argument of Schumpeter (1911) was later advanced as the McKinnon-Shaw (1973) hypothesis, which is a policy analysis tool for developing countries with strong recommendation for high capital accumulation and decentralised financial intermediation. McKinnon-Shaw (1973) explain that misallocation of resources, interest ceilings, poor investment and inefficiency are usually associated with the policy of financial repression that was prevalent in the 1960s and 1970s in the Less Developed Countries (LDCs). Therefore, the viable alternative is financial liberalisation which stimulates saving and investment, ultimately leading to high economic growth. The above hypothesis became formalised and popularised through the endogenous growth models of Fry (1988), Greenwood and Jovanovic (1990) and Pagano (1993). The endogenous growth model addresses some of the weaknesses associated with the

McKinnon-Shaw hypothesis especially *“the lack of explicit modelling of the link between financial and real sector variables”* (Anderson and Tarp 2003, p.192).

The Endogenous growth model

Solow (1956) presents a neoclassical growth framework based on the assumption that all prices have fully adjusted and with three factors determine the output: labour, capital and technology. As a consequence, output per worker ($y = \frac{Y}{L}$) depends only on capital per worker ($k = \frac{K}{L}$) such that:

$$\mathrm{Y} = \mathrm{A}K\ \alpha \quad 0 < \alpha < 1 \qquad (1)$$

This means that when accumulation of capital is sufficiently large enough, a change in output per worker will lead to a change in the ratio of capital per worker. The model assumes a constant return to scale and a positive but diminishing marginal productivity of capital. Given this assumption, the economy can reach a steady state (i.e. a state where both output and capital remain constant). However; in the short-run, an increase in savings rate will have a positive effect on output but this is just temporary, because eventually, a new steady state will be reached and capital and output will be at a new constant level. In the long-run, after all adjustments, total saving is used to make capital grow exactly at the same rate as population implying that both new and existing workers get the same capital: i.e. capital per worker is the same. Thus, saving only affects the level of output and not its growth rate. The implication of this for the financial sector is that in the long-run, the rate of growth of output per worker is equal to that of the labour force regardless of saving rate which means that in the long-run, financial innovations have no effect on economic growth.

The body of literature that challenges the assumption of Solow's (1956) model came to be known as the endogenous growth model[13]. The endogenous growth model assumes that both capital and output can grow indefinitely and the growth rate is not exogenously determined, but rather determined through savings and investments. They present a mechanism that generates a positive relationship between scale and productivity. Through this process, productivity growth can offset the effects of diminishing return; thereby making production function lines straight indicating that there is no steady state. Such models are often referred to as Y =AK models simply because of the assumed linear relationship between capital per worker and output.

$\mathrm{Y} = \mathrm{A}K$ where $A > 0$

Here capital is accumulated from saving such that gross investment is

$$I = sY = sAK \qquad (2)$$

Capital depreciates at a constant proportional rate δ. Consequently, capital grows at the following rate:

$$\dot{K} = sY - \delta K \qquad (3)$$

If we re-write the capital accumulation equation by dividing both sides by K

$$\delta \frac{\dot{K}}{K} = s\frac{Y}{K} - \delta \qquad (4)$$

From the production function, we know that $\frac{Y}{K} = A$

Therefore, $\frac{\dot{K}}{K} = sA - \delta$ (5)

Taking logs and derivatives of the production function, we can see that the growth rate of output is equal to the growth rate of capital and therefore

[13] For a detailed discussion on the endogenous growth theory, see Romer (1990), Mankiw (1992) and Rebelo (1991).

$$gY = \frac{\dot{Y}}{Y} sA - \delta \qquad (6)$$

In summary, the implication of endogenous growth theory is that: the growth rate is endogenous as such technological progress and population growth are not necessary to generate per capita growth. Also, the growth rate is an increasing function of the saving rate: thus any public policy measure that can raise the saving rate will raise the growth. As with the AK model, the economy does not depend upon its initial capital stock, there is no convergence between economic with different initial capital stock even if they have the same saving rate, levels of technology and depreciation.

Pagano (1993) however presents the AK production model that incorporates the role of financial intermediaries. This is because the simple AK production model did not explicitly model the impact of financial intermediaries in the growth process. It simply states that the amount of output saved by the economy is available for investment. The implication of this assumption is that the transfer of fund between the surplus unit and deficit unit is costless. However, one of the functions of the financial intermediaries is to facilitate the transfer of funds from surplus ends to deficit ends but the process is not without cost as it charges commission fees and other costs. Thus Pagano's (1993) endogenous model is specified as follows:

$$Y = AK_t A > 0, y = \frac{Y}{L} \text{ and } k = \frac{K}{L} \qquad (7)$$

By introducing the financial intermediation through the savings function, the model assumes that a fraction of saving (1-ϕ) is absorbed by financial intermediaries in the forms of fees and other charges. Therefore, only a proportion of ϕ of total saving is utilised for investment. The population is assumed to be constant (i.e. $n = 0$) and capital depreciates at the rate δ >0. Therefore, gross investment equals

$$I_t = K_{t+1} - (1 - \delta)K_t \qquad (8)$$

Capital market equilibrium requires that in a closed economy, gross saving equals gross investment.

$$I_t = \phi S_t \tag{9}$$

The growth rate of capital and output is given by:

$$G = \frac{Y_{t+1}}{Y_{t-1}} = \frac{K_{t+1}}{K_{t+1}}$$

$$G = {(I_t - \delta K_t)}\big/{K} = As\phi - \delta \tag{10}$$

Pagano (1993) therefore explains that financial development can affect growth through ϕ, *A* and *s*, where ϕ is the efficiency of financial intermediation; i.e. the proportion of saving channelled to investment. A is the social marginal productivity of capital and *s* is the private saving.

It is assumed that a proportion of saving (1-ϕ) is lost in the process of intermediation; i.e. in the process of transferring funds from surplus ends to deficit ends. It means that the higher the proportion (1-ϕ) of saving that is lost in the intermediation process, the lower will be the growth rates. The loss of saving is usually the cost of financial intermediation by banks. However, Gross (2001) observes that loss of saving could also be due to x-inefficiency or rents from market power or oligopolistic behaviour of financial intermediaries.

Another channel is the marginal productivity of capital (A). Financial intermediaries raise (A) through risk-pooling, screening of projects and effective monitoring of projects. It should however be noted that the problem of liquidity mismatch may arise because some high return projects are equally long term projects and therefore require long term commitment from investors. Savers on the other hand, prefer liquid investment which they can discharge as quickly as possible. Banks solve this mismatch problem by offering demand deposit to save and invest in a mixture of short and long term investments, thereby satisfying the demand for short term deposits and also the needs of high return investors.

Financial intermediaries can also affect growth through private savings. The overall effect of this according to Pagano (1993) is quite ambiguous. This is because of the fact that financial intermediaries could also reduce saving and eventually growth. This is true because, by allowing the diversification of risk, financial intermediaries lower the uncertainty for savers and may decide to lower their overall saving rates. Saving could also decline through the choice of financial instruments. For, example, the development of the insurance market could decrease the need for precautionary savings. Access to consumer credit and mortgages for example could also reduce the rate of saving.

It can thus be concluded from the above analysis that financial development can have a positive impact on economic growth. This is through a fraction of saving that is channelled to investment, social marginal productivity of capital and private saving. However, the saving channel is ambiguous because through diversification of risk in the credit market, it may lead to a decrease in saving rate and consequently growth rate.

Other endogenous growth models include the work of Greenwood and Jovanovic (1990), Bencivenga and Smith (1991) and Berthelemy and Varoudakis (1996). They argue that through research collection, risk pooling and analysis of information on competing technologies of production, financial intermediations can improve the flow of resources and enhance economic growth. Robinson (1952) however argues that finance does not influence economic growth; rather it is financial development that follows economic growth since expansion of the real economy means more demand for financial services and institutions. Lucas (1988, p.6) totally dismissed the positive role of financial development on economic growth; he argues that the role of the financial system in the growth process has been “badly overstressed”. Chandavarka (1992) on the other hand states that those development economists are always sceptical on the role of financial system and therefore often ignore it: *“…none of the pioneers of development economics… even list finance as a factor of development”* (p.134).

Additional variables

As explained above, the interaction between financial development and economic growth often occurs through a number of channels. According to Masih et al. (2009) there is no broad consensus on the specific number of channels but the common channels often found in the literature are investment and productivity. The investment channel is usually captured through capital stock and productivity through real interest rate. Therefore, in addition to the usual variables of real GDP and banking proxies used in the study of finance and growth, this study in line with other studies like Luintel and Khan (1999), Liang and Teng (2006), Gries et al. (2009) and Masih et al. (2009) applies multivariate VAR to the study of finance and growth in Nigeria by adding trade openness and real interest rate. It is believed that these additional variables could provide effective channels through which financial development influences economic growth.

Trade openness: This variable is added because of the important role the international trade has been playing in the economic development of Nigeria. Beck (2002) provides a formal link between international trade and financial development. His result indicates that the better the financial system of a country, the higher the shares of manufactured export/GDP. Svaleryd and Vlachos (2002) find a significant relationship between financial development and trade openness. Svaleryd and Vlachos (2005) further indicate that financial sector is a source of comparative advantage. Rajan and Zingales (2003) explain through their interest group theory of financial development that some incumbent interest groups will oppose financial development since it brings about competition. This competition will leave the incumbent groups in a weaker position as competition increases through cross border trade and financial flows. Therefore they suggest that simultaneous openness of both trade and finance promote financial development. Baltagi et al. (2009) through panel data for both developed and developing countries show that trade openness does have significant impact on financial development. On the relationship between trade openness and economic growth, empirical findings have also provided evidence that trade openness does have positive impact on economic growth. This can be found in the work of Sachs and Warner (1997), Dollar and Kraay (2004) and Freund and Bolaky (2008)

Real interest rate: McKinnon (1973) and Shaw (1973) have shown that one of the reasons behind the negative real interest rate and consequently lower growth for developing countries is their several decades of capping the nominal interest rates. Therefore, liberalising the interest rate will lead to a positive rate which in turn exerts positive effect on average productive capital leading to efficiency of investment and hence economic growth. World Bank (1989), Fry (1997), King and Levine (1993) and Beck et al. (2000) have all reveal a positive and significant relationship between average economic growth and real interest rate. However, study by (McKinnon and Pill, 1997), Hellmann et al. (2000) and Demirguc-Kunt and Detragiache, (1998a and 1998b) have argued that liberalising interest rate may lead to a weaker banking system and wide spread financial crises. Also study by Warman and Thirwall (1994) indicate a negative relationship for the Mexico; it indeed shows little evidence that real interest rate significantly affect economic growth. Also study by Demetriades et al. (1998) indicates negative relationship between real interest rate and average productive of capital for all the five countries in the sample with the exception of South Korea. India, The Philippines, Sri Lanka and Thailand all exhibit negative relationship. Liang and Teng (2006) also argue that the effect of real interest rate is ambiguous, this is because it effects on saving will depend on the relative strength of both income and substitution effects but World Bank (1989) believes that this substitution effect will always dominate the income effect in the developing countries due to positive correlation between saving and real interest rates.

From the above empirical model, we are interested in testing the following questions:

- Is there any long-run relationship between financial development and economic growth?
- What kind of effect exists between financial development and economic growth? Is it a positive or negative effect?
- Both in the short-run and the long-run, what type of causality exists between financial development and economic growth? Is it a supply-leading, a demand-following or bidirectional?

2.1.2 Stock Markets, Banks and Economic Growth

There are divergences of views when it comes to the specific role of banks and stock markets in promoting economic growth. The theoretical work of this study is based on the work of Boyd and Smith (1998) in which both banks and stock markets are considered necessary in promoting economic growth.

The role of the stock markets: Greenwood and Jovanovic (1990) presents a model in which financial intermediation and the rate of economic growth are endogenously determined. The model uses dynamic programming and explains that through research, collection and analysis of information, the flow of resources can be enhanced which leads to economic growth. Through this process financial intermediation becomes positively linked with economic growth. Bencivenga, Smith and Starr (1996), through overlapping generation models, indicate that stock market development facilitates reduction in transaction cost which helps in promoting economic growth, thus making it easy for investors and savers to frequently sell and buy their assets. Greenwood and Smith (1997) equally suggest that the stock market does play a critical role in the efficient allocation of resources which helps in promoting specialisation, reducing the cost of mobilising savings and ultimately higher economic growth. At the level of the firm, Jensen and Murphy (1990) carry out a study on the analysis of over 2000 CEOs and they indicate that stock markets enhance corporate control through reducing the principal-agent problem. Morck and Nakamura (1999) acknowledge that because of banks' inherent bias towards prudence, this tends to prevent corporate innovation and growth. Allen and Gale (2000) explain that although banks may be effective in eliminating duplication of information gathering and processing, they are not effective in gathering and processing information especially in uncertain situation involving innovative products and process.

The role of banks: Meanwhile, on the other hand, Stiglitz (1985) critically examines the activities of stock markets and banks by evaluating the behaviour of managers in relation to shareholders' funds, and he argues that stock market liquidity will not enhance incentives for acquiring information about firms or exerting corporate governance. Singh (1997) also explains that although financial liberalisation has promoted rapid expansion of stock markets in most of the leading developing economies that alone cannot lead to long-run economic growth. One of the main reasons for this is that the interaction between stock markets and credit markets in the wake of unfavourable economic shocks may exacerbate macroeconomic instability and reduce long-term growth.

The complementary role: Boyd and Smith (1998) present a framework in which both the debt and equity markets impact on the level of economic growth. They state that both debt and equity markets are considered as complements rather than substitutes in financing investment. Blackburn et al. (2005) present a model which is similar to that of Boyd and Smith (1998). Their overlapping generation models consider the joint determination of both banks and stock markets as determined by state-dependent and moral hazard conditions. In this model, there is a feedback effect from economic growth to the determination of financial structure; be it banking or stock market or a mixture of banks and stock markets. Capasso (2008) uses an optimal capital structure model to provide a link between components of stock markets and long-term economic growth. He indicates a strong relationship between stock market and economic growth with firms showing greater preference towards issuing equity than debt as capital continues to accumulate. That is: as the economy continues to grow, information costs continue to decrease as well, and so does the cost of equity relative to debt financing which promotes the development of stock market.

The theoretical framework for this study is based on the work of Boyd and Smith (1998). One important contribution of this model is the presentation of a framework in which both the debt and equity markets impact on the level of economic growth. Earlier theoretical models tend to focus either on debt (bank loans) - Greenwood and Jovanovich (1990) and Bencinvenga and Smith (1991), or equity markets – Levine (1991) and Bencinvenga and Smith and Starr (1996). They explain that both debt and equity markets are considered as complements rather than substitutes in financing investment.

In this model, investors have access to two types of technology both of which indicate stochastic constant return to scale. The first type of technology is publicly observed and yields low expected return on investment. The second type is not publicly observed and yields high expected return, but is subject to a costly state verification (CSV) problem[14]. This indicates that as the economy continues to grow, capital accumulates, leading to a relative fall in the price of capital, and this has implication for increasing the cost of monitoring. Therefore, at certain level of per capital income, the debt market is used, and beyond that level of threshold of income per capita the cost of verification of unobservable technology begins to increase. Eventually, as a result, the stock market with observable return technology comes in to use to reduce the effect of increasing the costly state verification. This implies an increase in the amount of equity finance relative to debt finance.

Boyd and Smith (1998), use an overlapping generation model for an economy that consists of two generations: old and young. During the young generation period, agents are divided into two types: borrowers and lenders. It is assumed that both of them are identical and comprise a fraction of the population - $\alpha \in (0,1)(\ 1-\alpha)$. Lenders are endowed with one unit of labour which they supplied inelastically and retire when they become old. On the other hand, borrowers are endowed with access to individual-specific, high return investment projects. The model assumes that both borrowers and lenders are risk neutral and are only concerned about their old period consumption. During the young period, income is saved and invested. It is also assumed that at each date, a single consumption good is produced at a constant return to scale with labour and capital as inputs. Therefore, final production of goods is given as: $f(K_t, L_t)$ where

[14] Costly state verification is a standard debt contract which requires a full information disclosure of an entrepreneur performance. However, such performance disclosure is subject to a monitoring cost borne by the investor. For a detailed discussion see Townsend (1979)

K_t is the capital stock at time t and L_t is the labour input at time t. It further shows that if $k_t \equiv K_t / L_t$ is the capital-labour ratio then $f(k_t) \equiv F(k_t, 1)$ is the intensive production function with assumption the $f(0) \geq 0, f'(k) > 0 f''(k)$ for all $k \geq 0$.

At each date, capital is produced using any of the three following technologies: The first is the non-stochastic linear technology under which a current output invested at time t yields r>0 of capital at time t+1. The second one is the stochastic linear technology which is for observable return on investment (φ). This technology produces output y unit of capital at $t+1$ per unit invested at time t which is assumed to be identically independently distributed across all agents and time periods. It is also assumed that $y \in \{y_1, y_2, ..., y_N\}$ and $p_n \equiv prob(y = y_n)$; therefore $0 \leq p_n \leq 1$ for all n, and $\sum p_n = 1$. Also, since technology is observable, it attracts zero cost. The third technology (ψ) is also the stochastic linear technology but for an unobservable return in investment. It produces q units of capital at time $t+1$ per unit invested at time t. Where q is identically independently distributed across all agents and time periods. Since this technology is unobservable by the investor, only by the agent, it attracts a fixed cost of $\gamma > 0$ of current consumption. It further assumes that only borrowers are endowed with access to the investment technologies (φ) and (ψ) respectively, and ownership of these investments cannot also be traded; therefore:

$$\hat{y} \equiv \sum_n p_n yn \quad (12)$$

$$\hat{q} \equiv \int_0^{\bar{w}} qg(q)dq \quad (13)$$

Where equation (1) is the expected gross return (in units of capital) on investments in observable technology (φ) and equation (2) is the expected gross return (in units of capital), in unobservable technology (ψ) excluding verification costs. It therefore assumes that: $\bar{q} > \bar{y} > r$.

When it comes to investment financing, the model assumes that borrowers obtain their funds by announcing their contract which gives details on how repayment can be made at various contingencies. It also assumes that investors do not face the problem of credit rationing as the supply of funds by lenders always matches the demand for funds by borrowers. Maintaining their symbolism, it gives us the following:

$$(1-\alpha)w(kt) \geq \alpha q \qquad (14)$$

Where $(1-\alpha)wt$ represents the amount of saving during the period at t and αq represents maximum demand for funds by borrowers. The above equation will hold only when any marginal saving is invested in the available technology and this yields r unit of capital per unit invested, and the opportunity cost of fund at time t is given as $r\rho_t + 1$.

Since the model allows investors to choose any convex combination of the two technologies, the optimal debt-equity ratio depends on the composition of its investment, verification cost and on the distribution of returns on both kinds of investment.

The hypothesis for the second empirical chapter is therefore to test for the following:

- To examine whether there exists any long-run relationship between stock market development and economic growth.
- To establish both in the short-run and in the long-run the nature of causality that exists between stock market development and economic growth for South Africa.

From the above theoretical discussion, and following Dritsaki and Dritsaki-Bargiota (2005), the model is specified as follows:

$$Y = f(SM, BCP, INV) \qquad (15)$$

Where Y represents GDP per capita, SM represents the stock market variables, market capitalisation to GDP, value of shares traded to GDP and turnover ratio to GDP. BCP is the bank credit to private sector which is a proxy for the banking system and INV is the level of investment

2.1.3 Financial Liberalisation and Stock Market Volatility

There are some theoretical models that establish the link between financial liberalisation and stock market volatility. In particular, these models show that as more and more traders join the markets, the volatility persistence tends to reduce. Prominent in this area are, amongst others, the works of Tauchen and Pitts (1983) and Andersen (1996). Their work is termed the "Mixture of Distribution Hypothesis" (MDH)[15].

Tauchen and Pitts (1983) show how price volatility and trading volume are normally distributed and jointly determined by a latent information arrival rate. Andersen (1996) modifies this model by distinguishing between informed and uninformed trading volume, with the information arrival rate determining volatility and only the informed component of trading volume.

In the above studies, the authors establish a significant reduction in the estimated measure of volatility persistence. They also observe a positive relationship between stock price volatility and trading volume.

[15] MDH states that changes in stock prices and volume are driven by the same information arrival rate to the market. In other words, the MDH simply measures the impact of news arrival on the serially correlated mixture of prices and volume of stock returns.

According to Kwan and Reyes (1997), the model of Tauchen and Pitts (1983) has implications for financial liberalisation and consequently a reduction in volatility. That is: an increase in the number of traders as a result of financial liberalisation tends to reduce equity market volatility. Liesenfield (2001) further extends the Tauchen and Pitts' (1983) model through "generalised mixture distribution hypothesis". He explains the problem with the standard mixture model of Tauchen and Pitts (1983) model, especially the assumption that sensitivity of market participants to new information is constant over time. In other words, the effect of every piece of information on stock prices and trading volume is the same. Liesenfield (2001) relaxes this assumption and allows traders' sensitivity to news items to be time-varying. He generalises the model in such a way that the latent news arrival process as well as traders' latent responsiveness to news items are allowed to be serially correlated random variables.

This study adapts this work of Liesenfield (2001) to examine the effect of liberalisation on stock market volatility. The model first reviews the standard mixture model of Tauchen and Pitts (1983) and later presents the generalised mixture distribution model. It is assumed that there are active J traders in the market and within a trading day, the market passes through a sequence of equilibria. Therefore, the movement from the $(i-1)th$ to the ith is as a result of arrival of new information to the market. At the ith equilibrium, the desired net position of the jth trader is assumed to be a linear function. $qij = \alpha[P_{ij}^{*} - p_i]$ $(j = i, 2 . . . J)$. Where α is constant, p_{ij}^{*} is the reservation price of the jth trader and pi is the current market price The equilibrium condition requires that $\sum_{j=i}^{J} qij = 0$ and this means that the market price is determined by average reservation price, and that any change in the market price is as a result of the arrival of new information given by the average of the log increment of the reservation prices $dp^*_{ij} - pi - 1, j$ This is assumed to follow a variance-component model that is common to all traders ϕ_i and specific to jth trader ψ_{ij} and is assumed to be identically independent and normally distributed. $dp^*_{ij} = \phi_i + \psi_{ij}$

Where ϕ_i ~ i.i.d. N ($(0, \sigma^2{}_\phi)$, ψ_{ij} ~ i.i.d $(0, \sigma^2{}_\psi)$ (16)

The parameters $\sigma^2{}_\phi$ and $\sigma^2{}_\psi$ measure the sensitivity of traders' reservation price with respect to new information. The variance-component has a joint distribution of the returns and trading volume that are normally distributed.

$$\sigma^2_{dp} = \sigma^2_\phi + \frac{\sigma^2_\psi}{J} \quad (17)$$

By definition, trading volume is one-half the sum of the absolute values of the changes in traders' positions. This equals $wi = (\gamma/2)\sum_j \left|dp^*_{ij} - dp_i\right|$. Assuming that wi is stochastically independent of dpi and J is normally distributed with mean and asymptotic variance express as follow:

$$\mu_w = \frac{\gamma}{2}\left(\frac{2(J-1)J}{\delta}\right)^{1/2} \sigma_\psi \text{ and } \quad \sigma^2_w = \left(\frac{\gamma}{2}\right)^2 \left(1 - \frac{2}{\delta}\right) J \sigma^2_\psi \quad (18)$$

While equations 2 and 3 indicate that both dpi and wi are increasing function of the variance of specific shocks $\sigma^2{}_\psi$, the common shocks $\sigma^2{}_\phi$ enters only the variance of dpi. Assuming the number of J traders and the variances $\sigma^2{}_\phi$ and $\sigma^2{}_\psi$ are constant over time, then the joint distribution of daily returns r_t and volume v_t are conditional on daily number of information arrivals k_t and this is presented as follows:

$$r_t | k_t \sim N(0, \sigma^2_{dp} k_t), \quad (19)$$

$$v_t | k_t \sim N(\mu_0 + \mu_w k_t, \sigma^2_w k_t), \quad (20)$$

And with $\text{cov}(r_t, \nu_t | k_{t)} = 0$ the parameter μ_0 is included to allow for a component of trading volume which is unrelated to information flow.

It is assumed that the unobservable number of information arrival is random and this means that from equations (4) and (5), the unconditional distribution of r_t and ν_t is a mixture of bivariate normal distribution with k_t as the common mixing variables. Therefore, k_t implies serial correlation in the conditional returns variance and the result of persistence in volatility is as a result of a persistent information arrival process. Autocorrelation in the information arrival process can be modelled as a Gaussian AR (1) process for the logarithm of the mixing.

$$\varphi_t = \ln(k_t) : \varphi_t | \varphi_{t-1} \sim N(\gamma_\varphi \varphi_{t-1}, \nu_\varphi^2), \qquad (21)$$

According to Liesenfield (2001), this stochastic volatility model is closely related to the EGARCH model, particularly parameter γ_φ which measures persistence in volatility.

2.1.3.1 The Generalised Model

The unobservable variances $\sigma^2{}_\phi$ and $\sigma^2{}_\psi$ of the variance-component model in the Tauchen and Pitts (1983) model can be used for additional time-varying factors. This implies that the sensitivity of traders is not constant over time and this may be due to fluctuations and uncertainty about the current and future state of the economic and political system. Therefore, these variances, $\sigma^2{}_\phi$ and $\sigma^2{}_\psi$ are directed by a common latent information random process and φ_t simply measures the fluctuations affecting these variances. The following log-linear function ensures that these variances are positive.

$$\ln(\rho_{\phi,t}^2) = \gamma\phi + \alpha_\phi \varphi_t \text{ and } \ln(\rho_{\psi,t}^2) = \gamma\psi + \alpha\psi\varphi_t \qquad (22)$$

Substituting equations (7) into equations (2) and (3) respectively, the mixture model of equations (4) and (5) now becomes:

$$r_t|\pi,\varphi_t \sim N(0,[\chi_1 e^{\phi\varphi t}+\chi_2 e^{\psi\varphi t}]e^{\lambda_t}) \tag{23}$$

$$v_t|\pi,\varphi_t \sim N(\mu_0+[\chi_3 e^{\psi\varphi t/2}]e^{\lambda t},[\chi_4 e^{\psi\varphi t}]e^{\lambda t}) \tag{24}$$

From equations (2), (3) and (7) it follows that χ_1,χ_2,χ_3 and χ_4 are positive parameters while equations (8) and (9) are random coefficients model.

As explained above, the heterogeneous volume-volatility dynamics and failure of information arrival process to account for high persistence suggest the existence of additional serially correlated factors: this is the asymmetric effect or the leverage effect. This is captured by allowing φ_t depending on the lagged value of returns r_{t-1} a situation that leads investors to react more to bad news and less to good news. However, it is also possible to introduce the leverage effect through λ_t

With this, the following specification for the latent process φ_t is as follows:

$$\varphi_t|\varphi_{t-1},r_{t-1} \sim N(0,[kr_{t-1}+\delta_\varphi\omega_{t-1},v_\varphi^2) \tag{25}$$

Both φ_t and λ_t are uncorrelated conditional on past returns, and for complete identification, Liesenfied (2001) imposes additional restriction $\varphi\phi\equiv 1$ and obtains the final version of generalised mixture model as follows:

$$r_t|\pi,\varphi_t \sim N(0,[\chi_1 e^{\varphi_t}+\chi_2 e^{\bar{\varphi}\psi\varphi t}]e^{\lambda_t}), \tag{26}$$

$$v_t|\pi,\varphi_t \sim N(\mu_0+[\chi_3 e^{\bar{\varphi}^{\psi\varphi t/2}}]e^{\lambda t},[\chi_4 e^{\bar{\varphi}^{\psi\varphi t}}]e^{\lambda t}), \tag{27}$$

$$\varphi_t|\varphi_{t-1},r_{t-1} \sim N(0,[\tilde{k}\,r_{t-1}+\delta_\varphi\omega_{t-1},\tilde{v}_\varphi^{\,2}),\ \varphi_t|\varphi_{t-1} \sim N(\gamma_\varphi\varphi_{t-1},v_\varphi^2), \tag{28}$$

Therefore, this model allows for heterogeneous volume-volatility dynamics because additional factor φ_t has an impact on the variance of returns and trading volume. Meanwhile, parameters $\tilde{K}$ and $\tilde{\varphi}_{\psi} \tilde{K}$ measure the asymmetry that is sensitive to common and specific shocks respectively.

The generalised mixture model is adopted for this particular work because it allows information arrival to be time-varying. It also makes possible the use of exponential generalised heteroskedasticity (EGARCH) model. However the generalised mixture model is slightly modified so that it can fit in to our model. We only use price volatility rather than using both price volatility and trading volume as explained by the model. In other words, we only use equity market return series for Nigeria and South Africa respectively.

Therefore, we are interested in testing the following hypothesis for the third empirical chapter:

- Has stock market volatility increased following financial liberalisation of the Nigerian and South African equity markets?

- Are structural breaks important when accounting for stock market volatility? And are these breaks associated with the financial liberalisation process?

2.2 Empirical Evidence:

2.2.1 Financial Development and Economic Growth

Most empirical investigations on finance and growth have been conducted in three major ways: First in the form of cross-country, second in the form of panel studies and third as time-series investigation. Meanwhile, results from these empirical studies are still conflicting and inconclusive. While the focus of this chapter is on time-series, attempts are made briefly to review some of the important cross-country and panel studies.

King and Levine (1993a) carry out a cross-country study with an endogenous growth model on eighty countries with data covering the period 1960-1989. The results show that financial development has a positive impact on economic growth. Meanwhile, the issue of causality could not be resolved due to the cross-country technique employed in their analysis. Khan and Senhadji (2003) use both panel and cross- sectional methodologies on 159 countries for the period 1960-1999. They conclude that financial development does have positive impact on economic growth. Beck, Levine and Loayza (2000) however use the Generalised-Method-of-Moments (GMM) technique and the overall results of their findings reveal that financial development is positively related to both per capita GDP growth and total factor productivity growth. The same results are obtained also by Levine, Loayza and Beck (2000) and Beck and Levine (2004). Favara (2003) however finds a result that contrasts with the findings of Levine, Loayza and Beck (2000) using both the instrumental-variables regression and the GMM panel estimation. His results indicate that financial development does not have significant effect on economic growth.

Christopoulos and Tsionas (2004) use panel unit root and panel cointegration techniques to examine the relationship between financial development and economic growth and results suggest that long-run causality runs from financial development to economic growth and there is no evidence of bi-directional causality. Zang and Chul Kim (2007) also carry out a panel data test to establish the direction of causality between financial development and economic growth. Their results however contradict the findings of Levine et al. (2000) by showing that economic growth leads financial development. Using a sample of fourteen countries, Luintel et al. (2008) apply time-series and dynamic heterogeneous panel methods to examine the relationship between financial structure and economic growth. The results indicate that for most countries in the sample, financial structure and financial development tend to have a strong impact on economic growth. Meanwhile, on the time-series, there is a long-run relationship between the level of output, capital stock, financial structure and financial development. Akimov et al. (2009) have established strong and robust evidence between financial development and economic growth in 27 transition economies. Through unbalanced panel data analysis, all the four measures of financial development indicate a robust and positive relationship between financial development and economic growth.

This chapter focuses on time series and some of the empirical time-series works that relate to this study are briefly reviewed below:

Earlier empirical works include: Patrick (1966), Gupta (1984), Jung (1986), McKinnon (1988) and Demetriades and Hussein (1996). Arestis and Demetriades (1997) highlight the importance of time-series over the cross-section data. They argue that cross-section regressions do not always reflect individual countries' circumstances especially in the cases of financial institutions, policy regimes and effectiveness of governance.

Through time-series data and VAR methodology Demetriades and Hussein (1996) obtain results that contrast with most of the cross-sectional studies. Most of their findings on the 16 countries studied indicate bidirectional causality between financial development and economic growth. Others even show unidirectional causality from economic growth to financial development. Calderon and Liu (2003) establish bidirectional causality between financial development and economic growth. However, in the case of developing countries, financial development contributes more to the causal relationship, while in the case of developed countries; economic growth contributes more than financial development to the causal relationship. Shan (2005) uses a VAR framework through variance decomposition and impulse response function analysis. The results show very little or weak evidence that financial development leads economic growth. Singh (2008) utilises time-series data for India and through bivariate reduced VAR model, the results obtained suggest the existence of bidirectional causality between financial development and economic growth.

Luintel and Khan (1999) argue that bivariate VAR tests *"suffer from omitted variable problems and lead to erroneous causal inferences"* (p.383) and after using the multivariate VAR tests and theoretical over-identifying restrictions on 10 countries, the results reveal a bidirectional causality between financial development and economic growth in all the sample countries studied. Moreover, Liang and Teng (2006) use similar methods for China for the period 1952-2001 but the results reveal a unidirectional causal relationship from economic growth to financial development. Ang and Mckibbin (2007) also obtain similar results for Malaysia using multivariate VAR framework. Their findings reveal that in the long-run, it is economic growth that causes financial development while in the short-run there is no causality between financial development and economic growth in all the models analysed. Chang and Caudill (2005) analyse the relationship between financial development and economic growth in Taiwan based on a multivariate VAR model. The results of their findings suggest a unidirectional causality running from financial development to economic growth. Ang (2008), through Autoregressive Distributed Lag (ARDL), examines mechanisms that provide the linkage between financial development and economic growth for Malaysia. These are: financial development, private saving, foreign direct investment, saving-investment correlation, private investment and aggregate output. The results indicate that financial development has a strong link with economic growth through qualitative and quantitative channels. Through the use of vector error correction model and variance decomposition technique, Masih et al. (2009) obtain results that contrast that of Ang (2007) for Saudi Arabia. After examining the direction of causality between financial development and economic growth in a multivariate VAR framework, their findings show a unidirectional causality from financial development to economic growth. Handa and Khan (2008) also use time series data on 13 countries. After applying VEC model the results show the existence of unidirectional causality from economic growth to financial development for Bangladesh, Sri Lanka, Brazil, Malaysia, Thailand and Turkey. Meanwhile, for Germany, Japan, India, Argentina, the UK and the USA they establish bidirectional; and no causality exists for Pakistan.

From Africa, Ghirmay (2004) examines the causal relationship between financial development and economic growth in 13 sub-Saharan African countries. He uses bivariate VAR model and the result reveals that financial development leads economic growth in eight countries while six countries depict a bidirectional causal relationship. Atindehou et al. (2005) find weak causal relationship between financial development and economic growth for all the 12 sample countries in West Africa with the exception of Mauritania which exhibits unidirectional causality from finance to growth. The paper uses time-series data for the period 1960-1997 and the estimation is based on VAR methods. Odhiambo (2007) examines the causal relationship between financial development and economic growth in three Sub-Saharan African countries. The findings reveal that in both Kenya and South Africa, the direction of causality is from economic growth to financial development while Tanzania also exhibits unidirectional causality; but this is from finance to economic growth. Abu-Badr and Abu-Qarn (2008) also obtain similar results for Egypt using annual data from1960 to 2001 and applies a multivariate VAR method. Their results reveal bidirectional causality for all the four measures of financial development employed. Wolde-Rafael (2009) applies multivariate VAR and Modified Wald test (MWALD) for Kenya. He establishes bidirectional causality between financial development and economic growth in three out of four measures of financial development used. His study uses annual data and covers the period 1966 to 2005. Gries et al. (2009) also carry out a similar multivariate VAR studies but on a wider scope covering 16 sub-Saharan African countries. Using finance, trade openness and economic growth, they establish weak causal relationship between finance and growth in most countries in the sample. However stronger evidence is established between finance and trade openness and also between trade openness and economic growth.

2.2.2 Stock Markets, Banks and Economic Growth

Since the second empirical chapter is also a time-series work, we focus our attention on the related studies. However, a brief review of some of the important cross-country and panel studies are also examined.

Levine and Zervos (1998) assess the impact of stock markets and banks on long-run economic growth using an endogenous growth model. After examining data on 47 countries over a period of 1976 to 1993, the results show that both stock markets' and banks' development are positively and significantly related with economic growth and both are good predictors of economic growth, capital accumulation, and productivity growth. Levine and Zervos (1996) using two sample periods 1976-1985 and 1986-1993 in their cross-country regression on 41 countries to show that stock market development promotes long-run economic growth. Demirguc-Kunt and Maksimovic (1996) evaluate the impact of stock market development on firms' level by comparing the choice of capital structure of firms and financial market development using a sample of 30 countries for the period 1980-1991. The overall results show that initial stock market development tends to produce a higher debt-equity ratio particularly for firms and thus more business for banks. Rousseau and Wachtel (2000) use panel vector autoregression with generalised method of moment technique to examine simultaneously the relationship between stock markets, banks and economic growth. After examining the relationship between 47 countries using annual data from 1980-1995, their results indicate that both banks and stock markets promote economic growth. Beck and Levine (2004) also obtain similar results after using a dynamic panel data set on 40 countries. Their results show that after controlling for simultaneity and omitted variables bias; both stock market and financial development enter all of the system panel growth regression significantly.

Arestis et al. (2001) examine the relationship between stock market development and economic growth through quarterly time-series data for five developed economies while controlling for the effect of banking system and market volatility. These countries are: the USA, the UK, France, Germany, and Japan. The period covered 1968-1998 although the data span is different for different countries in the sample. The results reveal that in Germany, there is evidence of bidirectional causality between banking system development and economic growth. The stock market on the other hand is weakly exogenous to the level of output. In the USA, financial development does not cause real GDP in the long-run. Japan exhibits bidirectional causality between both banking and stock market variables and the real GDP, while in the UK the results indicate evidence of unidirectional causality from banking system to stock market development in the long-run, but the causality between financial development and economic growth in the long-run is very weak. The evidence in France suggests that in the long-run both the stock market and banking system contribute to real GDP but the contribution of the banking system is much stronger.

Capasso (2006) uses a sample of 24 advanced OECD and some emerging economies to investigate the link between stock market development and economic growth covering the period 1988-2002. The findings show a strong and positive correlation between stock market development and economic growth and he later concludes that stock markets tend to emerge and develop only when economies reach a reasonable size and with high level of capital accumulation. Carporale et al. (2004) examine the causal relationship between stock market and economic growth. Through vector autoregression (VAR) methodology, the paper uses a sample of seven countries, Argentina, Chile, Greece, Korea, Malaysia, the Philippines and Portugal. The overall results indicate that a well developed stock market can foster long-run economic growth. Carporale et al. (2005) in another study use the vector autoregression (VAR) framework to test the endogenous growth hypothesis for four countries: Chile, South Korea, Malaysia and the Philippines. The overall findings indicate that the causality between stock market components, investment and economic growth is significant and is in line with the endogenous growth model. It shows also that the level of investment is the channel through which stock markets enhance economic growth in the long-run.

Dritsaki and Dritsaki-Bargiota (2005) use a trivariate VAR model to examine the causal relationship between stock, credit market and economic growth for Greece. Through monthly data covering the period 1988:1-2002:12, their results reveal unidirectional causality from economic development to stock market and bidirectional causality between economic developments and the banking sector. The paper establishes no causal relationship between stock market function and banking sector.

Enisan and Olufisayo (2009) through autoregressive distributed lag (ARDL), evaluate the long-run relationship between stock market development and economic growth in seven of the Sub-Saharan African countries. The results indicate that stock market has a positive and significant impact on growth. Causality results indicate unidirectional causality from stock market development to economic growth for both South Africa and Egypt. While Cote D'Ivoire, Kenya, Morocco and Zimbabwe indicate bidirectional causality, Nigeria on the other hand shows weak evidence that growth causes finance.

2.2.3 Financial Liberalisation and Market Volatility

In this sub-section, our empirical literature review briefly focuses on two areas: First is the empirical literature that uses the GARCH models to examine the effect of stock market volatility and financial liberalisation. The second part focuses on the literature that account for structural breaks in the conditional variance using GARCH models. While the first part is related to the first hypothesis, the second part is related to the second hypothesis of the third empirical chapter.

Desantis and Imrohoroglu (1997) employ GARCH model to examine the impact of financial liberalisation on emerging markets using weekly stock return from the last week of December 1988 to the second week of May 1996. The sample is divided into three geographical regions: European/Mid-east, Asia and Latin America, and they later extend their study to include mature markets, Japan, Germany, the UK and the USA. Their results indicate that the level of volatility in emerging markets is much higher than that of mature financial markets. It however shows that volatility decreases following financial liberalisation.

Kim and Singal (2000) assess the benefits and risks associated with stock market liberalisation. They use ARCH and GARCH models to estimate stock returns volatility for 20 emerging markets. After estimating changes in the level and volatility of returns, inflation and exchange rates, their findings reveal that stock market returns increase immediately after market liberalisation but there is no accompanying increase in volatility. Therefore, they conclude that stock market liberalisation leads to efficient markets and low volatility.

Kassimatis (2002) employs EGARCH model to examine stock market volatility before and after a financial liberalisation programme in six emerging markets: Argentina, India, Pakistan, the Philippines, South Korea and Taiwan. The sample period covers 1988-1998 except for South Korea and Pakistan where it ends in 1997. The evidence shows that stock market volatility decreases after capital market liberalisation, thereby supporting the financial liberalisation hypothesis that stock market volatility declines following liberalisation. However Edwards et al. (2003) obtain a contrasting result after using ARCH, GARCH and EGARCH models to estimate volatility on monthly stock returns for Argentina, Brazil, Chile, Mexico and South Korea. They employ nonparametric approach to examine the key characteristics of market cycles. In order to account for differences induced by financial liberalisation they divide the sample size into two sub-periods: 1975-1989 (bull-phase) and 1990-2001 (bear-period). They also examine other key characteristics: duration, amplitude, and volatility. Their results reveal that the while the bull period is shorter, the bear phases are longer. The amplitude and volatility of both phases in emerging markets are higher than in developed markets. Therefore, financial liberalisation leads to higher volatility in Latin American and Asian economies. Jayasuriya (2005) uses a number of GARCH models to examine financial liberalisation and stock market volatility on 18 emerging stock markets. The results from the findings show that volatility may increase or decrease or even remain unchanged after a financial liberalisation programme. Huang and Yang (2000) also obtain similar results after employing daily stock returns data for ten emerging markets, South Korea, Malaysia, the Philippines, Thailand, Taiwan, Turkey, Argentina, Brazil, Chile and Mexico. The sample period ranges from 5 January 1988 to

2 April 1998. The objective of the study is to examine the effect of stock market liberalisation on market volatility. After applying ARCH model, they establish mixed results with South Korea, Mexico and Turkey exhibiting high volatility following financial liberalisation. Argentina, Chile, Malaysia and the Philippines show a decrease in volatility following financial liberalisation. Taiwan, Thailand, and Brazil exhibit no definitive pattern after liberalisation. These results have shown that the effect of financial liberalisation on market volatility depends on each country's economic characteristics.

Recent empirical works have tested for structural breaks in the conditional volatility to ascertain whether exclusion of structural shifts tend to exaggerate the volatility persistence after financial liberalisation.

Aggarwal et al. (1999) examine the changes in volatility in emerging markets and also developed markets. Countries in the sample are: the USA, the UK, Japan, Germany, Hong Kong, Singapore, Argentina, Brazil, Chile, India, Korea, Malaysia, Mexico, the Philippines, Taiwan, and Thailand. The data cover a ten year period from May 1985 to April 1995. After using an iterated cumulative sums of squares (ICSS) algorithm tests to identify structural break points, they find that high volatility is associated with several shifts. They examine these shifts in volatility using global and local events during the period of high volatility. The results indicate that most of the events are local rather than global and also show that changes in variance are not constant across the countries; rather this varies from one country to another and it may also depend on the frequency of data.

Cunado et al. (2006) seek to examine whether the dynamic behaviour of stock market volatility in six emerging markets has changed following financial liberalisation. In particular, they examine whether structural breaks are important when accounting for stock market volatility and whether these breaks are associated with the financial liberalisation process. Countries in the sample are: Argentina, Brazil, Chile, Korea Mexico and Thailand. The study applies monthly data from 1976:1 to 2004:12 and after using GARCH (1, 1) model and endogenous structural break tests, the authors conclude that following financial liberalisation the level of volatility has generally reduced for the six emerging markets.

Nguyen (2008) uses a sample of seven emerging market economies (Argentina, Brazil, Chile, Columbia, Malaysia, Mexico and Thailand) to test for structural breaks in the conditional volatility for pre-liberalisation and post-liberalisation periods. His results tend to support Aggarwal (1999). He uses GARCH (1,1) model to estimate market volatility, and after applying the endogenous structural break technique of Bai and Perron (1998, 2003), the results indicate that none of the estimated break dates in the conditional volatility indices are directly linked to the official liberalisation dates.

Wang and Theobald (2008) investigate the regime-switching behaviour of six Asian emerging stock markets - Indonesia, Korea, Malaysia, the Philippines, Taiwan and Thailand - for the period 1971-2004. The objective of the study is to examine the volatility changes around the financial liberalisation dates for stock markets returns in six Asian stock markets. The overall result shows strong evidence of regime-switching behaviour. It indicates that Malaysia, the Philippines and Taiwan are characterised by two regime changes, while Indonesia, Korea and Thailand are characterised by three regime changes. They conclude that the impact of financial liberalisation depends on each country's features and particular situation. They find that Indonesia, Korea and Thailand shows evidence of vulnerability to foreign investment following financial liberalisation while Malaysia, the Philippines and Taiwan are not affected by financial liberalisation.

Diamandis (2008) uses weekly stock returns for the period January 1988 to July 2006 to analyse the impact of financial liberalisation on stock market volatility for four emerging markets (Argentina, Brazil, Chile and Mexico) and the USA The paper uses two different methodologies. The first is the dynamic conditional correlation (DCC) to examine the conditional short-term relationship between the four Latin America economies and the US markets. The second method applies the Markov switching ARCH-L (SWARCH-L) technique to investigate the existence of structural breaks in volatility of these markets during the period of financial liberalisation. The findings show that the conditional correlation coefficients are relatively low for the majority of bivariate cases which indicate evidence of contagion. SWARCH-L on the other hand indicates that there are episodes of high volatility for all markets after financial liberalisation.

Eizaguirre et al. (2009) consider both structural breaks and outliers on market volatility for eight emerging markets for the period 1976-2002. The results indicate that on average, volatility tends to reduce after financial liberalisation. Outliers occur around financial liberalisation and are mainly associated with local events. Although global events seem to affect all eight countries in the sample, this is temporary and does not bring about any structural changes in these economies.

CHAPTER 3

FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH: EVIDENCE FROM NIGERIA

3.1 Introduction

The objective of this empirical chapter is to examine the long-run causality between financial development and economic growth. Given the unresolved conclusions on the nature of causality in the time-series studies, this study applies the recent long-run structural modelling of Pesaran and Shin (2002) and also uses the Wald test to examine Vector-error correction (VECM) based short run Granger causality. Gries et al. (2009) uses multivariate vector autoregression to examine the relationship between financial development and economic growth. Their work controls for trade openness for the 16 Sub-Saharan Africa countries including Nigeria. Although both studies are based on multivariate VAR and applies principal component analysis (CPA), this study however departs from this and other earlier works in Nigeria and thereby contributes to the knowledge in the following ways:

1. The study applies a new data set with a longer period of observation (1961-2007) and also controls for the real interest rate in the VAR system, which may help in minimising the problem of omitted variables.
2. This study applies the long-run structural modeling of Pesaran and Shin (2002). This allows us to use economic theories to motivate the long-run relationship between financial development, economic growth, and other determinants of growth. It helps to correct for Johansen (1988, 1992) and other conventional cointegration tests which are *atheoretical* in nature; that is, they impose

restrictions arbitrarily based on the scale of data rather than the use of economic theory.

3. This study also uses the variance decomposition (VDC) and impulse response functions (IRF). The VDC easily captures the relative degree of exogeneity and endogeneity of the variables in the VAR system. While IRF captures the general dynamic of the responses to the shocks in the system.
4. Gries et al. (2009) applies only Philip-perron unit root test while several works by Perron (1989, 1998), Zivot and Andrews (1992), Gregory (1994), and Volgelsang and Perron (1998) have shown that both augmented Dickey Fuller (ADF) and Philip-Perron (PP) exhibit high size distortion: that is, a probability of accepting a false null and also incorrect probability of rejecting a true null. To avoid these problems and to allow for robustness, this study uses four unit root tests. (ADF, PP, D-F GLS, and KPSS). In addition to these tests, Zivot and Andrew endogenous structural break test is used, which further confirms whether a consistency could be established with the conventional unit root tests. The economic and political events surrounding the break points are also briefly explained.

The study however uses three models based on the three indicators of financial development employed. Model (A) uses financial development index (DEPTH), Model (B) and (C) apply bank credit to the private sector (BCP) and bank liquid liabilities (LL) respectively. Other variables included in the models are: real GDP per capita (GDP), real interest rate (RR), and trade openness (TOP).

The study establishes significant long-run relationship between GDP per capita, real interest rate, trade openness, and financial development. The results from the long-run causality tests indicate unidirectional causality from economic growth to financial development using bank credit to private sector (BCP) while the liquid liabilities (LL), reveals bidirectional causality between financial development and economic growth. There is no short-run causality between financial development and economic growth using bank credit to private sector. However, using liquid liabilities, there is short-run causality running from finance to growth. Therefore, with liquid liabilities, the result is consistent with Gries et al. (2009) but with bank credit to private sector, it is unidirectional causality from economic growth to financial development. Also with the new data set, the study could not establish any cointegration using financial development index, which is in contrast to the Gries et al. (2009) finding of one cointegrating vector. This is an indication that although financial development index may reduce the problem of multicollinearity, it may still not be a perfect measure of financial development. Following this introduction, the study is organised as follows: Section 2 discusses the empirical model, measurement and sources of data. Section 3 provides the empirical results of the study. Section 4 concludes the study.

3.2 Empirical Model

3.2.1 Multivariate Cointegration

Before conducting the multivariate vector autoregressive tests, it is necessary to establish the order of integration of individual series and to achieve this; four unit root tests are performed: Augmented Dickey-Fuller (ADF), Detrended Dickey-Fuller (DF-GLS), Phillip-Peron (PP) and the KPSS test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992). In addition to this, a structural break test for unit root is also performed.[16]

[16] I would to thank Junsoo Lee for providing the gauss code for the Zivot and Andrew's (1992) test. It can be downloaded at: www.cba.ua.edu/~jlee

Studies carried out by Perron (1989, 1998), Zivot and Andrews (1992) and Volgelsang and Perron (1998) have shown that long period data are susceptible to structural breaks and their presence if ignored may bias the standard ADF test towards non rejection of the null hypothesis of a unit root. Perron (1989) developed a procedure for testing the hypothesis that a given series (Y) occurs at time TB (i.e. break point) with the assumption that the break dates are exogenously determined. Zivot and Andrews (1992) however, develop an alternative and superior model that allows a unit root test with endogenous structural break. This study adopts Zivot and Andrew's (1992) model to carry out the break test.

Model A: $y_t = \mu^A + \theta^A DU_t + \beta^A t + \alpha^A y_{t-1} + \sum_{j=1}^{k} cj\Delta y_{t-j} + \varepsilon_t$

Model B: $y_t = \mu^B + \beta^B t + \gamma^B DT_t^* + \alpha^B y_{t-1} + \sum_{j=1}^{k} cj\Delta y_{t-j} + \varepsilon_t$

Model C: $y_t = \mu^c + \theta^C DU_t + \beta^C t + \gamma^C DT_t^* + \alpha^C y_{t-1} + \sum_{j=1}^{k} cj\Delta y_{t-j} + \varepsilon_t$ (1)

Model A allows a change in the level of individual series; Model B allows a change in the slope of the series or in the trend function, and finally Model C allows both changes in the level and in the slope of the trend function of the time series.

Meanwhile, DU_t and DT_t^* represent the dummy variables for both at level and the slope respectively. $DU_t = 1 \text{ if } t > T_B; 0$ otherwise; $DT_t^* = t - T_B \text{ if } t > T_B, 0$ otherwise and K is the optimal lag. The above equation is estimated sequentially over all possible break dates within the sample and calculates the minimum t-statistics for the estimated coefficients. That is, the selected break point is that value of T_B at which t-statistics is minimised. Through this process the null hypothesis of a unit root against the alternative hypothesis of a trend stationary with a one- time break (TB) in the intercept and the slope is established. If Y_{t-1} is significantly different from zero we reject the null hypothesis of a unit root.

Having established the order of integration, the next thing is to use Johansen's (1988, 1992) procedure of maximum likelihood to determine the number of cointegrating vectors.

Consider the following level vector autoregression, VAR of order P[17]

$$Z_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + ... + \phi_{p-1} Y_{t-p+1} + \phi_p Y_{t-p} + \varepsilon_t \quad (2)$$

The model specified in (2) can be reparameterised as a vector error correction model (VECM)

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + ... + \Gamma_{p-1} \Delta Z_{t-p+1} + \Pi Z_{t-1} + \varepsilon_t \quad (3)$$

Where Z_t = (GDP, FD, RR, TOP) is 4×1 vector of the first- order integrated variables, Γ are 4×4 coefficient matrices, and ε_t is a vector of disturbances or white noise residuals. GDP represents the GDP per capita; FD is financial development which in this study is represented by bank credit to the private sector (BCP), domestic credit to private sector (DCP), and bank deposit liabilities (LL) respectively. On the other hand, RR is the real interest rate and TOP is the trade openness. All these variables are in logarithm form except the interest rate. The maximum likelihood procedure of Johansen (1988, 1992) can be used to identify the existence of cointegrating vector in the VAR framework. The rank (r) of the matrix determines the number of cointegrating vectors in the system. If all the elements Z_t are stationary, then Π is a full rank m $\times$m matrix. However, if all the elements of Z_t are I (1) but not cointegrated, Π is said to be of rank zero and if all the elements of Z_t are I (1) and cointegrated with rank (Π) = r,

[17] Patterson (2000, p.600) explains that VAR is linear model of multivariate relationship which is an extension of autoregressive univariate model. A VAR is not only related to its own lagged values but also lagged values of other variables in the same model. He further explains that a VAR has two dimensions: the order p or the longest lag length and number k variables being jointly modelled.

this implies that Π is rank deficient and there exist $m \times r$ matrices α and β rank r such that $\Pi = \alpha\beta'$ where the α matrix contains the error adjustment coefficients to the long-run equilibrium and the β matrix on the other hand, contains distinct cointegrating vector.[18] The Π rank is $(0 < r < 4)$ cointegrating vectors with $\alpha\,(4 \times r)$ and $\beta\,(4 \times r)$ respectively. Given this, equation (3) can be represented as:

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + --- + \Gamma_{p-1} \Delta Z_{t-p+1} + \alpha(\beta' Z_{t-1}) + \varepsilon_t \qquad (4)$$

Where $\beta' Z_{t-1}$ is the linear stationary process of cointegration relations indicating that all the variables in the VAR system are stationary.

According to Pesaran and Shin (2002), from the VAR model specified above in equations 2-4, some identification problems arise because without additional information, matrices α and β cannot be uniquely identified from the data alone and this means that for any $r \times r$ non-singular matrix G, we can define matrices $\alpha^* = \alpha G$ and $\beta^* = G^{-1}\beta'$ such that:

$$\Pi = \alpha^* \beta^{*'} = \alpha\, G G^{-1} \beta' = \alpha\beta' \qquad (5)$$

Equation (4) gives us the same value because β' does not provide any information with which to identify the short-run dynamics. Pesaran and Shin (2002)[19] therefore have developed a model of identification and explain that the common approach of imposing the r^2 in the Johansen statistical approach of just-identified

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[18] The two types of likelihood tests proposed by Johansen (1988) are the trace test and maximum eigenvalue tests. The two are specified as follows: trace test; $\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$ maximum eigenvalue test: $\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1})$ According to Lutkepolh et al. (2001) maximum eigenvalue and trace tests for cointegration are all likelihood ratio tests but they operate under different assumptions regarding the deterministic part of the data generation process.

[19]Pesaran and Shin (2002) explain that the Johansen cointegrating framework always gives rise to two identification problems: the first one is the traditional identification of the contemporaneous coefficients and the second one is the long-run identification of β coefficients which usually occurs when all variables are I (1).

restriction in the multiple cointegrating vectors is inadequate. This approach according to them does not convey any economic meaning since it is designed for "mathematical convenience". They establish, based on economic theory, a set of formal conditions for identification through the test of $r^2 + k$ (where $k \geq 1$) restrictions, where r^2 is the just-identifying restriction and k is used for the over-identifying restriction. If $K < r^2$, the model is under-identified, if $K = r^2$, the model is exact or just-identified and if $K > r^2$, then the model is over-identified. Each vector must have at least r restrictions and one of them should be normalisation restriction and such restrictions must be motivated by economic theory in such a way that the identified (restricted) cointegrating vectors are now interpreted as long-run economic relationship. However, when only one cointegration is established we simply use a normalisation restriction. Therefore, recent development emphasises the use of economic theory as a guide in searching for long-run exact and over-identifying restrictions (Pesaran and Shin 2002).

Meanwhile, Wickens (1996) points out that for the restrictions to be meaningful, the adjustment coefficients must be statistically significant and their signs must be negative.

After identifying cointegrating vectors, the next stage is to test for causality between financial development and economic growth. A test of zero restriction (i.e. α =0) is a test of weak exogeneity,[20] (Johansen and Julius, 1992) and, as shown by Hall and Milne (1994),[21] weak exogeneity in a cointegrated system is a notion of long-run causality. If the null hypothesis $\alpha_{11} = 0$ is rejected, then the economic growth vector

[20] According to Enders (2004 p.368) a weak exogeneity is simply a variable in a cointegrated system that does not respond to discrepancy arising from long-run relationship. In other words, a variable is weakly exogenous if the coefficient of the speed of adjustment is zero i.e. $\alpha_i = 0.$ and this indicates that there is no feedback response from the system.

[21] Hall and Wickens (1993) and Hall and Milne (1994) have shown that the long-run causality is more efficient in that it does not require two-steps procedure of estimating the cointegration relationship and the test of non- causality in ECM framework. According to Luintel and Khan (1999), the long-run causality is slightly different from the normal Granger causality in that it does not take into account the short-run dynamics.

represented by GDP is not weakly exogenous to the financial development vector and this means that financial development may cause economic growth in the long-run. If on the other hand the null hypothesis $\alpha_{21} = 0$ is rejected, then the financial development vector is not weakly exogenous to economic growth, indicating that economic growth may cause financial development. However, rejection of the null $\alpha_{11} = 0 \Omega \ \alpha_{21} = 0$ means there is a bidirectional causal relationship between financial development and economic growth in the long-run. The study also examines the VECM based short-run Granger causality using the Wald test.

This study further examines variance decomposition (VDC) and the impulse response function (IRF). Variance decomposition or forecast error-variance examines the percentage of innovation each variable is contributing to the other variables in the VAR system. This enables us to know which of the variables is relatively endogenous or exogenous to the system by simply decomposing the proportion variance due to its own shock and shock of other variables in the system. For example, if the shocks of other independent variables in the system explain less of the forecast error-variance of the dependent variable, it means that the dependent variable is exogenous to the system. However, if it turns out that most of the shocks of the independent variables explain the forecast error-variance of the dependent variable, it means the later is endogenous to the system.

The impulse response function is used to trace the time path of structural shocks in the VAR system. One of the common methods used to examine the time path of the shock is the Sims (1980) framework of cholesky decomposition. This approach however has been criticised on the grounds that it is quite sensitive to the ordering of the variables in the system. This is because it is not unique as errors in the system are orthogonal to each other, indicating that they are contemporaneously uncorrelated with standard errors. To solve this problem, the study adopts the Generalised impulse response function (GIRF) of Pesaran and Shin (1998). This method is invariant to the ordering of the variables in the VAR system. The approach is unique since it shows that structural errors are correlated and therefore a unit shock to one error affects other errors in the system.

3.2 Measurement and Data Sources

As already indicated, this study attempts to establish the causal relationship between financial development and economic growth in Nigeria. It employs annual data from 1961-2007 (47years) for all the variables used. These are: Gross Domestic Product per capita (GDP), real interest rate (RR), trade ratio (TOP), and financial development represented by bank credit to the private sector (BCP), domestic credit to the private sector (DCP) and liquid liabilities (LL). All the data series are transformed into logarithms except for real interest rate and these data are obtained from the Financial Development and Structure Database of Beck, Demirguc-Kunt, and Levine (2009), The Penn World Table, version 6.3 compiled by Heston, Summers and Aten (2009) and Central Bank of Nigeria statistical bulletin (2009)

Financial development encompasses quality and quantity of investment, exchanges of goods and services, saving mobilisation, and management of risk. These functions cannot be captured by a single measurement. Also at the moment there is no broad consensus as to which of the proxies is the best measurement of financial development. Therefore, the essence of using three financial indicators is to allow for robustness test; so as to confirm whether a consistent result could be obtained using different proxies.

The first measure of financial development used in this study is the bank credit to the private sector (BCP). It is measured as bank credit to private sector divided by

GDP. This proxy according to Beck et al. (2000) is superior to other measures of financial development because it excludes credit to the public sector and better reflects the extent of efficient resources allocation. It is based on the assumption that private sector are more productive than the public sector when it comes to the utilisation of funds.[22] The second measure of financial development used in this study is domestic credit to the private sector (DCP). This includes both credits of deposit money banks and other financial institutions. The third measure is the liquid liabilities (LL). This measurement of financial deepening is usually represented by M2 or M3. It has been used for example by the World Bank (1989), Levine and King (1993a and 1993b) and Calderon and Liu (2003). This measurement has been widely criticised by Demetriades and Hussein (1996), Luintel and Khan (1999) and Liang and Teng (2006). They observe that the proxy of financial development through the ratio of broad money (M2) nominal GDP is simply the measure of the extent to which financial transaction are monetised rather than the function of the financial system such as saving mobilisation and efficient allocation of resources as presented in the theoretical models. Ang and McKibbin (2007) explain that there is no broad consensus among economists as to which of the proxies of financial development is the best measurement and more so these proxies are highly correlated. Therefore, it may be necessary to construct an index through the principal component analysis (PCA) in order to reduce the effect of multicollinearity. This study adopts this approach of Ang and McKibbin (2007) to construct the financial development index through the PCA using the three financial development proxies: bank credit to private sector, domestic credit and liquid liabilities respectively. Other measures include the real interest rate (RR) which is measured by the bank lending rate

[22] Both Beck et al. (2000) and Levine et al. (2000) have indicated that it is better to use bank credit to private sector as a proxy of financial indicator since it excludes credit to public sector.

deflated by the CPI and the trade openness (TOP) measured as a ratio of import plus export divided by nominal GDP.[23]

Table 3.1 below presents the result of the principal component analysis. It shows the index of financial development from the proxies of financial indicators, bank credit to private sector, domestic credit to private sector and liquid liabilities. The first eigenvalue indicates that 93.8% of variation is captured by the first principal component while the second principal component explains 5.4% of the total variation. The third principal component accounts for only 0.7% of the total variation. From the table, it shows that the first principal component is the best measure of the index since it captures about 94% of the information from these proxies. It also shows the first vector with almost equal weight, indicating a similar pattern. For this reason, we use the first principal component, PC1.

Table 3.1: Principal Component Analysis for Financial development index

	PC1	PC2	PC3
Eigenvalues	2.815	0.163	0.022
Proportion %	0.938	0.054	0.007
Cumulative %	0.938	0.993	1.000
Variable	Vector 1	Vector 2	Vector 3
BCP	0.580	-0.156	0.630
DCP	0.589	-0.269	-0.762
LL	0.563	0.813	0.147

3.3 Empirical Results

To evaluate the empirical relationship between financial development and economic growth in Nigeria, the study starts with a unit root test which is a necessary condition for cointegration analysis. After the unit roots test, the second step is the cointegration test using the maximum likelihood procedure of Johansen (1988) and

[23] International trade as a factor has been widely used by many researchers in their studies on financial development and economic growth relationship among which include: Beck, (2002), Beck and Levine (2004), Shan (2005), Chang (2002), and Levine (1993, 1997).

Johansen and Juselius (1992). Meanwhile, theoretical and economically meaningful cointegrating vectors are identified through a test of identifying restriction framework of Pesaran and Shin (2002). Finally, long-run causality between financial development, economic growth and other determinants of growth are tested following the Hall and Milne (1994) weak exogeneity test. The short-run Granger causality tests are also examined through the Wald test.

3.3.1 Unit Root Test

In order to determine the order of integration of the variables, five unit root tests are applied. These are the Augmented Dickey-Fuller (ADF), the Detrended Dickey-Fuller (DF-GLS), the Phillip-Peron (PP), the KPSS test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992) and the Zivot and Andrews' structural break test. It has been generally noted that the ADF and PP tests have problems of lower power in rejecting the null of a unit root as shown in the work of Luintel and Khan (1999) and Liang and Teng (2006). The DF-GLS and KPSS are found to have very large powers over the conventional unit root test; as such they are used to serve as complementary to the results of ADF and PP tests.[24]

The results from tables 3.2 and 3.3 respectively reveal that financial development represented by BCP, DCP and LL are level non-stationary and stationary after first difference. Also, other variables GDP, RR and TOP support the presence of a unit root at the level and absence of any unit root after first difference except for GDP and RR which are I (0) based on the KPSS tests. Meanwhile, since three out of four unit roots tests for GDP and RR indicate I (1) series, it is thus concluded that all variables are I (1) series.

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[24] Liang and Teng (2006) have shown that the KPSS test generally has greater power than other unit root tests.

The Zivot and Andrews (1992) minimum t-test statistics of one-time structural break test is presented in table 3.4. The evidence from the table suggests the non rejection of the null of a unit root hypothesis. The results are consistent with the ADF, DF-GLS, PP, and KPSS respectively which show that all the variables are I (1) series. For all the variables, model C is the most appropriate model except for bank credit and real interest rate where model A is the appropriate model. The plausible break dates for the series occur in 1985 for LL and RR, 1986 for both BCP and DEPTH respectively while 1987 for DCP. 1995 is the break date for GDP and 1999 is for TOP. Some of the important events surrounding the periods are briefly discussed below:

1985: This is the year of continued interest rate ceiling, exchange rate control and Government ownership of banks. 1986: This period coincided with the introduction of World Bank/IMF-sponsored Structural Adjustment Programme (SAP). Its basic features include restructuring and diversifying the productive base of the economy in order to lessen the dependence on the oil sector; achieving fiscal and balance of payment viability; privatisation of public enterprises, and adoption of a realistic exchange rate policy coupled with the liberalisation of the external trade and payment system. 1987: This period marked the beginning of financial liberalisation policy in Nigeria with the deregulation of the interest rate in 1987. Also in this year, conditions for the licensing of new banks were relaxed, a situation that led to a phenomenal increase in the number of banks from 26 in 1980 to 120 in 1993. 1999: This period was characterised by political activities especially the new democratic government after several years of military rule. 1995: The Federal Government liberalised the capital market with the abrogation of Laws that prevent foreign investors from participating in the domestic capital market.

Table3.2: Unit root test: Level

variable	ADF	PP	DF-GLS	KPSS
BCP	-1.627	-1.124	-1.659	0.656*
DCP	-1.626	-1.093	-1.658	0.605*
LL	-2.005	-1.711	-2.071	0.384*
GDP	-1.292	-1.442	-0.777	0.215
TOP	-2.409	-1.399	-2.299	0.424**
RR	-2.092	-3.576**	-1.958	0.152
DEPTH	-1.801	-1.324	1.869	0.414*

*, and **, imply 1%, and 5% levels of significance respectively.

Table 3.3: Unit root test: First Difference

variable	ADF	PP	DF-GLS	KPSS
BCP	-5.787*	-5.341*	-5.686*	0.070
DCP	-5.965*	-5.510*	-5.904*	0.073
LL	-6.572*	-6.584*	-6.568*	0.080
GDP	-3.969*	-4.012*	-3.856*	0.091*
TOP	-7.514*	-7.332*	-7.585*	0.109
RR	-7.233	-7.283	-12.78	0.432
DEPTH	-6.189*	-5.883*	-6.136*	0.072

*, and ** imply 1%, and 5% levels of significance respectively.

Table 3.4: Zivot-Andrews unit root tests for one break

Variable	Model	Break date	$t(\hat{\lambda}_{\inf})$	k (lags)
GDP	C	1995	-3.996	3
BCP	A	1986	-4.304	2
DCP	C	1987	-3.072	5
LL	C	1985	-3.609	0
DEPTH	C	1986	-3.353	1
RR	A	1985	-3.525	0
TOP	C	1999	-3.376	3

Critical values are for model A and B are taken from Zivot-Andrews (1992). The 10% and 5% critical values for model A are -4.58 and -4.80 while that of model C are -4.82 and -5.08, respectively.

3.3.2 Johansen Cointegration Test

The table 3.5 presents the result of the cointegration for model (A) using financial development Index (DEPTH). It is based on the maximum likelihood approach of Johansen (1988) and Johansen and Juselius (1992). The study uses the Lagrange Multiplier (LM) test to examine the evidence of serial correlation in the residuals. The lag order selection is based on sequential modified test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HR) criteria. Lag order 1 is selected for this model. The result of the LM test statistics at lag 1 indicates no serial correlation in residuals, (0.2564). The table indicates no evidence of cointegration both from the trace test statistics and maximum eigenvalue statistics.

Table 3.5: Model A: VAR= (GDP, PC1, TOP, RR) = lag (1)

Null	*Alternative*	*λ Trace*	*95%critical value*	*λ max*	*95% critical value*
r = 0	r≥1	45.157	47.856	25.742	27.584
r ≤ 1	r≥2	19.415	29.797	11.600	21.132
r ≤ 2	r≥3	7.8150	15.495	7.4101	14.265
r ≤ 3	r =4	0.4048	3.8415	0.4048	3.8415

r indicates the number of cointegrating vector. (*) and (**) indicate statistical significance at 1% and 5% levels respectively.

Robustness test

It is evident from the model (A) that there is no long-run relationship using financial development index (DEPTH). This study, therefore, uses two other indicators of financial development, BCP and LL in the multivariate VAR framework to examine whether a cointegration could be established. It starts with the unit roots test; i.e., ADF, DF-GLS, PP and KPSS which all indicate that the series are I (1) after taking the first difference. The structural break test also confirms the non rejection of a unit root hypothesis which makes it consistent with ADF, DF-GLS, PP and KPSS unit root tests. Also, all the remaining variables (i.e. GDP, RR, TOP) included in the model exhibit I

(1) series after first difference. The cointegration test as shown below in the tables 3.6 and 3.7 indicate evidence of one cointegrating vector for both the trace and maximum eigenvalue tests and both are significant at 1% and 5% respectively[25]. The lag selection criteria suggest lag 5 and 3 for model B and C respectively. The LM test suggests no evidence of serial correlation at selected lags in the both models showing (0.1596) and (0.9487) respectively. The diagnostic results are presented in the appendix 3A and they clearly indicate no evidence of serial correlation for the three models

Table 3.6: Model B: VAR= (GDP, BCP, TOP, RR) = lag (5)

Null	*Alternative*	*λ Trace*	*95%critical value*	*λ max*	*95% critical value*
r = 0	r ≥ 1	63.682*	47.856	29.766**	27.584
r ≤ 1	r ≥ 2	33.916**	29.797	20.396	21.132
r ≤ 2	r ≥ 3	13.519	15.495	13.379	14.265
r ≤ 3	r =4	0.1409	3.8415	0.1409	3.8415

r indicates the number of cointegrating vector. (*) and (**) indicate statistical significance at 1% and 5% levels respectively.

Table 3.7: Model C: VAR= (GDP, LL, TOP, RR) = lag (3)

Null	*Alternative*	*λ Trace*	*95%critical value*	*λ max*	*95% critical value*
r = 0	r ≥ 1	77.759*	47.856	48.622*	27.584
r ≤ 1	r ≥ 2	29.137	29.797	18.114	21.132
r ≤ 2	r ≥ 3	11.023	15.495	9.5582	14.265
r ≤ 3	r =4	1.4649	3.8415	1.4649	3.8415

. r indicates the number of cointegrating vector. (*) and (**) indicate statistical significance at 1% and 5% levels respectively.

The long-run coefficient elasticities of the cointegrating vectors are examined by following the long-run structural modelling of Pesaran and Shin (2002). They explain that the Johansen cointegration test imposes restriction arbitrary without any prior economic assumptions. To solve this problem, Pesaran and Shin (2002) model uses economic theory to identify restrictions.

[25] It should be noted that in the model (B) the trace test statistics indicate two cointegrating vectors while maximum eigenvalue test shows only cointegrating vector. We use the maximum eigenvalue test which gives us one cointegrating vector. The reason for this is that Gregory (1994) has shown through Monte Carlo simulation that although both tests exhibit size distortion but the maximum eigenvalue performs better because it uses only one eigenvalue as against the trace test that uses all the eigenvalues. Patterson (2000) and Walters (2004) have also shown that the maximum eigenvalue performs better

However, since there is only one cointegrating vector from the Johansen cointegration test, the study imposes normalisation restriction only. Also, since the main focus of this study is on the long-run causality between financial development and economic growth, we impose normalisation restriction on the GDP per capita. The results are presented below in the tables 3.8 and 3.9 respectively.

The cointegrating vector of Model B shows that all the cointegrating coefficients are statistically significant at 1% level with the exception of financial development indicator (bank credit to private sector) which although is positive but not statistically significant. The GDP per capita (GDP) indicates a positive function of real interest rate and trade openness (TOP). Therefore, as predicted by finance and growth literature, the real interest rate has shown a positive productivity effect on the GDP per capita. This is in line with the predictions of the World Bank (1989), Fry (1997), King and Levine (1993) and Beck et al. (2000). On the trade openness, the result is also consistent with theory and empirical findings of Sachs and Warner (1997), Dollar and Kraay (2004) and Freund and Bolaky (2008). All indicate a positive relationship between trade openness and economic growth. The error correction coefficient is rightly signed (negative) and statistically significant at 1% level. It simply measures the speed of adjustment of GDP per capita to the long-run equilibrium. The adjustment speed in the cointegrating vector of model B is about 24.2%. Model C on the other hand, uses liquid liabilities as a proxy of financial development. It shows that financial development, GDP per capita, trade openness, and real interest rate are positively related and all the cointegrating coefficients are statistically significant at 1% level. The positive relationship between the GDP per capita and financial development is in line with the predictions of the endogenous growth models of Greenwood and Jovanovic (1990), Pagano (1993), and Levine (1993). Also the positive relationship between trade openness and financial development is in line with the empirical findings of Svaleryd and Vlachos (2002), Svaleryd and Vlachos (2005) and Baltagi et al. (2009). The loading factor is also statistically significant with right sign (negative) and with adjustment speed of 15.22%.

Table 3.8: Long-run coefficient of the cointegrating vector (Model B)

Normalising on GDP				Loading factor (α)
GDP=2.128 +0.760BCP+0.655TOP+0.0079RLR**				*-0.2419**
	(1.089)	*(2.460)*	*(4.437)*	*(-2.135)*

(*) (**) and (***) show the rejection of null hypothesis at 1% 5% and 10% respectively and all figures in parentheses are t-statistics.

Table 3.9: Long-run coefficient of the cointegrating vector (Model C)

Normalising on GDP				Loading factor (α)
GDP=0.390 +2.308LL+1.853TOP*+0.0059RLR**				*-0.1522**
	(5.734)	*(8.026)*	*(4.640)*	*(-2.374)*

(*) (**) and (***) show the rejection of null hypothesis at 1% 5% and 10% respectively and all figures in parentheses are t-statistics.

3.3.3 Causality Tests

According to Engle and Granger (1987), once a set of variables are I (1) and a cointegration has been established, any dynamic analysis should incorporate the error correction mechanism, which measures the deviation from the long-run equilibrium. This study therefore examines the issue of causality in two parts: The first part is the VECM based Granger causality using the Wald test and the second part is the long-run causality using the weak exogeneity test following the work of Hall and Milne (1994).

The results of the short-run causality are presented in table 3.10 for both Model B and Model C respectively. The result for Model B which uses bank credit to private sector indicates no evidence of short-run causality between financial development and economic growth. There is however bidirectional short-run Granger causality between trade openness and financial development. It further indicates bidirectional Granger causality between economic growth and trade openness. There is no short-run Granger causality between real interest rate and financial development. Model C, which uses

Liquid liabilities, shows that in the short-run, financial development Granger causes economic growth. However, there is no feedback effect from the economic growth. There is also no short-run Granger causality between trade openness and financial development which is not consistent with the result of Model B. Meanwhile, there is bidirectional causality between trade openness and economic growth. This is consistent with the result obtained in the Model B. The causality between real interest rate and financial development indicate evidence of non short-run Granger causality which also makes consistent with Model B.

Table 3.11 presents the weak exogeneity/long-run causality test. Although the main focus of this study is to examine the long-run causality between financial development and economic growth, attempts is made to further examine the causality between other variables in the system. Model B indicates unidirectional causality from economic growth to financial development and there is no feedback effect from financial development. However, there is bidirectional causality between trade openness and economic growth. Model B further indicates unidirectional causality from trade openness to financial development, which is consistent with the empirical findings of Baltagi et al. (2009). There is no long-run causality between real interest rate and financial development. Model C, which uses liquid liabilities indicates bidirectional causality between financial development and economic growth. It also indicates bidirectional causality between financial development and trade openness. Meanwhile, in the long-run, the causality is unidirectional from financial development to real interest rate.

Table 3.10: VECM-Granger non causality test

Hypothesis: **Model B**	Short-run Granger non- causality	Hypothesis: **Model C**	Short-run Granger non- causality
Ho: ΔGDP $\rightarrow$ Δ BCP	(all $\beta_{11i} = 0$)	Ho: ΔGDP $\rightarrow$ Δ LL	(all $\beta_{11i} = 0$)
Chi-square	6.478 (5)	Chi-square	6.152 (3)
Ho: ΔBCP $\rightarrow$ ΔGDP	(all $\beta_{21i} = 0$)	Ho: ΔLL $\rightarrow$ ΔGDP	(all $\beta_{21i} = 0$)
Chi-square	2.197 (5)	Chi-square	0.0917 (3)**
Ho: ΔBCP $\rightarrow$ ΔTOP	(all $\beta_{21i} = 0$)	Ho: ΔLL $\rightarrow$ ΔTOP	(all $\beta_{21i} = 0$)
Chi-square	15.49 (5)**	Chi-square	5.596 (3)
Ho: ΔTOP $\rightarrow$ ΔBCP	(all $\beta_{31i} = 0$)	Ho: ΔTOP $\rightarrow$ ΔLL	(all $\beta_{31i} = 0$)
Chi-square	15.91 (5)**	Chi-square	2.359 (3)
Ho: ΔGDP $\rightarrow$ Δ TOP	(all $\beta_{11i} = 0$)	ΔGDP $\rightarrow$ Δ TOP	(all $\beta_{11i} = 0$)
Chi-square	13.86(5)**	Chi-square	7.611(3)***
Ho: ΔTOP $\rightarrow$ Δ GDP	(all $\beta_{31i} = 0$)	ΔTOP $\rightarrow$ ΔGDP	(all $\beta_{31i} = 0$)
Chi-square	10.58(5)***	Chi-square	7.187(3)***
Ho: ΔRR $\rightarrow$ ΔBCP	(all $\beta_{41i} = 0$)	Ho: ΔRR $\rightarrow$ ΔLL	(all $\beta_{41i} = 0$)
Chi-square	8.544 (5)	Chi-square	4.093 (3)
Ho: ΔBCP $\rightarrow$ ΔRR	(all $\beta_{21i} = 0$)	Ho: ΔLL $\rightarrow$ ΔRR	(all $\beta_{21i} = 0$)
Chi-square	2.208	Chi-square	1.474

Table 3.11: Weak exogeneity test/Long-run causality

Model B:Equation for Bank Credit	**Model C**: Equation for Liquid liabilities
GDP(Ho: α_{11} =0)	GDP(Ho: α_{11} =0)
Chi-square(1): 5.7299 Probability: 0.0167**	Chi-square(1): 7.2235 Probability: 0.0072*
BCP(Ho: α_{21} =0)	LL(Ho: α_{21} =0)
Chi-square(1): 1.9503 Probability: 0.1625	Chi-square(1): 3.6313 Probability: 0.0567***
TOP(Ho: α_{31} =0)	TOP(Ho: α_{31} =0)
Chi-square(1): 4.4861 Probability: 0.034172**	Chi-square(1): 8.2325 Probability: 0.0041*
RLR(Ho: α_{41} =0)	RLR(Ho: α_{41} =0)
Chi-square(1): 1.5343 Probability: 0.215467	Chi-square(1): 0.7176 Probability: 0.3969

(*) and (**) indicate level of significance at 1% and 5% respectively.

3.3.4 Variance Decomposition and Impulse Response Function

Since the main focus of this chapter is to examine the long-run relationship between financial development and economic growth, our analysis of variance decomposition and impulse response function focuses on these two variables.

Tables 3.12 and 3.13 below present the variance decomposition estimates for both Model B and Model C respectively. The forecast horizon is 10 years and the contribution of each variable own shocks and to the shocks of other variables in the system are explained. Masih et al. (2009) explain that with error correction mechanism, one can dictate a variable which is endogenous or exogenous to the system but the relative degree of its endogeneity or exogeneity can only be effectively determined through the variance decomposition. Therefore, if a variable is mainly explained by its own shocks and less by the other variables in the system, it can be said that such variable is exogenous.

Table 3.12 (Model B) indicates that the contribution of each variable to its own shock in explaining the proportion of forecast error variance at the end of 10 years horizon are 58% for the DGDP, 36% for the DBCP, 30% and 63% for the DLOP and DRLR respectively. The results further show that financial development represented by bank credit to private sector explains only 11% of the variation in GDP while GDP explains 38% of the variation in BCP. This indicates that GDP is the most exogenous variable and it is leading financial development. Model C results are presented in table 3.13. It shows that the own shock of each variable in explaining the forecast error are 83% for the GDP, 69% for the liquid liabilities, 35% for the trade openness and 91% for real interest rate respectively. It indicates that the liquid liabilities indicator is the most exogenous variable in the VAR system. It explains 13% of the variation in GDP while

GDP only explains about 6% of the variation in liquid liabilities. This indicates that finance is the leading indicator in this model.

The impulse response function is analysed at two levels: The first level is at unrestricted VAR level while the second is computed at vector error correction (VEC) level. Although the first impulse response is unrestricted, it has a standard error band of ± 2 S.E. It is computed using 10,000 Monte Carlo simulation techniques. The VEC impulse response function which is based on the theoretical restriction has no error band.[26] The essence is that the first level VAR serves as a complement to the second VEC level.

Figures 3.1 and 3.2 present the estimates of the impulse response function for the level VAR and for the VEC level respectively. At the level VAR, the impulse response function indicates that the large response of both GDP and BCP is due to their own past shocks. This makes it consistent with the variance decomposition result. Also, the response of GDP to BCP and BCP to GDP is positive. However, the response of the later is stronger than the response of the former. While the response of BCP to the shock of GDP persists even after the tenth period, that of GDP to BCP dies out at the beginning of fifth year. Figure 3.2 shows that at the initial stage, the responses of GDP and BCP are largely due to their own shocks while that of GDP remains consistently high and positive. BCP indicator however continues to decline and becomes negative at the eighth year. While the response of GDP to BCP is negative that of BCP to GDP is positive. The persistence of the shocks for both GDP and BCP continues even after the tenth period.

Figures 3.3 and 3.4 are the estimates of impulse responses for Model C (using liquid liabilities) both at the VAR and restricted VEC levels. Figure 3.3 shows that the

[26] Eviews 6 has no standard error band for impulse response functions at VEC levels.

responses of GDP and LL are due to their own shocks. While the response of GDP to its own shock dies out at the tenth period, the response of LL to its own shock turns to negative at the fifth period. The response of GDP to LL quickly dies out and remains positive but it is rather weak. The response of LL to GDP is negative at the initial stage and becomes positive after the third period with the persistence of the shock continues after the tenth period horizon. Figure 3.4 represents the impulse response function at the VEC restriction level. It shows that the responses of both GDP and LL are due to their own shocks. While the response of GDP to LL remains negative, that of LL to GDP is initially negative but later rises to a positive level and eventually dies out at the eighth period.

Table 3.12: Variance Decompositions for restricted VEC model, Model B

Horizon (year)	S.E.	GDP	Bank credit (BCP)	Trade openness (TOP)	Real interest rate (RLR)
1.Variance Decomposition of DGDP					
		Explained by shocks in			
2	0.055	99.17	0.005	0.237	0.583
4	0.077	93.91	1.487	0.473	4.132
6	0.115	78.66	5.932	3.944	11.46
8	0.150	66.09	10.47	5.177	18.26
10	0.172	**58.61**	11.80	5.663	23.93
2. Variance Decomposition of Bank credit (DBCP)					
2	0.023	18.42	74.61	6.835	0.137
4	0.028	16.93	74.48	7.297	1.284
6	0.039	23.30	63.88	6.916	5.892
8	0.048	22.16	49.94	7.016	20.87
10	0.057	38.38	**36.56**	9.379	15.68
3. Variance Decomposition of Trade openness (DTOP)					
2	0.072	41.26	4.989	51.54	2.215
4	0.105	26.69	21.65	38.48	13.18
6	0.127	26.99	19.10	36.57	17.33
8	0.151	27.85	22.63	30.89	18.63
10	0.172	32.24	23.04	**30.36**	14.36
4. Variance Decomposition of Real interest rate (DRLR)					
2	21.06	9.991	3.041	0.107	86.86
4	22.30	17.13	3.218	0.377	79.27
6	23.06	16.47	6.865	1.864	74.80
8	24.82	24.55	6.325	1.866	67.25
10	26.47	28.86	5.713	1.790	**63.63**

Table 3.13: Variance Decompositions for restricted VEC model, Model C

Horizon (year)	S.E.	GDP	liquid liabilities (LL)	Trade openness (TOP)	Real interest rate (RLR)
1.Variance Decomposition of DGDP					
		Explained by shocks in			
2	0.059	98.14	0.528	1.014	0.311
4	0.090	89.77	9.252	0.443	0.530
6	0.120	85.85	11.56	0.980	1.598
8	0.142	84.16	12.72	1.795	1.322
10	0.158	**83.70**	13.38	1.805	1.108
2. Variance Decomposition of Bank credit (DLL)					
2	0.046	16.56	70.49	9.311	3.633
4	0.065	10.79	68.90	11.51	8.793
6	0.081	8.259	66.56	15.36	9.818
8	0.088	6.960	68.13	16.09	8.807
10	0.097	5.827	**69.06**	16.08	9.026
3. Variance Decomposition of Trade openness (DTOP)					
2	0.079	19.99	32.22	47.44	0.338
4	0.102	17.73	29.09	45.03	8.134
6	0.118	18.57	30.51	38.82	12.10
8	0.129	19.06	30.75	35.41	14.78
10	0.142	22.06	30.19	**34.97**	12.78
4. Variance Decomposition of Real interest rate (DRLR)					
2	20.95	3.057	0.082	0.013	96.85
4	23.37	8.837	0.348	0.025	90.79
6	26.17	7.310	0.703	2.422	89.56
8	28.45	6.402	0.608	2.658	90.33
10	30.75	5.569	0.595	2.710	**91.12**

Figure 3.1: Model B: Generalised impulse response at VAR level

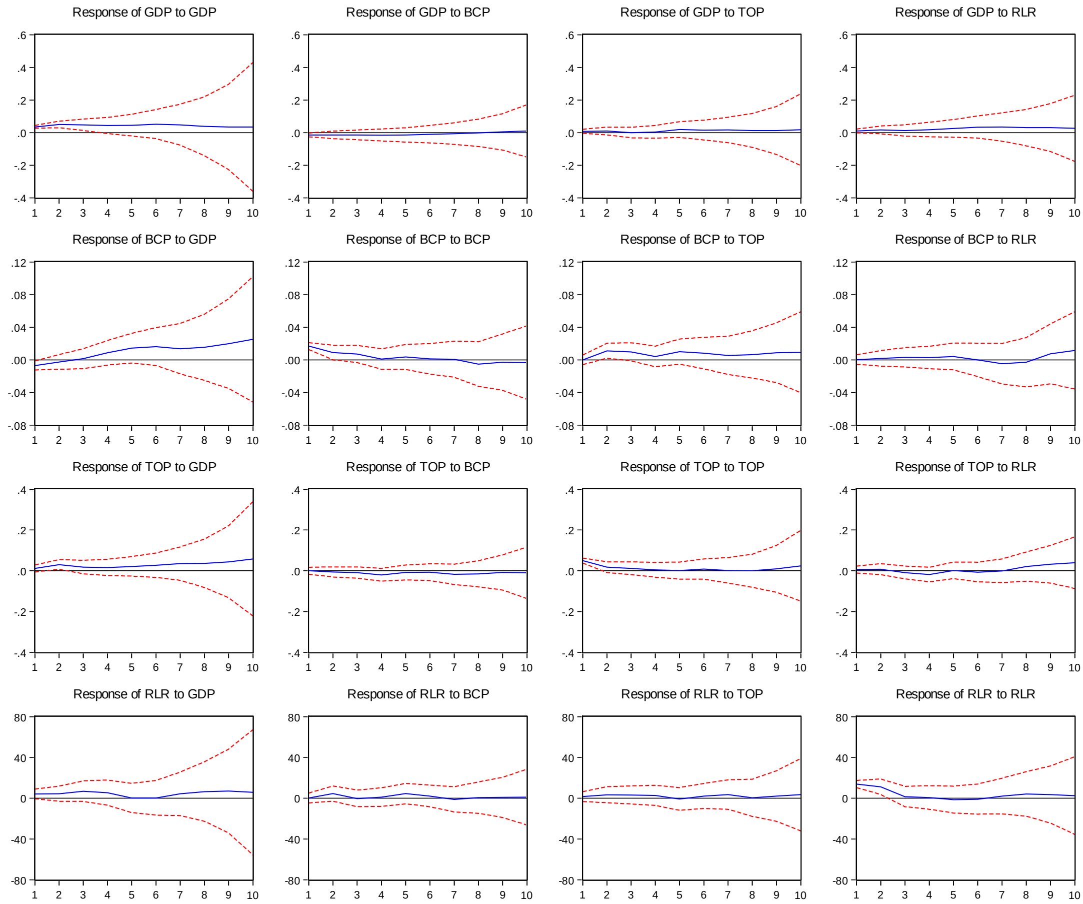


Figure 3.2: Model B: Generalised impulse response at VEC level

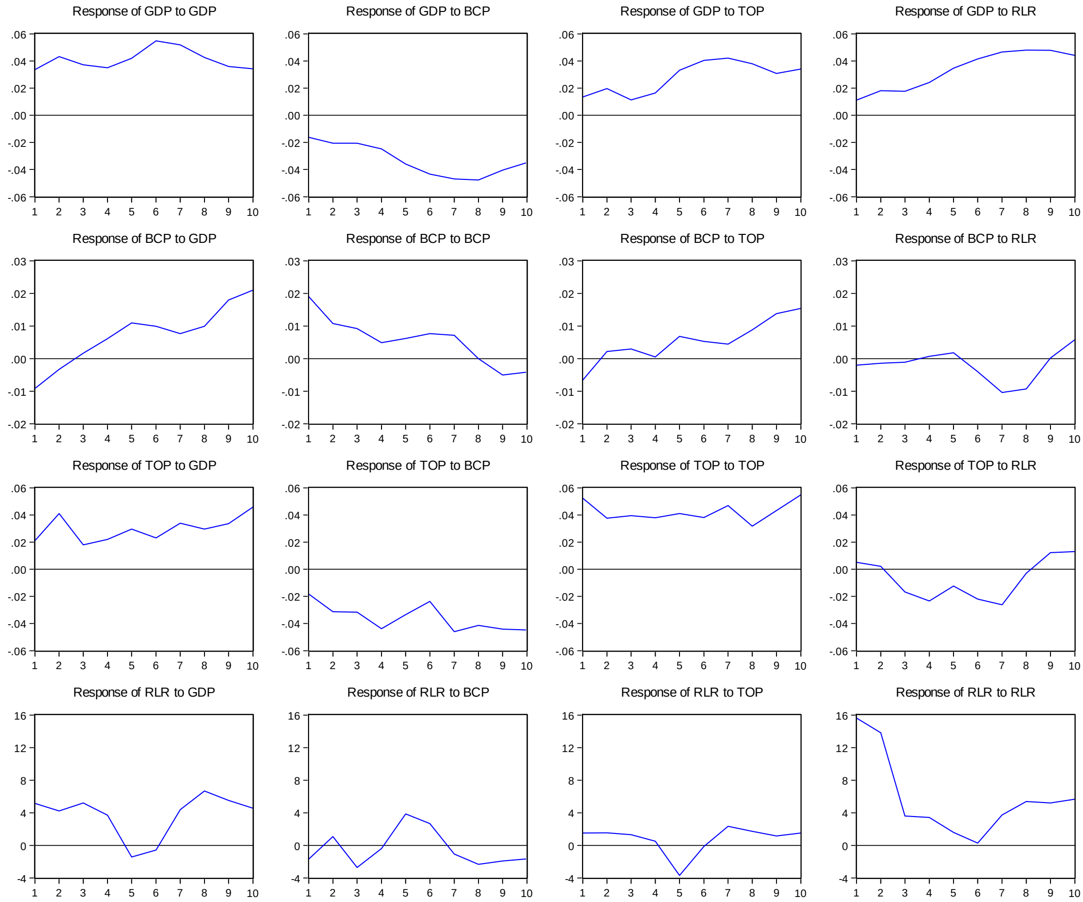


Figure 3.3: Model C: Generalised impulse response at VAR level

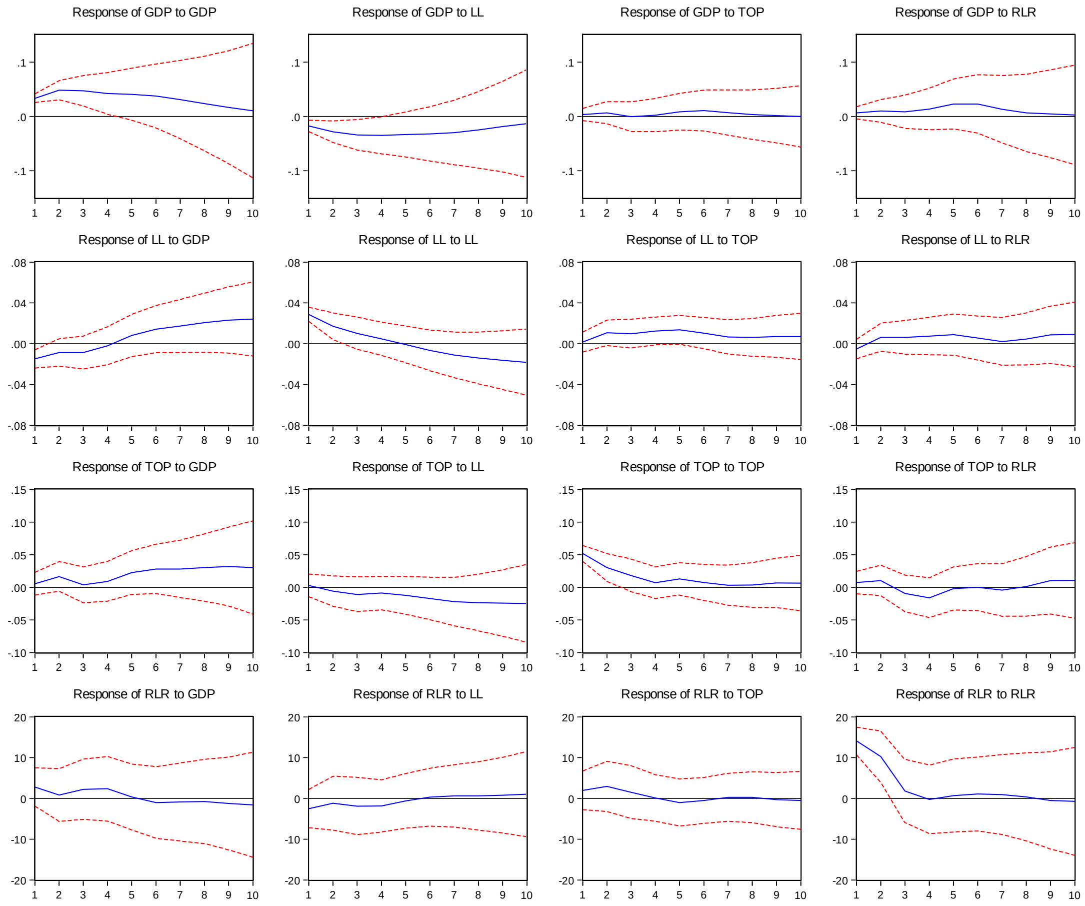
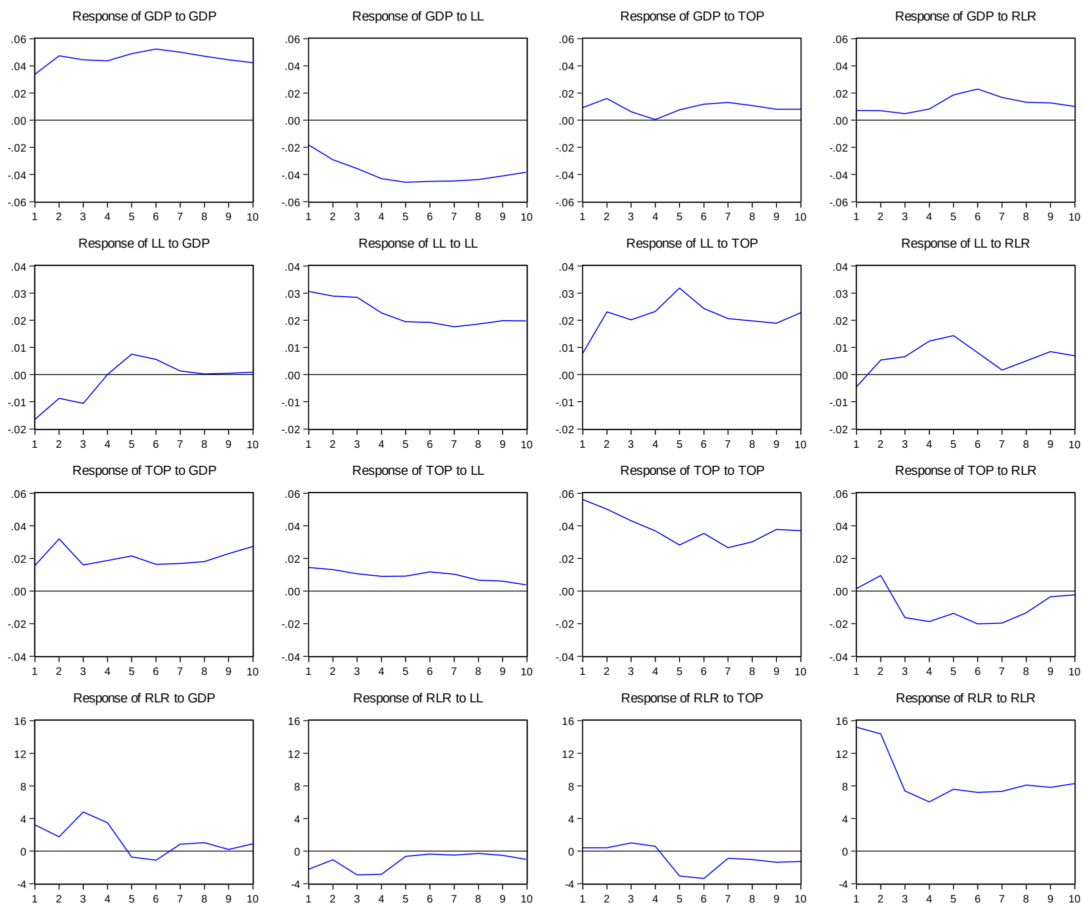


Figure 3.4: Model C: Generalised impulse response at VEC level



3.4 Conclusions

This chapter seeks to empirically examine the long-run relationship between financial development and economic growth in Nigeria using annual data for the period 1961-2007. To achieve this objective, the study uses multivariate VAR framework to evaluate the long-run relationships between financial development, GDP per capita, trade openness, and real lending rate. The study also establishes the long-run causality between financial development and economic growth. Three financial indicators are used and these are: bank credit to private sector (BCP), liquid liabilities (LL) and domestic credit to private sector (DCP). A measure of financial development index is obtained from these three indicators. In the financial development index equation, no cointegration is established and this contrasts to the finding of Gries et al. (2009) where they established one cointegrating vector. However, using two individual financial indicators, bank credit to private sector and liquid liabilities, the study establishes one cointegration each. There is no short-run causality between financial development and economic growth using bank credit to private sector but with liquid liabilities (LL), the result indicates unidirectional causality from finance to economic growth. In the Long-run, there is strong evidence that economic growth is leading financial development when bank credit to private sector is used thereby supporting the demand following hypothesis. Gries et al. (2009) did not use this proxy, however, we consider this proxy very important because it has been considered to be the best measurement of financial development, Beck et al. (2000). With the liquid liabilities (LL), the long-run causality is bidirectional between financial development and economic growth. Therefore, in the overall, financial development has not led growth for the case of Nigeria.

In Nigeria, for the financial system to clearly promote economic growth, monetary authorities must ensure that banks provide necessary funds to the real sector of the economy. At present, there is a weak link between the real sector and the financial system, an indication that the majority of banks loans are channelled to unproductive sector of the economy. Monetary authorities therefore must pursue appropriate policies that will increase the level of financial intermediation, achieve positive interest rate and increase the level of investment.

CHAPTER 4

STOCK MARKETS, BANKS AND ECONOMIC GROWTH IN SOUTH AFRICA: EVIDENCE FROM VECTOR ERROR CORRECTION MODEL (VECM)

4.1 Introduction[27].

The objective of this study is to examine the causal relationship between financial development and economic growth using stock market development while controlling for the banking variable through a vector autoregression (VAR) approach. Generalised impulse response functions (GIRF) and variance decomposition (VDC) are computed and analysed to further evaluate the inter-relationships among the variables of interest. Through VECM-based causality tests the results indicate that in the short-run for model A, there is a unidirectional causality from stock market development to GDP and also from GDP to banking system. However, in the long-run the causality runs from economic growth to stock market development. When the banking system is used, the result indicates bidirectional causality between banking development and economic growth. In the model B, the short-run causality runs from stock market to GDP and in the long-run, causality runs from economic growth to both stock market and banking system. Although Enisan and Olufisaya (2009) carry out a similar work on stock market and economic growth in 7 sub-Saharan African including South Africa, this study however departs from their study and advances the knowledge based on the following:

a) The sample size in the work of Enisan and Olufisaya (2009) is quite small (25 observations) for a meaningful time series study. This study uses quarterly

[27] I would like to thank members of the academic staff and PhD colleagues of the Department of Economics, University of Leicester for their valuable comments during the PhD conference organised by the Department on the 11th March 2009. I would also thank the participants at the 14th annual conference of the African Econometric Society in Abuja, Nigeria, for helpful comments. It was held on the 8th -10th July 2009.

observation (100 observations), which is obviously longer and therefore free from asymptotic distribution problems that usually characterise small sample data.

b) This study also advances the knowledge on stock market and economic growth in South Africa by carefully solves the stock and flow variable problems. It is a common knowledge that banks and stock markets are stock variables while Gross Domestic Product (GDP) is a flow variable. This indicates that there is a stock- flow problem and a processed if ignored according Beck and Levine (2004) may lead to a misleading result. This is because a stock variable is measured at one specific time that is accumulated in the past while a flow variable is defined relative to a period or measured over an interval of period. This study carefully resolves this problem.

c) Although the data sample is too small which justifies the use of auto distributed lag (ARDL) model in the Enisan and Olufisaya (2009) work, this approach cannot be better than vector autoregression (VAR) in testing for cointegration. With VAR, which is used in this study, we can easily indentify; distinctly the number of cointegration vectors in the system. This is not possible with an ARDL model because it is a single equation-based model. For example, in their work they use four variables: stock market, GDP, discount rate and openness ratio but we cannot be sure with an ARDL model whether there is more than one cointegrating vector. This therefore, further creates identification problems as can be found in the work of Asteriou and Hall (2007) and Enders (2004).

d) This study also controls for banking variable, which is the dominant sub-sector not only in South Africa but also in Sub-Saharan African. Evidence from the World Bank (2007) clearly indicates that Sub-Saharan Africa is a bank-based economy. According to the IMF (2008), the banking sub-sector in South Africa is the dominant segment of the financial sector constituting about 120% of the GDP. Therefore, studies on the effect of stock market on economic growth in South Africa or any Sub-Saharan African that do not control for banking variable may likely suffer from an omitted variable problem. The evidence from the developed financial market (using time-series) has also shown that they do control for banking variable as can be found in the work of Arestis et al. (2001)

Following this introduction, the rest of the study is organised as follows: Section two consists of data, measurement and econometric methodology. Section three presents the empirical results and section four concludes the study.

4.2 Data, Measurement and Econometric Methodology

This study uses quarterly data with the sample period from 1983:q1 to 2007:q4 (100 observations). The data consist of four variables: real GDP (GDP), investment ratio (INV), banking system and stock market variables. The banking variable is represented by bank credit to private sector (BCP) while the stock market variables are represented by turnover ratio (TR), value of shares traded (VT) and market capitalisation (MC). While the turnover ratio (TR) serves as the main indicator for stock market development in this thesis, the remaining two variables, VT and MC serve as alternative measures in order to allow for the robustness check. All the data are measured in logarithm form. The data are obtained from International Financial Statistics (IFS), South Africa Reserve Bank (SRB), and Johannesburg Stock Exchange (JSE).

Investment ratio: This is obtained from gross fixed capital formation divided by nominal GDP. According to endogenous economic theory, investment provides a positive link to economic growth. Ndikumana (2000), Yartey and Adjasi (2007) and Xu (2000) all used this measurement in their work.

Turnover Ratio: This measures the market liquidity which is usually given as total value of shares traded divided by total value of listed shares or market capitalisation. Beck and Levine (2004) prefer this measurement to other measurements of stock market variables. This is because unlike other measures, the numerator and denominator of turnover ratio contain prices.

Value Traded: Rousseau and Wachtel (2000) and Beck and Levine (2004) both use this measurement and it is given as the ratio of value shares traded to nominal GDP. However, according to Beck and Levine (2004), the value traded has two weaknesses: (1) *"it does not measure the liquidity of the market, it just measures trading relative to the size of the economy" (2) "also since value traded is the product of quantity and price, this means that it can rise without an increase in the number of transaction"* (p.428).

Market Capitalisation: This is measured as the value of listed shares divided by nominal GDP. Meanwhile, Beck and Levine (2004) have shown that with market capitalisation, there is no theory suggesting that mere listing of shares will influence resource allocation and economic growth. Levine and Zervos (1998) also indicate that market capitalisation is not a good predictor of economic growth[28].

Bank credit to private sector: This proxy is believed to be superior to other measures of financial development because it excludes credit to public sector which better reflects the extent of efficient resources allocation[29]

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[28] However, Arestis et al. (2001) have shown that in the context of time-series data, market capitalisation tends to perform better than other measures of stock market development.

[29] Bank credit to private sector indicates the value of allocation of resources by financial intermediaries to private sector divided by GDP. Beck et al. (2000), Levine et al. (2000), Beck et al. (2004), Levine and Zervos (1998), and World Bank (2007) have all argued that bank credit to private sector is the best measure of financial development. This is because it is the proxy that relates to the quality and quantity of

This study follows Beck and Levine (2004), Levine and Zervos (1998) and Beck et al. (2000) by deflating stock market variables and bank credit to private sector. This is because real GDP is a flow variable which is defined relative to a period whilst bank credit to private sector (BCP) and market capitalisation (MC) are for example stock variables which are measured at the end of period. Therefore, this indicates that there is a stock-flow problem; a process if ignored may produce a misleading result. The problem is solved by deflating end of year bank credit to private sector and market capitalisation by end of year consumer price index (CPI) and deflates the GDP by the CPI. Then take the average of bank credit to private sector (BCP) and market capitalisation (MC) in period t and period t-1 and relate it to the real flow variable for period t[30].

4.3.1 Econometric Methodology

The study employs the vector autoregression (VAR) framework which is made up of four variables: real Gross Domestic Product (GDP), Investment ratio (INV), which is given by gross fixed capital formation, financial development proxy is given by bank credit to private sector (BCP) and stock market development proxy is given by

investment and hence economic growth. According to the World Bank (2007), bank credit can be considered as the best measure because it essentially captures the degree to which banks are channelling the society's saving to most productive uses and hence economic growth. This measure according to them excludes credit to public sector because in most cases especially in the developing countries where credits to public sector are not as efficient as to those in the private sector due to the problems of mismanagement, corruption and bureaucracies.

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[30] BCP = 0.5* $\dfrac{\left[\dfrac{BCP_t}{CPI_t} + \dfrac{BCP_{t-1}}{CPI_{t-1}}\right]}{\dfrac{GDP_t}{CPI_t}}$ CPI= consumer price index in year t.

market by capitalisation (MC), turnover ratio (TR), and total value of shares traded (VT)[31].

The VAR is adopted for this particular work because with VAR, according to Ang and McKibbin (2007), once the variables are cointegrated; it becomes easy to distinguish between the short-run dynamics and long-run causality. Also the VAR framework eliminates the problems of endogeneity by treating all the variables as potentially endogenous, as explained by Sims (1980).

The basic aim of our empirical estimation is to: First examine the long-run relationship among the banks, stock market and the level of GDP; second, evaluate the dynamics causal relationship among these four variables; and third, use generalised impulse response function and variance decomposition to examine how each variable response is shocked by other variables of the VAR framework.

The VAR of order p model can be expressed as follows:

$$X_t = \mu + A_1 x_{t-1} + \_\_\_\_\_\_\_\_\_\_\_ + A_{p-1} x_{t-p} + \varepsilon_t \quad (1)$$

The VAR can be expressed in VECM form once the variables are I (1) order of integration:

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[31] It should be noted that some studies like Arestis et al. (2001) control for volatility to account for uncertainty that usually characterises equity markets. In this study, we could not control for volatility due to the following:

a) Pagan (1986) clearly indicates in his study, the effect of combining a constructed data with observed data. He notes that such combination could create inconsistencies in estimators, lacking efficiency, leading to a “misleading” result and “invalid inferences”. (Pagan 1986, p.517)

b) Beck et al. (2004) also express concern with the construction of volatility in VAR model especially through moving average representation. This is because the use of vector error correction model (VECM) is not capable of capturing the high frequency factors that usually characterise the stock markets.

C) It is a common knowledge that VAR is a linear model that captures the dynamic relationship among variables of interest as can be seen in the work of Patterson (2000), Sims (1980), Asteriou and Hall (2007). While volatility is often non-linear in nature that can be best captured using non-linear models like Generalised heteroskedasticity (GARCH) model – Chris (2004) and Engle (1982). Therefore, since VAR is a linear model and volatility is non-linear, constructing a volatility which is non-linear in nature in to a VAR model could affect the critical values of the estimation. This is may be due to high level of errors and uncertainty that could have been added to the linear model.

d) The above problem partly explains why a separate chapter (chapter five of this thesis) is dedicated to the study of uncertainty or volatility using the appropriate models.

$$\Delta x_t = \pi_0 + \pi x_{t-1} + \pi_1 \Delta x_{t-1} + \pi_2 \Delta x_{t-2} + ... + \pi_{p-1} \Delta x_{t-\rho+1} + \alpha x_{t-p} + \varepsilon_t \qquad (2)$$

Where π_0 an (4x1) vector of intercept with elements π_{j0} and π_i is $(n \times n)$ coefficient matrices with elements $\pi_{jk}(i)$ Meanwhile, ε_t is an independently and identically distributed n-dimensional vector with zero mean and constant variance Therefore, if π is of rank $1 < r < 4$, this means that it can be decomposed into $\pi = \alpha\beta'$ where β is the matrix of cointegrating vectors and α is the matrix of adjustment.

$$\Delta x_t = \pi_0 + \pi x_{t-1} + \pi_1 \Delta x_{t-1} + \pi_2 \Delta x_{t-2} + ... + \pi_{p-1} \Delta x_{t-\rho+1} + \alpha(\beta' x_{t-p}) + \varepsilon_t \qquad (3)$$

The term $\alpha\beta' x_{t-p}$ is the linear combination process. According to Engle and Granger (1987), when a set of variables are I (1) and are cointegrated then short-run analysis of the system should incorporate error correction term (ECT) in order to model the adjustment for the deviation from its long-run equilibrium. The vector error correction model (VECM) is therefore characterised by both differenced and long-run equilibrium models, thereby allowing for the estimates of short-run dynamics as well as long-run equilibrium adjustments process. In this study, given the four variables, the VECM is expressed as follows:

$$\Delta LGDP_t = \phi_1 + \alpha_{11} ECT_{t-1} + \sum_{i=1}^{p-1} \beta_{11i} \Delta RGDP_{t-i} + \sum_{i=1}^{p-1} \beta_{12i} \Delta INV_{t-i} + \sum_{i=1}^{p-1} \beta_{13i} \Delta BCP_{t-i} + \sum_{i=1}^{p-1} \beta_{14i} \Delta SM_{t-i} + \varepsilon_{1t}$$

$$\Delta LINV_t = \phi_2 + \alpha_{21} ECT_{t-1} + \sum_{i=1}^{p-1} \beta_{21i} \Delta RGDP_{t-i} + \sum_{i=1}^{p-1} \beta_{22i} \Delta INV_{t-i} + \sum_{i=1}^{p-1} \beta_{23i} \Delta BCP_{t-i} + \sum_{i=1}^{p-1} \beta_{24i} \Delta SM_{t-i} + \varepsilon_{2t}$$

$$\Delta BCP_t = \phi_3 + \alpha_{31} ECT_{t-1} + \sum_{i=1}^{p-1} \beta_{31i} \Delta RGDP_{t-i} + \sum_{i=1}^{p-1} \beta_{32i} \Delta INV_{t-i} + \sum_{i=1}^{p-1} \beta_{33i} \Delta BCP_{t-i} + \sum_{i=1}^{p-1} \beta_{34i} \Delta SM_{t-i} + \varepsilon_{3t}$$

$$\Delta SM_t = \phi_4 + \alpha_{41} ECT_{t-1} + \sum_{i=1}^{p-1} \beta_{41i} \Delta RGDP_{t-i} + \sum_{i=1}^{p-1} \beta_{42i} \Delta INV_{t-i} + \sum_{i=1}^{p-1} \beta_{43i} \Delta BCP_{t-i} + \sum_{i=1}^{p-1} \beta_{44i} \Delta SM_{t-i} + \varepsilon_{4t}$$

(4)

Where ΔSM represents the stock market variables, which in this study comprise turnover ratio (TR), value of shares traded (VT) and market capitalisation ratio (MC). ECT^{t-1} is the error correction term lagged one period and ε_t's the Gaussian residuals. Ang and McKibbin (2007) explain that there are two sources of causation: through the ECT ($\alpha \neq 0$) and through the lagged dynamic terms. That is; through the VECM framework, two types of Granger causality tests can be performed: the short-run Granger non-causality test and the long-run causality through the weak exogeneity test. The VECM-based causality test is performed through the Wald test and it is used to analyse both the short-run dynamics and long-run causality between finance and economic growth. For example, in equation 8, if we want to test that, in the short-run, ΔBCP_t does not cause $\Delta RGDP_t$, this can be done by testing the lagged dynamic terms under the null hypothesis Ho: all $\beta_{13i} = 0$ if the null is not rejected it means that financial development, represented by banking system, does not Granger cause economic growth. The long-run causality is examined through the weak exogeneity test of Ho: $\alpha_{11} = 0$ by using likelihood ratio test with χ^2 distribution. The strong exogeneity test is performed under the null hypothesis that ΔBCP_t does not cause $\Delta RGDP_t$, and is expressed as Ho: $\beta_{13i} = 0 = \alpha_{11} = 0$ is not rejected. However, for robustness test, the dynamic specification is estimated using four lags and statistically least significant lag variables are sequentially eliminated so that parsimonious results are obtained. The parsimonious Granger causality tests based on the multivariate error-correction model is used to examine the direction of causality between finance represented by both banking system and stock market variables and economic growth.

4.2.2 Generalised Impulse Response Function (GIRF)

Once the presence of cointegration is established, the VAR can be used for forecasting through the impulse response function and variance decomposition of forecast-error.

The impulse response can be used to trace the time path of the structural shocks on the dependent variables of the VAR model. Sims' (1980) Cholesky decomposition can be used to identify the impulse response function in a VAR model by ensuring that shocks are uncorrelated. However, this method is not unique since it is based on the assumption of "orthogonality" which means that results may be sensitive to the Cholesky ordering scheme of variables in the system. The implication of this is that reordering the variables in the system may lead to a number of different conclusions.

To overcome this problem, this study employs the generalised impulse response function (GIRF) developed by Pesaran and Shin (1998). The GIRF is invariant to the ordering of the variables in the VAR system. It is based on some of the following assumptions: (1) that the disturbances are normally distributed with a constant covariance matrix Σ; that is, $u_t \sim N(0, \Sigma)$, (2) variables are stationary and (3) regressors are not perfectly collinear. The generalised impulse response function is obtained by transforming VAR into infinite moving average representation.

$$X_t = \sum_{i=0}^{\infty} A_j u_{t-j} \tag{5}$$

Where the (n x n) coefficient matrices A is obtained through a recursive process,

$$Aj = \phi_1 A_{j-1} + \phi_2 A_{j-2} + ... + \phi_p A_{j-p}, \; j = 1,2,... \tag{6}$$

With $A_0 = I_n$ and $A_j = 0$ for $j < 0$

Denoting the known history of the economy up to time $t-1$ by the non-decreasing information set Ω_{t-1}, the generalised impulse response function (GIRF) developed by Pesaran and Shin (1998) is specified as follows:

$$GI_x(h,\delta,\Omega_{t-1}) = E(x_{t+h}|\varepsilon_t = \delta, \Omega_{t-1}) - E(x_{t+h}|\Omega_{t-1}) \quad (7)$$

Where δ is some known vector, and for the VAR process with infinite moving average representation, it means that $GI_x(h,\delta,\Omega_{t-1}) = A_h\delta$, and this is independent of the history of economy Ω_{t-1} but depends on the composition of shocks defined by δ. Therefore the choice of δ is critical in the determination of time profile for any generalised impulse response function. As an alternative to cholesky decomposition of shocking all the elements of ε_t, the generalised impulse response shocks only one element such that $\varepsilon_{jt} = \delta_j$ based on the assumption of historically observed distribution

$$GI_x(h,\delta,\Omega_{t-1}) = E(x_{t+h}|\varepsilon_{j_t} = \delta_j, \Omega_{t-1}) - E(x_{t+h}|\Omega_{t-1}) \quad (8)$$

Assuming that ε_t is Gaussian, it follows:

$$E(\varepsilon_t|\varepsilon_{jt} = \delta_j) = (\omega_{1j}, \omega_{2j}, ..., \omega_{hj})'\omega_{jj}^{-1}\delta_j = \sum ej\omega_{jj}^{-1}\delta_j \quad (9)$$

The un-scaled generalised impulse response of the effect of a shock in the jth equation based on $nx1$ vector is:

$$\left(\frac{A_h\sum ej}{\sqrt{\omega_{jj}}}\right)\left(\frac{\delta_j}{\sqrt{\omega_{jj}}}\right), n = 0,1,2,..., \quad (10)$$

Letting $\delta_j = \sqrt{\omega_{jj}}$ the standard deviation of ε_t and assumed ε_t is normal distribution, the scaled generalised impulse response function is given by

$$\psi_j^g(h) = \omega_{jj}^{-1/2} A_h \sum e_j, h = 0,1,2,..., \quad (11)$$

This measures the effect of one standard deviation error shock to the jth equation at time t on expected values of x at time $t+h$

Pesaran and Shin (1998) also shown that generalised impulse response function can be computed for cointegrating VAR models. They have shown that when generalised impulse response function is considered on the cointegrating relations β'_{xt}, the effects of shocks is bound to die out and their time profile contains viable information about the speed of convergence of the model to its equilibrium state. The effect of a unit shock to the $i-th$ variable on the $j-th$ cointegrating relations can be given by generalised impulse response function as follows:

$$GI(\beta_{jxt} N) = \frac{\beta'_j AN \sum ei}{\sqrt{\omega ii}} \quad (12)$$

Variance Decomposition: The forecast-error of variance decomposition analysis allows us to infer the proportion of the movement in sequence due to its own shocks and shocks in other variables. That is how much of a change in a variable is due to its own shock and how much is due to shocks to other variables.

Through the generalised impulse response and variance decomposition, we can examine the short-run dynamics among the economic variables in the VAR system. The study also draws some inferences about the direction of causal flows among the economic variables in the system. In this study, the generalised impulse response and variance decomposition are presented in two stages: stage one is the generalised impulse response function (GIRF) and variance decomposition (VDC) at unrestricted VAR level with four lags as suggested by selection criteria. The second one is generalised impulse response and variance decomposition at VEC restriction level. The first one is estimated by generating standard errors through a 10,000 Monte Carlo simulation. The second one is obtained at cointegrated level after normalising on the level of GDP.

4.3 Empirical Results

This study starts the analysis of empirical results with unit root tests. This is followed by cointegration tests using maximum likelihood procedure of Johansen (1988) and Johansen and Juselius (1992). The next stage is the examination of short-run dynamics and long-run causality between financial development and economic growth through the Engel-Granger vector error correction model (VECM). However, the impulse response function and variance decomposition are also obtained and analysed at two levels: unrestricted VAR level and restricted VEC level.

4.3.1 Unit Root Tests

To examine the existence of stochastic non-stationary in the series the study establishes the order of integration of individual time series through the unit root tests. Three unit root tests are carried out. These are: The augmented Dickey-Fuller (ADF), the Detrended Dickey-Fuller (DF-GLS), and the Phillip-Peron (PP). The series are: real GDP (RGDP), investment ratio (INV), turnover ratio (TR), value of shares traded (VT), market capitalisation (MC) and bank credit to private sector (BCP). The results indicate that all the series are of integrated order one I (1). That is all the series are non-stationary at level but stationary at first difference. The results are presented below in tables 4.1 and 4.2 respectively.

Table 4.1: Unit root test: Level (constant)

Variables	ADF	DG-GLS	PP
RGDP	1.774	2.860	2.340
INV	-2.940	-0.689	-2.416
BCP	0.027	0.749	0.132
TR	0.155	0.309	-1.426
VT	2.813	2.346	-0.822
MC	-1.308	-0.570	-0.138
	First difference (constant)		
Variables	ADF	DG-GLS	PP
RGDP	-5.627*	-5.520*	-5.704*
INV	-7.851*	-2.386**	-8.345*
BCP	-10.39*	-9.794*	-10.39*
TR	-12.20*	-3.215*	-16.74*
VT	-5.221*	-3.714*	-14.77*
MC	-4.089*	-3.296*	-5.904*

The asterisk *, and ** implies 1%, and 5%, levels of significance respectively.

Table 4.2: Unit root test: Level (constant and trend)

Variables	ADF	DG-GLS	PP
RGDP	-0.364	-0.668	-0.016
INV	-1.017	-0.309	-0.758
BCP	-1.191	-1.506	-1.131
TR	-1.944	-1.405	-3.837
VT	-0.344	-0.297	-3.660
MC	-2.203	-2.340	-1.157
	First difference (constant and trend)		
Variables	ADF	DG-GLS	PP
RGDP	-6.052*	-6.017*	-5.938*
INV	-9.097*	-6.602*	-9.278*
BCP	-10.49*	-10.54*	-10.49*
TR	-12.21*	-3.175*	-17.03*
VT	-12.51*	-3.215*	-19.29*
MC	-4.096*	-3.951*	-5.882*

The asterisk * and ** implies 1%, and 5%, levels of significance respectively.

4.3.2 Tests for Cointegration

The cointegration tests are carried out based on the Johansen (1988) and Johansen and Juselius (1992) maximum likelihood framework. The aim is to establish whether long-run relationship exists among the variables of interest. The results of the tests for the three models are presented in table 4.3 and they indicate that both the trace test and maximum eigenvalue statistics reject the null hypothesis of r $\leq$ 0 against the alternative $r \geq 1$ at 5% level of significance. The results suggest evidence for the presence of one cointegrating vector in both models A and B respectively. However, there is no evidence of cointegration in model C. Since VAR models are always sensitive to lag, the study uses AIC, SC, FPE and LR selection criteria, all of which suggest the use of VAR lag-length of four for both models A and B and lag-length two for model C. Model C is however dropped for the causality test since there is no evidence of cointegration.

Table 4.3: Johansen Cointegration Test

Model A: (RGDP, INV, BCP, TR) VAR lag =4

H_0	H_1	λ Trace value	5%critical value	λ max	5%critical
$r = 0$	$r \geq 1$	59.22 ***	47.85	35.71***	27.58
$r \leq 1$	$r \geq 2$	23.51	29.80	13.60	21.13
$r \leq 2$	$r \geq 3$	9.908	15.49	8.071	14.26
$r \leq 3$	$r \geq 4$	1.837	3.841	1.837	3.841

Model B: (RGDP, INV, BCP, VT) VAR lag = 4

H_0	H_1	λ Trace value	5%critical value	λ max	5%critical
$r = 0$	$r \geq 1$	52.15	47.86 **	32.35**	27.58
$r \leq 1$	$r \geq 2$	19.79	29.80	12.09	21.13
$r \leq 2$	$r \geq 3$	7.703	15.49	7.571	14.26
$r \leq 3$	$r \geq 4$	0.132	3.841	0.132	3.841

Model C: (RGDP, INV, BCP, MC) VAR lag =2

H_0	H_1	λ Trace value	5%critical value	λ max	5%critical
$r = 0$	$r \geq 1$	39.07	47.86	23.15	27.58
$r \leq 1$	$r \geq 2$	15.92	29.80	10.02	21.13
$r \leq 2$	$r \geq 3$	5.901	15.50	5.606	14.26
$r \leq 3$	$r \geq 4$	0.295	3.841	0.295	3.841

r indicates the number of cointegrating vector. (**) and (***) denote statistical significance at 5% and 10% respectively.

Table 4.4: Long-run coefficient of the cointegrating vector normalised on BCP

Model A	BCP	constant	RGDP	INV	TR	loading factor(α)
	1	89.79	+ 14.94*	+ 2.551*	- 0.513*	-0.0870*
			(5.967)	(3.329)	(-5.540)	(-2.947)
Model B	**BCP**	**constant**	**RGDP**	**INV**	**VT**	**loading factor(α)**
	1	-102.3	+ 15.90*	+ 6.419*	+ 0.339*	0.0496 **
			(4.549)	(6.016)	(4.729)	(1.983)

(*) and (**) indicate 1% and 5% level of significance respectively. Figures in parentheses are t- values.

The study carries out misspecification tests for serial correlation, normality and heteroskedasticity tests for models A, B and C respectively. Table 4E in the appendix, indicates lag-length selection for the order of multivariate VAR and diagnostic tests. The lag selection criteria used for the three models are: sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC) and Schwarz information criterion (SC). The results from these lag selections criteria indicate the selection of lag 4 for model A. The LM-test (the Lagrange multiplier) indicates no serial correlation at the selected lag. Model A also passes the normality test through the joint Jarque-Bera (JB) statistics. It indicates that residuals are normally distributed. It also passes the heteroskedasticity test with a chi-square distribution of 331.6 and 0.3163 respectively. In model B, all the optimal lag selections indicate lag-length 4 except the SC criterion, which selects lag 1. The LM-test indicates no serial correlation. The model however, fails the normality test but passes the heteroskedasticity test at 0.1598 with a chi square distribution of 345.2. The optimal lag selection for Model C is 2 as indicated by all lag selection criteria. There is no evidence of serial correlation at the lag selected. However, it fails normality and heteroskedasticity tests, indicating 0.048 and 0.003 respectively with a chi-square distribution of 229.8.[32]

[32] Details of selection of the order of the multivariate VAR and residual misspecification results are presented in appendix table 4E.

Table 4.4 presents the long-run coefficients of the cointegrating vector normalising on BCP for both models A and B respectively. Model A indicates a positive relationship between financial development represented by banking variable (BCP) and real GDP and level of investment (INV), and statistically significant at 1% level. This positive relationship is consistent with theoretical predictions of the endogenous growth models as shown in the works of King and Levine (1993), Levine (1997) and Levine and Zervos (1998). However, the relationship between banking system (BCP) and stock market (TR) is negative and statistically significant at 1% level. The adjustment or the long-run elasticity of BCP is 0.087 or 8.7% and it has right sign (negative) and is statistically significant at 5% level.[33] The results from model B are also consistent with the endogenous growth model. The banking system is positively related with real GDP, LINV and stock market variable, and value of shares traded (VT). The adjustment factor although it is statistically significant at 5% level, it does not have the right sign (negative) as stated by Wickens (1996).[34]

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[33] Wickens (1996) points out that for the restrictions to be meaningful, the adjustment coefficients must be statistically significant and their signs must be negative.

[34] Since the adjustment coefficient of the Model B has positive sign instead of negative as stated by Wickens (1996) the most important thing to do for this model to be acceptable is to check for stability condition of the VAR model through the eigenvalues or characteristic roots of the π matrix. Lutkepohl (2005, p.15,) and Patterson (2004, p.605) explain that the condition which ensures that a VAR model is stable is that eigenvalues of (π) have modulus less than one. Therefore, the eigenvalues which are the roots of the kth order characteristic polynomial $(A - \lambda I)$ is obtained by solving the characteristic equation $(A - \lambda I) = 0$ where $|A|$ is characteristic determinant det $(A - \lambda I) = 0$ For complex roots $\phi_j = \phi j^r + \phi j^i$ is used where $\phi j^r and \phi j^i$ are the real and imaginary parts of ϕ_j The modulus $|\phi_j|$ is defined as $|\phi_j| = \left[(\phi_j{}^r)^2 + (\phi_j{}^i)^2\right]^{0..5}$ The eigenvalues for non symmetric matrix are calculated using REG-X soft ware by S.G. Hall. The results indicate the following: real part = -0.2517, imaginary part = 0.0000 and modulus = -0.2517. From this result, it shows that modulus is less than one and this means that the VAR is stable.

4.3.3 Causality Tests

Once the level of cointegration has been established, the next stage is to carry out VECM causality tests among the variables of interest. This study performs three causality tests and these are: Short-run Granger non-causality, Weak exogeneity and Strong exogeneity tests respectively. These are performed through the popular Wald test. The study also performs parsimonious VECM through the general to specific procedure.

The results of the Wald test are presented in table 4.5 for model A and table 4.6 for model B. From model A, the short-run causality indicates that TR which represents the stock market system, Granger causes the real GDP and it is statistically significance at 5% level. Also, in the short-run, real GDP Granger causes BCP which represents the banking system. It is also significance at 5% level. The long-run causality also indicates evidence of bidirectional causality between financial development and economic growth and this is statistically significant at 5% level. This result is consistent with Luintel and Khan's (1999) results. However, with the stock market system, there is evidence of no feedback effect as the result indicates unidirectional causality from economic growth to turnover ratio (TR). This result is also consistent with the results of Dritsak and Dritsaki-Bargiota (2005). The overall causality in the system is tested through the strong exogeneity and shows that the null hypothesis that financial development does not Granger cause GDP is rejected at 5% level of significance with the banking variable (BCP) and 1% level of significance with stock market variable (TR). The null hypothesis that GDP does not Granger-cause financial development is rejected at 5% level of significance with the banking system, while the null hypothesis is not rejected for stock market variable.

Table 4.6 presents the results for model B and suggests that in the short-run stock market system (VT) also Granger causes real GDP and it is significance at 5% level. In the long-run, the weak exogeneity tests indicate unidirectional causality from real GDP to financial development using both the banking system (BCP) and stock market variable (VT). However, there is no short-run causality between the banking system and economic growth and this is consistent with Ang and McKibbin (2007) results for Malaysia. The strong exogeneity tests also support the evidence of weak exogeneity.

Table 4.5: Model A {RGDP, INV, BCP, TR} Granger non-causality tests

Hypothesis	Short-run Granger non- causality	Weak exogeneity test	Strong exogeneity test
Ho: Δ BCP $\rightarrow \Delta$ GDP	(all $\beta_{13i}=0$)	($\alpha_{11}=0$)	(all $\beta_{13i}=\alpha_{11}=0$)
Chi-square	9.163(4)	11.75(1)*	15.05(5)**
Ho: Δ TR $\rightarrow \Delta$ GDP	(all $\beta_{14i}=0$)	($\alpha_{11}=0$)	(all $\beta_{14i}=\alpha_{11}=0$)
Chi-square	10.63(4)**	11.75(1)*	15.31(5)*
Ho: Δ GDP $\rightarrow \Delta$ BCP	(all $\beta_{31i}=0$)	($\alpha_{31}=0$)	(all $\beta_{31i}=\alpha_{31}=0$)
Chi-square	13.13(4)**	7.849(1)*	13.69(5)**
Ho: Δ GDP $\rightarrow \Delta$ TR	(all $\beta_{41i}=0$)	($\alpha_{41}=0$)	(all $\beta_{41i}=\alpha_{41}=0$)
Chi-square	2.368(4)	0.00008.13(1)	2.514(5)

Numbers in parentheses represent the degree of freedom for the chi-square. (*), and (**) imply 1% and 5% level of significance respectively.

Table 4.6: Model B {RGDP, INV, BCP, VT} Granger non-causality tests

Hypothesis	Short-run Granger non- causality	Weak exogeneity test	Strong exogeneity test
Ho: Δ BCP $\rightarrow \Delta$ GDP	(all $\beta_{13i}=0$)	($\alpha_{11}=0$)	(all $\beta_{13i}=\alpha_{11}=0$)
Chi-square	6.261(4)	12.04 (1)*	13.75(5)**
Ho: Δ VT $\rightarrow \Delta$ GDP	(all $\beta_{14i}=0$)	($\alpha_{11}=0$)	(all $\beta_{14i}=\alpha_{11}=0$)
Chi-square	10.01(4)**	12.04(1)*	14.31(5)*
Ho: Δ GDP $\rightarrow \Delta$ BCP	(all $\beta_{31i}=0$)	($\alpha_{31}=0$)	(all $\beta_{31i}=\alpha_{31}=0$)
Chi-square	7.673(4)	2.873(1)	8.741(5)
Ho: Δ GDP $\rightarrow \Delta$ VT	(all $\beta_{41i}=0$)	($\alpha_{41}=0$)	(all $\beta_{41i}=\alpha_{41}=0$)
Chi-square	1.842(4)	2.402(1)	3.273(5)

Numbers in parentheses represent the degree of freedom for the chi-square. (*), and (**) imply 1% and 5% level of significance respectively.

The parsimonious vector error correction model (VECM) for both models are presented in table 4.7 and 4.8 respectively. The parsimonious VECM is obtained following general to specific framework. In Model A, the long-run causality (ECM_{t-1}) suggests bidirectional causality between financial development and economic growth using the banking system (BCP) and unidirectional causality for economic growth to stock market system (TR). Model B also shows unidirectional causality from economic growth to stock market system (VT) and bidirectional causality between financial development and the banking system (BCP). The overall results are consistent with the Wald test results. The diagnostics tests are good except for BCP that fails the normality test in both models A and B[35].

Table 4.7: Model (A) Parsimonious VECM

Variables	ΔRGDP	ΔBCP
C	0.001(4.55)*	0.0119(1.84)
Δ $RGDP_{t-1}$	0.435(3.94)*	4.254(2.09)**
Δ $RGDP_{t-3}$	-	-3.659(-2.50)**
Δ INV_{t-2}	0.069(2.37)**	-
Δ INV_{t-4}	0.080(2.11)**	-
Δ TR_{t-1}	-0.002(-2.87)*	-0.035(-2.40)**
Δ TR_{t-2}	-0.001(-2.44)*	-0.031(-2.92)*
Δ TR_{t-3}	-0.001(-2.35)*	-
ECM_{t-1}	-0.056(-2.95)*	-0.060(-3.12)*
$AdjR^2$	0.477	0.149
B-GLM test χ^2	0.221	0.099
Hetro. test χ^2	0.223	0.369
Normality	0.259	0.033

Asterisks indicate the following level of significance, *1% and **5% respectively using t- statistics.

[35] Gonzalo, (1994 p.221) has explained that there is no problem when normality test fails particularly under Johansen (1988) cointegrating framework. This is because the procedures of reduced rank simultaneous least squares do not make any assumption about the distribution error term.

Table 4.8: Model (B) Parsimonious VECM

Variables	ΔRGDP	ΔBCP	ΔINV
C	0.002(4.71)*	0.0075(1.146)	-0.0065(-4.22)*
Δ $RGDP_{t-1}$	0.391(4.56)*	-	-
Δ $RGDP_{t-3}$	-	-	1.094(3.45)*
Δ $RGDP_{t-4}$	-		0.932(2.78)*
Δ INV_{t-2}	0.061(2.32)**	-0.763(-1.779)***	-
Δ INV_{t-3}	-	-	0.159(2.74)*
Δ INV_{t-4}	0.070(2.94)*	-	-
Δ BCP_{t-1}	-	-	0.045(2.66)*
Δ BCP_{t-2}	-	-	0.029(2.32)**
ΔVT_{t-1}	-	0.0133(2.003)**	
ΔVT_{t-2}	-	-	-0.001(-1.98)*
ΔVT_{t-4}	-	0.020(2.926)*	-
ECM_{t-1}	-0.032(-2.89)*	0.033(2.218)**	-0.046(-2.53)*
$AdjR^2$	0.338	0.161	0.425
B-G LM test χ^2	0.321	0.467	0.184
Hetro. test χ^2	0.020	0.295	0.542
Normality	0.144	0.009	0.070

Asterisks indicate the following level of significance,*1%, **5% and ***10% respectively using t-statistics.

4.3.4 Generalised Impulse Response Function

The results of generalised impulse responses for unrestricted VAR level are shown in figure (4.1) together with a 10,000 Monte Carlo simulation and two-standard error band. The dynamic responses are obtained from twentieth quarter time-intervals. At the initial stage, it shows that the responses of all the variables in the system are due to their own shocks although this gradually decreases over time. This means that the variables return to the previous equilibrium value of zero if there are no further shocks over some periods. In this study, since we are interested in the causal flows between financial development and economic growth, only the impulse responses for GDP, BCP, TR and VT are analysed.

From figure (4.1), model (A), it can be observed that there is a large response of each variable in the system to its own innovations. For example, the figure shows that there is immediate response of GDP to its own shock but this begins to decline after the eighth quarter. The response of BCP to GDP shock is quite minimal at the initial stage but after the eighth quarter period, the effect continues to increase even after the twentieth quarter period. Meanwhile the response of TR to a standard deviation shock from GDP is negative and not significant; but later picks up to a positive position and still the effect of the shock is not significant. However, the response of GDP to one standard deviation shock from BCP is positive and it continues after the twentieth quarter period. Although the response of GDP to TR is zero in the first quarter period, it immediately picks up and the effect continues even after the twentieth quarter. Therefore, from these results above, it can be concluded that there is bidirectional Granger causality between economic growth and financial development for banking system (BCP) and a unidirectional Granger causality from economic growth to stock market system (TR).

Figure 4.2 model A shows the generalised impulse response function at VEC restriction level. The results indicate that all the variables in the system are due to their own shocks. The response of GDP due to its own shock is quite strong and positive. Also the response of GDP to BCP and TR shocks is positive and the effect continues even after the sample period. The response of BCP to GDP indicates a positive effect by showing a significance increase in response to a standard shock in GDP, but the response of TR to GDP shock is negative and not significant. The overall results of generalised impulse response function with restriction indicate a bidirectional causality between financial development and economic growth with banking system (BCP) and unidirectional causality from GDP to stock market system (TR). The evidence here is consistent with the Wald test Granger non-causality and also with unrestricted level VAR.

Figure 4.1: Model A: Generalised impulse response at VAR level

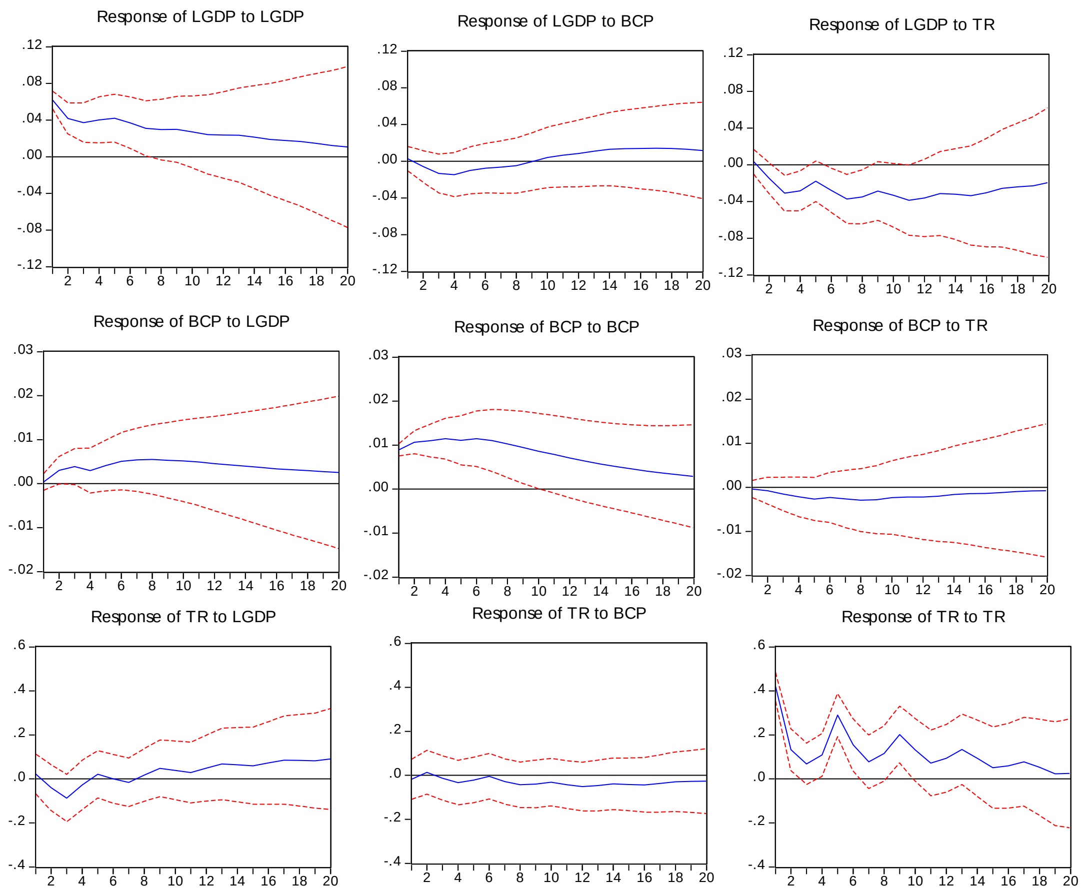
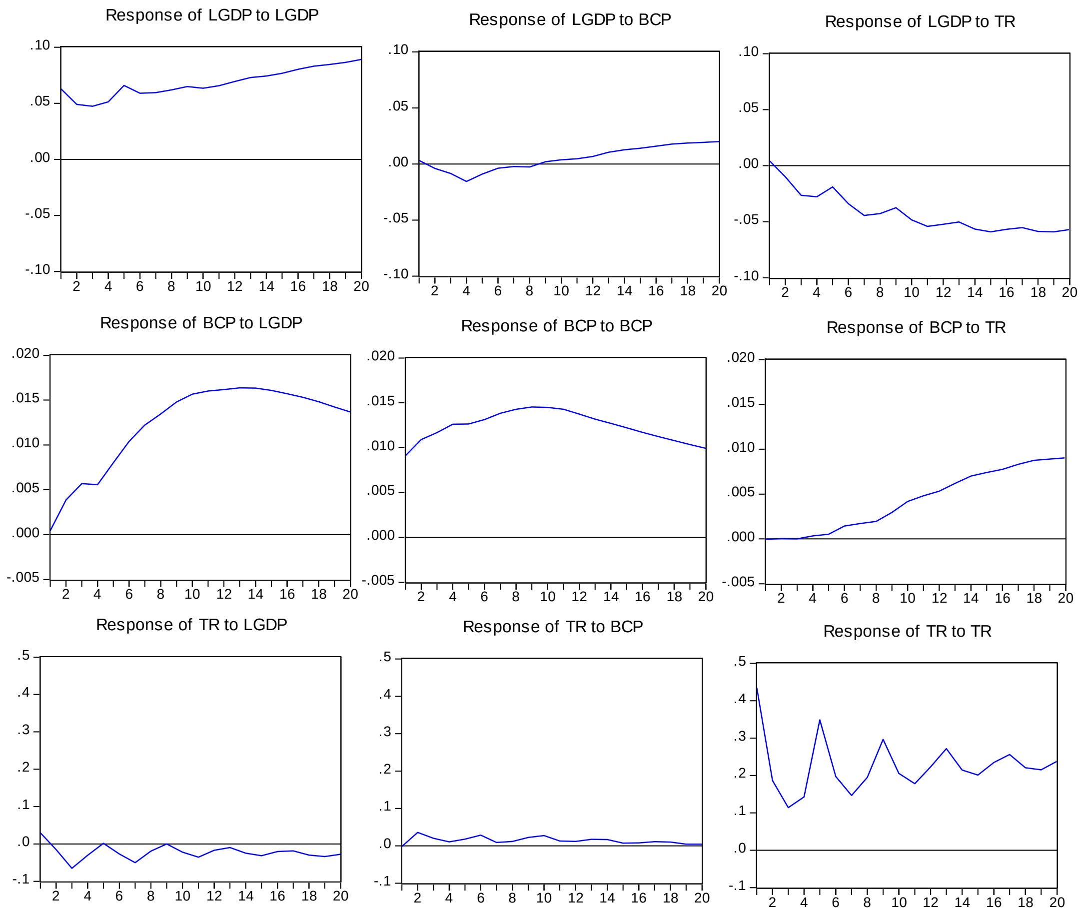


Figure 4.2: Model A: Generalised impulse response at restricted VEC level



The model B presents the generalised impulse response both at unrestricted VAR level and cointegrated level. The unrestricted VAR level is presented in figure 4.3. It can be observed that there is an immediate response of GDP, BCP and VT to their own shocks. The effect shocks of GDP and BCP continue after the twentieth quarter, while the shock of VT to its own shocks dies out after the twentieth quarter. The response of BCP to a standard deviation shock in GDP is quite positive; the effect begins to increase as from the eighth quarter and it continues beyond the sample period. Also the response of VT to a standard deviation shock in GDP shows an immediate effect but drops to zero level after the second quarter. However, it does pick up again to a positive level and the effect continues to increase beyond the twentieth quarter. Meanwhile, the response of GDP to a one standard deviation shock in BCP dies out in the tenth quarter and after that period, it goes to negative and this continues beyond the sample period. The generalised impulse response for BCP shocks tends to lead to a positive increase in GDP; and that of VT to GDP indicates a positive effect by showing a significance increase in response to a standard deviation shock in GDP. The overall results indicate unidirectional Granger causality from economic growth to financial development using banking system (BCP).

Figure 4.4 indicates the generalised impulse response function at VEC restriction level. It is shown that the response of GDP to a shock to BCP and VT are positive but quite weak. The impulse responses of BCP and VT to a shock in GDP are also positive and significant. The overall results indicate unidirectional causality from GDP to BCP (banking system) and VT (stock market system)

Figure 4.3: Model B: Generalised impulse response at VAR level

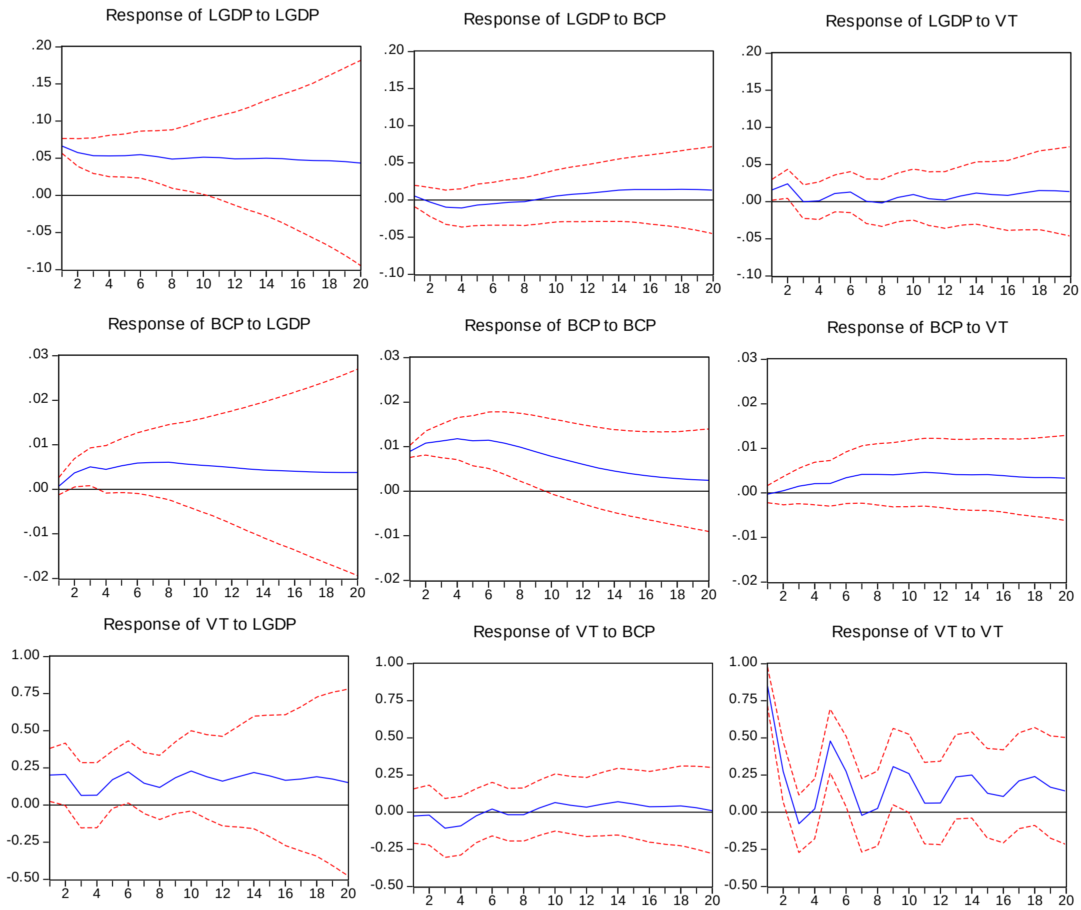
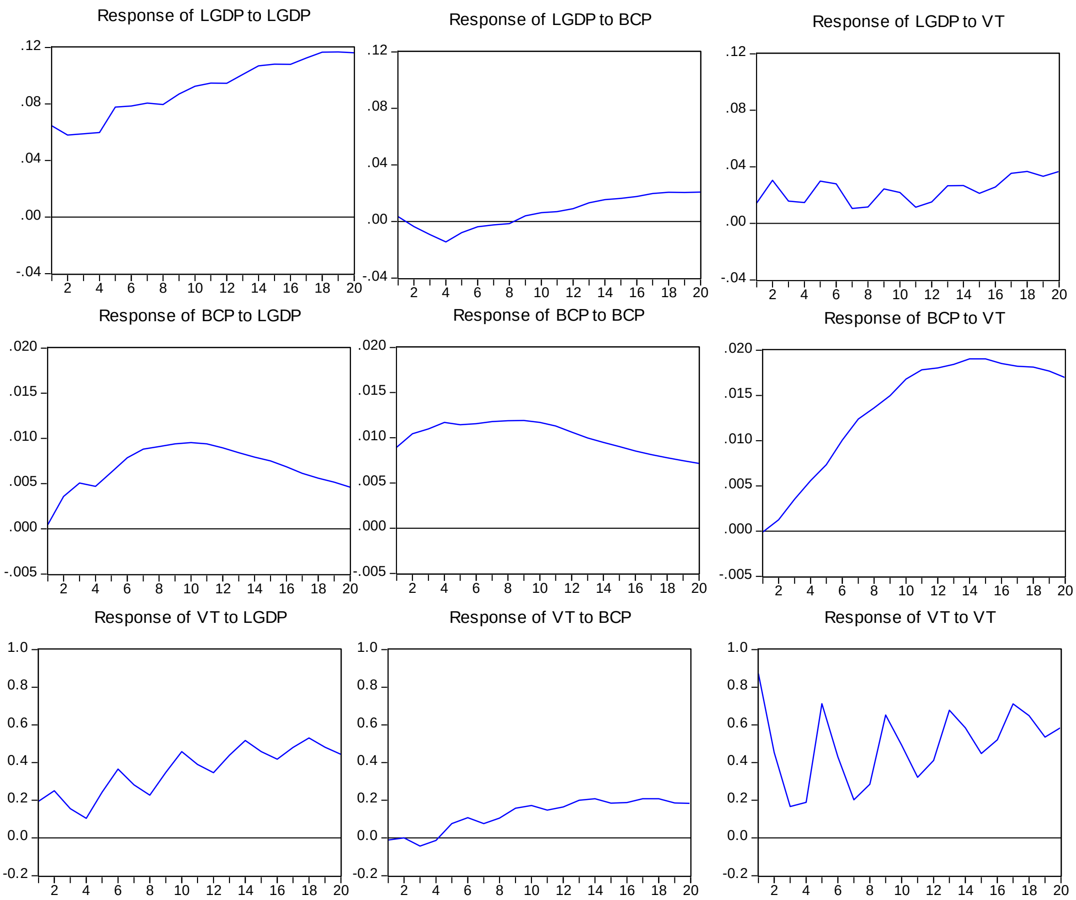


Figure 4.4: Model B: Generalised impulse response at restricted VEC level



4.3.5 Variance Decomposition

The results of variance decomposition at unrestricted level VAR reveal the forecast error in each variable that can be attributed to innovations in other variables over twentieth quarterly periods. In model A, the forecast error variances of all the variables in the system are largely due to their own innovations, although over time the innovations of other variables show a tendency to increase gradually.

The results in table (4A) in the appendix first shows the variance decomposition of GDP and indicates that a large percentage of forecast error is due to its own innovations (about 66% up to twentieth quarter), while the innovations of BCP, INV, and TR explain about 14%, 10%, and 11% respectively of the variation in GDP. The variance decomposition of investment shows that about 75% forecast error variance is due to its own innovation in the fourth quarter. This percentage, however, declines to 39% in the twentieth quarter and GDP, BCP, and TR explain about 49%, 48% and 4% respectively of the variation in INV. The variance decomposition of BCP indicates that about 65% of innovations in BCP are due to its own shocks in the fourth quarter (accounted for about 65%); however, by the twentieth quarter this percentage declines to 28%. On the other hand, GDP, INV and TR explain about 34%, 3% and 35% of the variation in the BCP during the twentieth quarter. The variance decomposition of TR indicates that in the first quarter period, 91.5% of the forecast error variances are due to its own innovations and in the twentieth quarter, it declines to 80.6%. The remaining variation in the forecast error variances are explained by GDP (3.5%), INV (4.3%) and BCP (11.5%) respectively.

Table (4B) in the appendix presents the results of variance decomposition at the VEC level for model A with normalisation on GDP. The results indicate that a large percentage of forecast error variances are due to their own innovations, which is almost consistent with the unrestricted VAR estimate of variance decomposition. The GDP indicates that 87% of forecast error variance is due to its own innovation in the fourth quarter. This declines to 54% in the twentieth quarter while the shocks of INV, BCP and TR explain about 1%, 33% and 12% respectively. For the BCP, 62.6% of the forecast error variances are due to its own innovations; it however declines to about 40% in the twentieth quarter while the remaining variations of about 27%, 1% and 33% are explained by GDP, INV and TR respectively. In the TR variance decomposition, it shows that 95.7% of the forecast error variances are due to its own innovation in the fourth quarter. The trend however continues to increase from 95.7% to 97.5% in the twentieth quarter while only 0.6%, 0.6% and 1.27% are explained by GDP, INV and BCP respectively.

For model B, the results are presented in table (4C) of the appendix and the forecast error variances at unrestricted VAR level are analysed. It indicates that forecast error variances of GDP are mainly explained by its own shocks from the fourth quarter to the twentieth quarter, although it shows gradual decline from 98% in the fourth quarter to 65% in the fifth quarter. By the twentieth quarter, the forecast error variances explained by INV, BCP, and VT are 21%, 3% and 10.8% respectively. The variance decomposition of investment equally shows that the forecast error variances are due to its own innovations. This accounts for about 79% in the fourth quarter and later declines to 43.4% in the fifth quarter and in the same time period, GDP accounts for 41%, BCP 12.5% and VT 2.7% respectively of the variation in INV. It can also be observed that most of the forecast error variances of BCP are explained by its own shocks; accounting for about 89% of innovations in the first time period and later declining to 76% in the twentieth quarter. Meanwhile, the innovations of GDP, INV and VT explain 18.9%, 1.5% and 3.0% respectively of the variation in BCP in the twentieth quarter. The variance decomposition of VT also indicates that a high percentage (79.9%) of variations is due to its own shocks in the fourth quarter. The variations of 6.9%, 3.4% and 9.7% are explained by GDP, LINV and BCP respectively. By the twentieth quarter, the forecast error variances of VT has declined to 40.6% from about 80% in the fourth quarter and that of GDP increases to 38.8% in the fifth quarter. The remaining percentages of 1.5% and about 19% of INV and BCP explained the variations in VT respectively.

Table (4D) indicates variance decomposition with VEC restriction for model B. The results show that a large percentage of the forecast error variance are due to their own innovations; that is both the GDP, BCP, and VT show clearly that large variations in the forecast error are explained by their own innovations. This however declines over a period of time. The results obtained are quite consistent with the estimate of unrestricted VAR for model B.

4.4 Conclusions

The objective of this study is to examine the causal relationship between stock market development and economic growth while controlling for banking system in South Africa using quarterly time series data from 1983:q1-2007:q4. The study uses Vector Error Correction Model- (VECM) based causality tests to establish a link between financial development (represented by both banking and stock market systems) and economic growth.

Generalised impulse response function (GIRF) and variance decompositions (VDC) are computed and analysed to further evaluate the interrelationships among the variables of interests. The empirical investigation suggests that in the long-run, there is evidence of bidirectional causality between financial development and economic growth using the banking system proxy by bank credit to private sector (BCP). However, when stock markets variables are used - turnover ratio (TR) and value of shares traded (VT) - the results indicate unidirectional causality from economic growth to stock market system. The impulse response function (IRF) and variance decompositions (VDC) indicate that financial development (BCP, TR, and VT) have short-run effects on economic growth at the immediate year of initial shocks, and VDCs shows that all the indicators for financial development contain some viable information in predicting future economic growth.

From this study, it is indicated that the South African financial market has not played a significant enough role in the growth process of the South African economy. Since the advent of democracy in the 1990s, South Africa's financial system has undergone massive restructuring in line with market-based liberalisation reforms. Although these reforms have now made the South African financial market into one of the best in the world by providing world class financial infrastructure and services, the country has not yet been quite as successful in translating these achievements into proper growth process. It is therefore recommended that there is the need to further develop more policies that would deepening the equity market in South Africa so that it can complement other sectors of the economy in achieving a sustained growth.

CHAPTER 5

FINANCIAL LIBERALISATION, STRUCTURAL BREAKS AND MARKET VOLATILITY: EVIDENCE FROM NIGERIAN AND SOUTH AFRICAN EQUITY MARKETS

5.1 Introduction[36]

The main objective of this study is to examine the effect of financial liberalisation on stock market volatility using EGARCH model for South African and Nigerian equity markets. Therefore, the plan is to build a good time-series model and test for the effect of financial liberalisation on stock market volatility. To achieve this objective, the study starts with endogenous structural break tests using the Bai and Perron (2003) OLS-type test and the CUSUM-type test of Inclan and Tiao (1994) and Sanso et al. (2004) respectively. These breaks are performed at two levels: first in the stock returns and second in the conditional variances over pre- and post-liberalisation periods. Considering structural breaks both in the stock returns and in the conditional variance is a major contribution of this study because it departs from previous studies that consider breaks at unconditional variance of stock returns only to analyse volatility. The significant break points identified through algorithm are incorporated into EGARCH models. Another important departure from the previous studies is the examination of the effect of financial liberalisation. The study analyses this by adding a liberalisation dummy using official liberalisation dates to the augmented EGARCH model. Overall, the findings show that none of the estimated break dates coincide with the official liberalisation dates for the two countries. The analysis further shows that after taking structural breaks into account, volatility declines following financial

[36] I am quite grateful to the participants for their insightful comments during the Midwest Economic Association Conference in Illinois, Chicago, United State which was held on 18th -21st March, 2010. I am also grateful to the participant at the 15th annual conference of the African Econometric Society Conference held in Egypt on the 7th-9th July 2010.

liberalisation. Also, after using official liberalisation dates, the results indicate that the effect of financial liberalisation for the two countries is negative and statistically significant.

This study consists of four sections: following the introduction, Section two comprises econometric methodology; section three consists of estimation results and analysis. The conclusion is section four.

5.2 Econometric Methodology

This sub-section consists of model specifications; endogenous structural breaks, the Exponential GARCH model, the news impact curves specification and day of the week models.

5.2.1 Structural break Test

The issue of multiple endogenous structural breaks has generated a great deal of research interest in financial time series. Some of the recent approaches include the cumulative sum of square test, the CUSUM-type test, such as the iterated cumulative sums of squares (ICSS) algorithm by Inclan and Tiao (1994) to test the structural breaks in unconditional variance. Others include locating structural breaks in mean or/variance (Andrew et al. 1996,, Lumsdine and Papell 1997, Bai and Perron 1998, 2003). However, in recent times, the CUSUM-type test of Inclan and Tiao (1994) of locating structural breaks at variance has been applied in many empirical works on stock market volatility but Sanso, Arago and Carrion (2004) and Andreou and Ghysels (2002) have shown that the ICSS algorithm of Inclan and Tiao (1994) suffers from size distortion since it does not consider the fourth moment properties of the disturbances and the conditional heteroskedasticity. Therefore, in this study, the main endogenous break test used is the Bai and Perron (2003) OLS-type test. Meanwhile, in addition to this, the

CUSUM type tests of Sanso, Arago and Carrion (2004) and Inclan and Tiao (1994)[37] serve as complementary tests.

5.2.2 Bai and Perron (2003) – Least square type Test

Bai and Perron (2003) present an efficient algorithm that considers multiple structural changes in a linear model estimated by least squares. This sequential test consists of locating the breaks one at a time, conditional on the breaks that have already been located. It is an efficient algorithm of obtaining global minimisers of sum of squared residuals.

Consider the following linear regression M breaks (m+1regimes)

$$
\begin{aligned}
y_t &= x_t'\beta + z_t'\delta_1 + u_t, \; t = 1,....,T_1, \\
y_t &= x_t'\beta + z_t'\delta_2 + u_t, \; t = T_1+1,....,T_2, \\
&\vdots \\
y_t &= x_t'\beta + z_t'\delta_{m+1} + u_t, \; t = T_m+1,....,T.
\end{aligned} \tag{1}
$$

Where y_t is the observed dependent variable at time t; $x_t(p\times 1)$ and $z_t(q\times 1)$ are vectors of covariates and β and δ_j $(j=1,\cdots,m+1)$ are vectors of coefficients and finally u_t is the disturbance at time t. However, the break points $(T_1,\cdots,T_m)$ are treated as unknown. The aim is to estimate these unknown regression coefficients and break points using a sample of T observation. The model presents two structural changes: the pure structural change model and the partial structural change model. In the pure model, all coefficients are different in each regime while in the partial one some of the coefficients are different in each regime. For each M- partition $(T_1,\cdots,T_m)$ denoted (T_j) the associated least squares estimate of β and δj are obtained by minimising the sum

[37] I would like to thank Mikail Karoglou for providing the gauss codes for Inclan and Tiao (1994).

of squared residuals as $S_T(T_1,\cdots,T_m)$, the estimated break point $(T_1,\cdots,T_m)$ =argmin $_{T1,\cdots,Tm} s_T(T_1,\cdots,T_m)$, where the minimisation is taken overall partition $(\hat{T}_1,\cdots,\hat{T}_m)$ such that $T_i,\cdots,T_{i-1} \geq q$ Thus the break-point estimator is global minimiser of the objective function.

In order to detect the number of multiple structural breaks, Bai and Perron (1998, 2003) developed a set of tests; the sup F type test, the double maximum tests and the test of ℓ versus $\ell+1$ breaks.

The sup F type test is carried out under the null hypothesis of no structural breaks $(m=0)$ versus alternative hypothesis that there are $m=k$ breaks.

The second type of test is the double maximum and this is carried out under the null hypothesis of UDmax and WDmax of no structural breaks against an unknown number of breaks given some upper bound M. The UDmax gives an equal weight while the WDmax test gives weight to individuals test in such a way that the marginal p values are equal across the values of M bound.

The third test is the sequential test $\sup F_T(\ell+1/\ell)$ where the null hypothesis is ℓ number of structural breaks and the alternative hypothesis is $\ell+1$ number of breaks. It amounts to application of $(\ell+1)$ tests of the null hypothesis of no structural change as against the alternative hypothesis of single change.

To run these tests, it is necessary to decide the minimum distance between two consecutive breaks, h; this is obtained as the integer part of trimming parameter, ε, multiply for the number of observation T [38]

[38] The critical values are obtained from Bai and Perron (2003). M is the maximal number of breaks allowed and h is the minimal length of a segment. The $\varepsilon(h)$ can take the critical values of 0.5, 0.10, 0.15, 0.20 and 0.25 respectively. This study uses $\varepsilon = 0.15$ and allows up to five breaks for the full sample size analysis.

Bai and Perron (2003) suggest three selection criteria: the Bayesian Information Criterion (BIC), the modified Schwarz criterion, and the Bai and Perron (1998) criterion which is based on sequential application of the $\sup F_T(\ell+1/\ell)$ test where the m breaks are estimated from the data in a sequential manner to determine the number of breaks.

5.2.3 The CUSUM-type Tests

In addition to Bai and Perron's (2003) least square method of structural break test, the study also applies two CUSUM-type tests: The Inclan and Tiao (1994) and Sanso et al. (2004) respectively. The two tests are based on the cumulative sum of squared returns and complement the OLS test of Bai and Perron (2003). Usually these tests show that if there is a break point in the series then the cumulative sums should depart from the normal behaviour of the data.

The Inclan and Tiao (1994)

This test is designed to endogenously find a break point in the unconditional variance of a stochastic process with unknown location. The test is based on the assumption that the disturbances are independently and identically distributed. The Inclan and Tiao (henceforth, I&T) test statistic can be specified as follows:

$$\text{I\&T}=\sqrt{\frac{T}{2}}\max_k(D_k) \qquad (2)$$

$D_k = \dfrac{C_k}{C_T} - \dfrac{k}{T}$, $k = 1,...,T$, with $D_0 = D_T = 0$ is the centred cumulative sum of squares function whose value can be expressed as usual F statistics for testing equality of variance among independent sub-samples. While $C_k = \sum_{t=1}^{K} \varepsilon_t^{\,2}, K = 1,2,........T$ is the cumulative sum of squares of series (ε_t), where ε_t is the return series with a zero-mean and identically and independently distributed random variables $iid(0\delta_t^{\,2})$. T is the sample size and the break date is taken to be the maximum D_K. Meanwhile, with homogenous variance the plot of D_K should oscillate around zero. When there is a break point, the D_K goes beyond the specified boundaries with high probability. The asymptotic distribution follows the Brownian Bridge.

Sanso et al. (2004)

Sanso et al. (2004) criticise the I&T test by showing that the test is particularly not effective for financial time series because it is based on the assumption of normally, identically and independently distributed random variables ε_t. Such an assumption, according to them, is unlikely to hold particularly for financial time series data. They indicate that the asymptotic distribution of the I&T will only hold on the condition that the stochastic process is mesokurtic and the conditional variance is constant which is unlikely for financial data. It therefore creates size distortions especially for leptokurtic and platykurtic innovations, and further shows that the size distortion is more severe for heteroskedastic conditional variance because the test is not free from nuisance parameters due to some persistence in the conditional variance. This results in spurious changes in the unconditional variance. To overcome these problems, they propose two new tests that consider the fourth moment properties of the disturbances and the conditional heteroskedasticity. Therefore, the first test of Sanso, Arago and Carrion (henceforth, SAC1) is defined as follows:

$$SAC_1 = K_1 = \underset{K}{SUP}\left|T^{-1/2}B_K\right| \qquad (3)$$

Where $B_K = \dfrac{C_k - \frac{K}{T}C_T}{\sqrt{\hat{\eta}_4 - \hat{\sigma}^4}}$ $C_K = \sum_{t=1}^{K}\varepsilon_t^{\,2}, k = 1,2,........T$, $\hat{\eta}_4 = \sum_{t=1}^{T}\varepsilon_t^{\,4}$ and $\hat{\sigma}^2 = T^{-1}C_T$

The second test of SAC:

According to Sanso et al. (2004), both I&T and K1 tests depend on the assumption of $iid(0\delta_t^2)$ but this assumption is too strong for financial data especially when there is evidence of conditional heteroskedasticity. Meanwhile, in order to allow for persistence in the conditional variance, they propose the second test of K2. This test requires some additional assumption that would allow imposition of the existence of moments greater than four and a common unconditional variance for all the variables in the sequence and this is expressed as Sanso, Arago and Carrion (henceforth, SAC2):

$$SAC_2 = k_2 = \underset{k}{SUP}\left|T^{-1/2}G_k\right| \tag{4}$$

Where $G_k = \hat{\omega}_4^{-1/2}(C_K - \frac{k}{T}C_T)$, $\hat{\omega}_4$ is a consistent estimator of ω_4 and this is interpreted as the long-run fourth moment of ε_t or the long-run variance of the zero-mean variance $\xi \equiv \varepsilon^2{}_t - \sigma^2$

$$\hat{\omega}_4 = \frac{1}{T}\sum_{t=1}^{T}(\varepsilon_t^{\,2} - \hat{\sigma}^2)^2 + \frac{2}{T}\sum_{l=1}^{m}\omega(l,m)\sum_{t=l+1}^{T}(\varepsilon_t^{\,2} - \hat{\sigma}^2)(\varepsilon_{t-1}^{\,2} - \hat{\sigma}^2)$$

Where $\omega(l,m)$ is a lag window like the Bartlett which is defined as $w(l,m) = 1 - l/(m+1)$, or the quadratic spectral. According to them, the estimator depends on the selection of the bandwidth m, which can be chosen using an automatic procedure proposed by Newey-West (1994)[39]

[39] It should however be noted that Bai and Perron (2003) usually gives lower number of breaks than those of the ICSS algorithm. Direct comparison may not be possible because, for example, Bai and Perron's method set some constraint on the number of potential breakpoints. The algorithm assumes that there exists a certain distance "q" between points.

5.2.4 EGARCH Model

Before specifying the EGARCH model, it is necessary to begin briefly with a review of the ARCH and GARCH models. Engle (1982) develops a new class of stochastic process; the Autoregressive Conditional Heteroskedasticity (ARCH) model which is a process where the conditional variance is a function of lagged squared residuals. Meanwhile, Bollerslev (1986) introduces the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) which is an extension of Engle's original work. It allows the conditional variance to be a function of the lagged variance; i.e. it allows for both autoregressive and moving average (ARMA) components in the heteroskedasticity variance. He shows that the GARCH model allows a better representation of the volatility process while being more parsimonious. The ARCH model can be specified as follow:

$$R_t = \alpha 0 + \sum_{i=1}^{k} \alpha_{1t-1} R_{t-1} + \varepsilon_t \quad (5)$$

$$\varepsilon_t / \Omega_{t-1} \approx N(0, h_t) \quad (6)$$

$$h_t = \alpha 0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 \quad (7)$$

Where in equation (18), R_t indicates the rate of stock market index at time t and R_{t-1} is the rate of stock market index at time $t-1$; while, $\alpha 0$ and $\alpha 1$ are the intercept and coefficient of the lagged rate return of the stock market respectively. The number of lag k in equation (18) is determined through the usual Box-Jenkins approach. Equation (19) indicates that N is the conditional normal distribution with zero mean and variance h_t and Ω_{t-1} is the information available to time $(t-1)$. In equation (20), h_t is the conditional variance at the current time t and $\alpha 0$ is a constant term, and $\varepsilon^2{}_{t-1}$, which is measured as the lags of the squared residual, represents the news about volatility from the past periods. The non-negativity restrictions on $\alpha 0$ and α_i are needed in order to guarantee h_t >0 and the upper bond α_i <1. This is needed in order to maintain the conditional variance stationary. Bollerslev (1986) extended Engle's original work by allowing both autoregressive and moving average (ARMA) components in the heteroskedasticity variance. Therefore, the GARCH model of Bollerslev introduces one more term into the right-hand side of equation (20)

$$h_t = \alpha 0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{i=1}^{P} \beta_j h_{t-j} \tag{8}$$

In the equation (21) above, h_{t-j} is the GARCH term which shows news of the last periods forecast conditional variance; while p and q are the number of lags from residuals and from variance h_t. They are specified based on the Box-Jenkins approach and the values of $\sum \alpha + \sum \beta < 1$. Since h_t is the forecast variance of the past period information, it is called the conditional variance.

However, Nelson (1991) argues that the GARCH model tends to have some drawbacks and introduces exponential generalised autoregressive conditional heteroskedasticity (EGARCH). He notes that EGARCH performs better than other GARCH models. In the first place, the EGARCH model does not require a condition of restriction which will ensure that all estimated coefficients are positive. Another advantage of using the EGARCH model is that it captures the asymmetric characteristics of data, "the leverage effect" which shows that volatility tends to rise in response to bad news (i.e. lower unexpected stock returns) and fall in response to good news (i.e. higher unexpected stock returns). This idea is motivated by earlier empirical work of Black (1976), Christie (1982) and French, Schwert and Stambaugh (1987). Therefore, good news and bad news have different predictability for future volatility as against other GARCH models which show symmetric effects. The study employs the

EGARCH model and it is specified under two equations, the mean and conditional variance equations.

Mean equation

$$Yt = \mu + \varepsilon_t \quad (9)$$

Variance equation

$$\log(\sigma^2) = \omega + \beta.\log(\sigma^2{}_{t-1}) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] \quad (10)$$

Where ω, β, γ and α are constant parameters. In the EGARCH model specified above, the natural logarithm of the conditional variance $\log(\sigma^2)$ is affected by the natural logarithm of conditional variance in past period $\beta.\log(\sigma^2_{t-1})$; that is, it measures the impact of last period's forecast variance. A positive β indicates volatility clustering which indicates that positive stock price changes are associated with future changes and vice versa. The unconditional normalised standard deviation in absolute values is being explained by α . In other words, it captures the magnitude of the shock. The γ measures the leverage effect; ideally γ is expected to be negative showing that bad news has bigger impact on volatility than good news of the same magnitude. While α coefficient is introduced which is ARCH term that measures the effect of news about volatility from previous period on current period volatility, while ε_{t-1} is the residuals from mean equation. The news impact curve (NIC) relates ε_{t-1} to σ^2 in such a way that past stock returns are related to current volatility.

5.2.5 The Combined EGARCH Model with Dummy variables:

The inclusion of dummy variables in GARCH models have been used in several empirical studies. This can be seen in the works of Diebold (1986), Lastrapes (1989), Hamilton (1990, 1994), Lamoureux and Lastrapes (1990) and Aggarwal et al. (1999) among others.[40]

Lamoureux and Lastrapes (1990) observe that persistence in volatility can be due to structural shifts in unconditional variance and, if not properly accounted for, could lead to misinterpretation of estimates of persistence in variance. After using a sample size of 4228 observations and using maximum likelihood of BHHH algorithm, their results indicate that the sums of GARCH parameters decrease when dummies are included in the variance equation. The same conclusions are also reached by Sumsel (2000), Malik et al. (2005) and Cunado et al. (2006). However, this study departs from previous studies by considering the breaks in the stock returns and in the conditional variance to assess the impact of financial liberalisation on market volatility.

In this section, the combined EGARCH model is used. This is achieved by including dummy variables in the EGARCH specified in equations (22) and (23) above, respectively. Although standard GARCH and EGARCH models are capable of capturing time varying volatility, they fail to capture breaks in the data that are caused by activities such as economic, political and financial events. Therefore, the EGARCH models in equations (22) and (23) are modified respectively to include sudden changes in mean and in variance equations.

This study first detects sudden changes or break points in the stock returns by using Bai and Perron's (1998, 2003) methodology and the CUSUM- type tests of Inclan and Tiao (1994) and Sanso et al. (2004) respectively. The second structural break test is on the conditional variance using only Bai and Perron's (1998, 2003) OLS-type tests. The break dummies for the stock returns are introduced in the mean equation and those of conditional variance are introduced in the variance equation of the model. The

[40] Lastrapes (1989): it should be noted that his work is based on exchange rate volatility and results also indicate that after including dummies in the GARCH model, the degree of ARCH persistence decreases.

combined EGARCH (1, 1) with dummy variables for sudden changes both in the mean and in the conditional variance can be specified as follows:

$$y_t = \mu + d1E1 + d2E2 + d3E3 + \varepsilon_t \qquad (11)$$

$$\log(\sigma^2) = \omega + \beta \log(\sigma^2{}_{t-1}) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + d1E1 + d2E2 + d3E3 \qquad (12)$$

Where E1, E2, E3, are the dummy variables taking the value of one from each break point in the mean and variance onwards and zero elsewhere.

The news impact curve: Following Engle and Ng (1993), the study also plots the news impact curves from the parameters of EGARCH. The curves exhibit the relationship between the news and future volatility and it is centred at $\varepsilon t - t = 0$. It increases exponentially in both directions but with different parameters for positive and negative values of the residuals.

$$ht = A \exp\left[\frac{(\gamma + \alpha)}{\sigma} \varepsilon_{t-1}\right] \text{ for } \varepsilon_{t-1} > 0$$

(13)

$$ht = A \exp\left[\frac{(\gamma - \alpha)}{\sigma} \varepsilon_{t-1}\right] \text{ for } \varepsilon_{t-1} < 0$$

Where $A \equiv \sigma^{2\beta} \exp\lfloor w - \alpha\sqrt{2/\pi} \rfloor$, σ is the standard deviation and w is the constant term, β is the parameter for the log (h_{t-1}) term, while α is the parameter for the $|\varepsilon_{t-1}|/\sqrt{h_{t-1}}$ term and γ is the parameter for the $\varepsilon_{t-1}/\sqrt{h_{t-1}}$ term in the EGARCH log-variance equation.

5.2.6 The Day of Week Effect

The issue of the day of the week or anomalies in stock returns, foreign exchange and T-bill markets are well documented and widely examined in the literature of financial markets. This study uses the daily data to examine the day of the week effect for both South Africa and Nigeria. Bekaert and Harvey (1995) explain that mean returns in financial assets usually depict low predictability from the past due to moving average error term induced by the calendar effect. Earlier work in this area includes Cross (1973), French (1980), Gibbons and Hess (1981), Keim and Stambaugh (1984) and Aggarwal and Rivoli (1989). All of the above works focus only on the mean returns of the stock market and use the Ordinary Least Squares (OLS) estimation method of regressing returns on five daily dummy variables.

Meanwhile, recent empirical studies tend to consider not only the mean returns but also the variances in returns - Hsieh (1988), Berument and Kiyamaz (2001), Kiyamaz and Berument (2003) and Yalcin and Yucel (2006). Engle et al. (1993) points out that those risk-averse investors would reduce their investment following higher return volatility. Therefore, consideration of both returns and volatility are critical to investors. Kiymaz and Berument (2003) clearly show that investors are not only concerned about the day returns but also about the corresponding volatility of the day, and having such knowledge allows investors to adjust their portfolio by taking into account day of the week variation in volatility.

This study follows Kiyamaz and Berument (2003) by considering day of the week in both returns and variance specifications. While Kiymaz and Berument (2003) use the GARCH (1, 1) model in their work, this study uses the Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) model. The essence of using the EGARCH model is to capture the possible asymmetric effects which are not possible with GARCH (1, 1) models.

The model is specified in two ways: first is the specification of the mean returns only and the second specification comprises both day of the week effect in return and volatility equations.

$$Rt = \alpha o + \alpha_M M_t + \alpha_T T_t + \alpha_{TH} TH_t + \alpha_F F_t + \sum_{I=1}^{n} \alpha_i R_{t-i} + \varepsilon_t$$

$$\log(\sigma^2) = \omega + \beta \log(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] \tag{14}$$

$$Rt = \alpha o + \alpha_M M_t + \alpha_T T_t + \alpha_{TH} TH_t + \alpha_F F_t + \sum_{I=1}^{n} \alpha_i R_{t-i} + \varepsilon_t$$

$$Log(\sigma^2) = V_C + V_M M_t + V_T T_t + V_{TH} TH_t + V_F F_t + \omega + \beta \log(\sigma_{t-1}^2) +$$

$$\gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] \tag{15}$$

Where Rt is the return and M, T, TH and F are the dummy variables for Mondays, Tuesdays, Thursdays and Fridays at time t respectively. The small n is the lag order which is included to eliminate the possible autocorrelation in the series. Each day takes the value of 1 and 0 otherwise and Wednesday’s dummy is excluded in order to avoid the dummy variable trap.

5.2.7 Data and Official Dates for Stock Market Liberalisation

This study uses both daily and monthly stock price indexes of Johannesburg Stock Exchange (JSE) and Nigeria Stock Exchange (NSE). The daily and monthly data for South Africa are obtained from JSE and DataStream International (JSE/Actuaries and FTSE/JSE). The Nigerian daily and monthly data are obtained from Data stream International (NSE all shares index, S&P/IFCG index). The returns are obtained by the log difference change in the price index:

$$Rt = \log Pt - \log Pt - 1$$

The total sample for South African daily stock return covers the period 1 January 1990 to 31 December 2008 [4957 observations], and the monthly returns covers April 1981 to December 2008 [333 observations]. For Nigeria, the daily returns series covers 1 August 1995 to 31 December 2008 [3503 observations], and the monthly data are for the period January 1985 to December 2008 [288 observations]. However, the official liberalisation dates for the two countries are summarised in table 5.1 below:

Table 5.1: Official liberalisation dates for South Africa and Nigeria.

Country	Bekaert et al. (2003)	Fuchs-Schundeln (2003)	Bekaert et al. (2005)	Bekaert et al. (2000)	Bhattacharya and Hazem (2002)
Nigeria	08/1995	08/1995	1995	08/1995	08/1995
South Africa	1996	03/1995	1996	NA	NA

5.3 Empirical Results

The empirical results are presented in three stages: the first stage is the presentation of summary statistics and endogenous structural breaks results and discussion of events surrounding the break points. The second stage is the presentation day of the week effect. The third stage is the presentation of EGARCH, augmented EGARCH estimates and the news impact curves.

Table 5.2: Summary Statistics for Stock Returns in South Africa and Nigeria-Daily data

South Africa	Full-sample (Jan 90- Dec 2008)	Pre- liberalisation (Jan 90 – Feb 95)	Post-liberalisation (Mar 95 – Dec 2008)
Mean	0.00040	0.00041	0.00039
S.D	0.01195	0.0093	0.0128
Skewness	-0.7038	-0.4015	-0.7274
Kurtosis	11.587	5.984	11.4348
J. Bera	15641.5	535.87	11023.0
Observation	4957	1346	3611
Nigeria	**Full-sample (Aug 95- Dec 2008)**	**_**	**Post-liberalisation (Aug 95 – Dec 2008)**
Mean	0.00069	-	0.00069
S.D	0.0095	-	0.0095
Skewness	-0.0393	-	-0.0393
Kurtosis	7.0695	-	7.0695
J. Bera	2417.368	-	2417.368
Observation	3502	-	3502

Table 5.3: Summary Statistics for Stock Returns in South Africa and Nigeria-Monthly data

South Africa	Full-sample (Apr 81- Dec 2008)	Pre- liberalisation (Apr 81 – Feb 95)	Post-liberalisation (Mar 95 – Dec 2008)
Mean	0.01037	0.012123	0.008615
S.D	0.06295	0.065340	0.060607
Skewness	-1.04178	-0.736164	-1.43666
Kurtosis	6.95042	4.69912	9.854868
J. Bera	275.934	34.96225	382.112
Observation	332	166	166
Nigeria	**Full-sample (Jan 85- Dec 2008)**	**Pre- liberalisation (Jan 85 – Jul 95)**	**Post-liberalisation (Aug 95 – Dec 2008)**
Mean	0.02198	0.02855	0.01684
S.D	0.05943	0.03642	0.07222
Skewness	-0.08746	2.19364	-0.14716
Kurtosis	8.09277	11.3769	5.91339
J. Bera	310.52	469.439	57.52.3
Observation	287	126	161

Summary of descriptive statistics for both daily and monthly stock returns for South Africa and Nigeria are presented in the above tables 5.2 and 5.3 respectively. The results are presented in two periods based on official liberalisation dates. That is: pre-liberalisation and post-liberalisation periods respectively.[41]

For South Africa, the daily mean returns for the two periods are almost the same; there is just a slight decline during the post-liberalisation period. The standard deviation which is the unconditional variance in returns increases during the post-liberalisation period to 0.0128 from 0.0093 in the pre-liberalisation period. The skewness is negative in both periods under consideration and kurtosis is quite above three in the two periods clearly indicating a leptokurtic distribution. The Jarque-Bera is well above the critical value with two degrees of freedom at 1% level of significance which is a rejection of the null hypothesis of normal distribution.

For Nigeria, the descriptive statistics shows that the mean or average daily return is about 0.0069. It has negative skewness and a positive kurtosis of 7.06 indicating a leptokurtic distribution. The standard deviation appears low during the post-liberalisation period. The Jarque-Bera has a high value indicating the rejection of the null hypothesis of a normal distribution.

For the monthly stock returns, South Africa shows a decline in the monthly mean returns in the post-liberalisation period when compared with 0.0121 during the pre-liberalisation period. Standard deviation also shows a decline in the post-liberalisation period. However, skewness, kurtosis and Jarque-Bera statistics all indicate a non-normality distribution. In the case of Nigeria, the monthly mean returns also decline during the post-liberalisation period from 0.0285 to 0.0168. Standard deviation, however, increases in the post-liberalisation period. Skewness, kurtosis and Jarque-Bera statistics all indicate that the distribution is not normal.

[41] Nigerian daily stock returns covers only the post-liberalisation period as there are no data available for the pre-liberalisation period.

5.3.1 Result from Structural Break Tests

Tables 5.4 and 5.5 present the daily and monthly structural break estimates for South Africa and Nigeria respectively. The structural break tests are performed in two stages: Table 5.4 presents the break estimates in the stock returns and table 5.5 presents it in the conditional variance. From table 5.4, the daily stock returns from South African stock market shows no break using Bai and Perron (2003) but eight breaks for Inclan and Tiao (1994), nine and six breaks are found using Sanso et al. (2004) (SAC1 and SAC2) respectively. For the monthly stock returns, there are no breaks using Bai and Perron (2003) OLS method but five breaks for Inclan and Tiao and one each for SAC1 and SAC2 respectively. For Nigeria, two breaks are found using the Bai and Perron (2003) method for the daily stock returns, fourteen breaks for Inclan and Tiao, and ten breaks for SAC1 and one break for SAC2 respectively. The Nigerian monthly stock returns indicate no break for Bai and Perron (2003), three for Inclan and Tiao and one each for SAC1 and SAC2.[42]

From table 5.5, the breaks in the conditional variance using Bai and Perron (2003)[43] OLS-type test indicate three and two break points for South Africa and Nigeria daily stock returns respectively. The monthly stock returns indicate zero and one for South Africa and Nigeria respectively. It can however be observed that from tables 5.4 and 5.5 below, none of the break dates correspond to the official liberalisation dates for the two countries and these periods of the increased volatility identified by algorithm

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[42] The Inclan and Tiao (1994) ICSS algorithm gives several breaks as indicated in the work of Aggarwal et al. (1999). This according to Andreou and Ghysels (2002) is due to some size distortions.

[43] Conditional variance implies a measure of variance with a given model that depends on the information set or prior information. I.e. conditional var (X) $= E(x - E(x/\Omega))^2$ while unconditional variance does not provide any prior information that can be used to forecast the level of volatility. Therefore, it is a standard measure of variance $E(x - E(x))^2$.

coincide with either stock market development policy, macroeconomic environment, political or global economic events.[44]

Table 5.4: Structural break tests in the stock returns for South Africa and Nigeria: daily and monthly data

Country	Bai & Perron	Inclan &Tiao	SAC1	SAC2	Nos. of Breaks used
Number of breakpoints	0	8**	9**	6**	6**
South Africa (Daily)	_	65, 215, 1026 1135,1309,1333 1433, 1436	1435, 2037 2049, 2245 2294, 4293 4355, 4581 4883	1435, 2037 2360, 3533 4187, 4873	1435[03/07/1995] 2037[22/10/1997] 2360[18/01/1999] 3533[17/07/2003] 4187[18/01/2006] 4873[04/09/2008]
Number of breakpoints	2**	14**	10**	1**	2**
Nigeria (Daily)	528 1101	19, 42, 84, 136 171, 182,183 3012,3034,3149 3195,3351,3436 3466	19, 42, 205 257,417,611 915,991,4366 3496	983	528[05/08/1997] 1101[17/09/1999]
Number of breakpoints	0	5**	1**	1**	1**
South Africa (Monthly)	_	17,47, 56, 58 109	109	109	109[05/1990]
Number of breakpoints	0	3**	1**	1**	1**
Nigeria (Monthly)	_	26, 36,105	123	123	123[04/1995]

** indicates 5% level of significance, while SAC1 and SAC2 indicate Sanso, Arago and Carrion (2004). The break tests are performed using Gauss 7.0

[44] The study after the estimates uses the Bai and Perron (2003) OLS type only for the conditional variance breaks as the Inclan and Tiao (1994) and Sanso et al. (2004) CUSUM–type tests gave so many breaks.

Table 5.5: Structural break tests in the conditional variance for South Africa and Nigeria: daily and monthly data

Country	Bai& Perron(2003)	Nos. of Breaks used
Number of breakpoints	3**	3**
South Africa (Daily)	2038 3459 4202	2038[23/10/1997] 3459[04/04/2003] 4202[08/02/2006]
Number of breakpoints	2**	2**
Nigeria (Daily)	977 2865	977[28/04/1999] 2865[24/07/2006]
Number of breakpoints	3**	3**
South Africa (Monthly)	0	0
Number of breakpoints	1**	1**
Nigeria (Monthly)	124	124[05/1995]

From the appendix, tables 5A to 5H present the Bai and Perron (3003) estimate of the endogenous structural breaks. Tables 5A to 5D present the endogenous break tests for Nigerian and South African daily and monthly return series. Table 5A presents the Nigerian daily return series and it shows that the $SupF_T$(k) tests are all significant. This is an indication that at least one break is present for the 5 maximum breaks allowed. $UD\max$ and $WD\max$ tests are also significant. The $SupF$ test selects 2 break points which is consistent with the sequential test that selects also 2 break points. The LWZ and BIC tests however select no break point. The confidence intervals for the two break points selected are 406-558 and 457-1313 at 5% level of significance respectively. Tables 5B, 5C and 5D are the Nigerian monthly series, South African daily and monthly return series. They indicate no break points from all the three tests. The break tests in the conditional variance series are presented in table 5E to table 5H for both daily and monthly series for Nigeria and South Africa respectively. Table 5E indicates that all coefficients of the $SupF_T$(k) test are statistically significant except for the 5th break. Both $UD\max$ and $WD\max$ tests are all significant. The $SupF$ test indicates no single break point but the sequential test indicates one break point and LWZ and BIC select 2 and 4 break points respectively. The study however uses only two break points. The confidence intervals are from 976-977 and 1130-4674 at 5% level of significance respectively. Table 5F is the Nigerian monthly conditional variance series. The $SupF_T$ (k) test indicates on single break point but both $UD\max$ and $WD\max$ tests are statistically significant. Using the information criteria, sequential selects no break point and LWZ and BIC both select one break point each. The confidence interval at 5% level of significance lies between 123 and 124 percentage points. Table 5G presents the South African daily conditional variance series, and after allowing for the maximum breaks of 5, LWZ and BIC both select 3 break points respectively. The confidence intervals for the 3 breaks at 5% level of significance are: 33-2133, 03429-4305 and 4018-4207 respectively. For the South African monthly return series, table H indicates no break point. Although LWZ shows 3 breaks but there are no confidence intervals and therefore conclude that the breaks are not significant.

5.3.2 Day of the Week Effect

Tables (5I) and (5J) in the appendix present the day of the week effect for pre- and post-liberalisation periods in South Africa. The results are presented in return and also both in return and in volatility equations. In the pre-liberalisation period, the returns are not significantly different from Wednesdays except for Mondays which is different from Wednesdays at 5% level of significance. This suggests that the returns for Wednesdays are higher than Mondays. Thursdays produce highest returns during this period while the lowest returns are recorded on Mondays.

In the return and volatility equations, the results of the returns do not significantly change. Mondays' returns are still the only returns that are significantly different from Wednesdays at 5% level of significance with the highest returns still on

Thursdays but lowest on Fridays. For the conditional variance equation, the estimated coefficients indicate that the volatility of Fridays is significantly different from the Wednesdays' volatility. The highest volatility occurs on Mondays while the lowest occurs on Fridays indicating that Wednesdays' volatility is higher than Fridays.

The diagnostics statistics of both Ljung-Box Q-statistics at levels and at squares indicate no serial correlation at lag 12 respectively. The ARCH-LM test also indicates no ARCH effect.

In the post-liberalisation period, there is no day of the week effect. All the days' returns are not significantly different from Wednesdays with the highest returns in the week being Thursdays followed by Mondays, and the lowest returns in the week being Tuesdays. The conditional variance equation indicates that the variances for the day of the week are not significantly different from Wednesdays for South Africa. Mondays have lower volatility than Wednesdays while highest volatility of the week is observed on Fridays. The autocorrelation tests show absence of autocorrelation at lag 12 and no ARCH effect in the data.

Table (5K) in the appendix is the Nigerian post-liberalisation period. It shows that the returns for the other days of the week are not significantly different from Wednesdays except for Mondays which are statistically significant at 10% level and this also indicates that Mondays' returns are lower than Wednesdays' returns in the week. From the conditional variance equation, it can be observed that volatility of Tuesdays is different from Wednesdays and statistically significant at 5% level. Mondays' volatility is lower than Wednesdays' and the highest volatility in the week is recorded on Tuesdays. The diagnostics tests indicate absence of autocorrelation and no ARCH effect from the data estimation.

5.3.3 Estimation from EGARCH Models

The results are presented in two forms: the first is the presentation of results without breaks and the second is presented with breaks.

5.3.3.1 Results from Daily and Monthly Series for South Africa (without breaks)

Table 5.6 below shows the EGARCH estimates for South African using daily data without any sudden changes. It shows that in pre- and post-liberalisation periods, the mean volatility return is negative and statistically significant. The table also reveals high volatility persistence in both periods although this slightly reduces in the post-liberalisation period from 97.6% to 97%. The ARCH term that measures the effect of news about volatility from previous period on current period volatility or the magnitude of the shocks also slightly reduces in the aftermath of liberalisation and is statistically significant at 1% level. The asymmetric effect is negative and its coefficients are statistically significant at 1% level, indicating that negative or bad news has more impact on market volatility than good news. This result is quite consistent with most empirical findings. The diagnostics tests for both periods indicate absence of serial correlation at lags (12). The ARCH LM test also indicates no ARCH effect.

Table 5.7 also below presents the results for monthly data and without a break; it indicates that mean returns for pre- and post–liberalisation periods are statistically significant at 5% and 1% level respectively. However in the variance equations, the volatility of pre-liberalisation is not statistically significant. The volatility persistence however increased from 66% in the pre-liberalisation period to 88% in the post-liberalisation period. Also the leverage effects and the ARCH term are statistically significant at 5% level respectively in the post-liberalisation period. In the pre-liberalisation period, no significant coefficients are observed. All the diagnostic tests of both Ljung-Box Q-statistics at levels and at squares indicate no serial correlation at lag 12 respectively. ARCH LM test also indicates no ARCH effect.

Table 5.6: Estimation of Egarch Model for South Africa (daily data) without breaks

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.00028	C 0.00057***
(0.1322)	(4.078)
Rt(-1) 0.17008***	Rt (-1) 0.077***
(6.929)	(4.848)
-	Rt(-2) 0.0280
	(1.797)
Variance equation	*Variance equation*
ω -0.391***	ω -0.4075***
(-45.22)	(-7.598)
α 0.2109***	α 0.1865***
(7.082)	(10.89)
γ -0.0502***	γ -0.0674***
(-2.969)	(-6.210)
β 0.976**	β 0.970***
(387.69)	(186.95)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
11.476 (0.489)	11.984 (0.447)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
11.721 (0.468)	1.1088 (1.000)
ARCH LM Test	ARCH LM Test
(0.6463)	(0.9634)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively.

Table 5.7: Estimation of Egarch Model for South Africa (Monthly data) without breaks

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.0128** (2.702)	C 0.0107*** (3.162)
Variance equation	*Variance equation*
ω -1.9206 (-0.729)	ω -0.8953*** (-3.248)
α 0.1075 (0.576)	α 0.2703** (2.067)
γ -0.0711 (-0.614)	γ -0.238** (-2.386)
β 0.665 (1.372)	β 0.880*** (19.48)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels 11.99 (0.371)	Ljung Box (12) Q stat- levels 9.548 (0.656)
Ljung Box (12) Q stat-squares 6.787 (0.871)	Ljung Box (12) Q stat-squares 4.853 (0.963)
ARCH LM Test (0.6902)	ARCH LM Test (0.6699)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively.

5.3.3.2 Results from South African Daily and Monthly Series (with breaks)

After identifying the structural breaks, the next step is to examine the effect of sudden changes, first in the mean equation, and second in both the mean and the variance equations of the augmented EGARCH model. The dummies of the mean equation are the breaks from the stock returns series and the dummies of the variance equations are the breaks from the conditional variance series. The dummies for these structural shifts are incorporated into an augmented EGARCH model to see whether high volatility persistence is observed following financial liberalisation.

Table 5.8 shows the presentation of the results from an augmented EGARCH model for South African daily data with sudden changes in the mean equation only. Initially, the study adopts six breaks identified by SAC2 algorithm; however after estimating with six dummies in the mean equations the third dummy was statistically insignificant and was subsequently dropped in order to obtain a parsimonious estimate. From the table it shows that all the breaks occur during the post-liberalisation period and all the remaining five dummies are statistically significant. The volatility persistence however increases by 2% from 97% in the pre-liberalisation period to 99% in the post-liberalisation period. The asymmetric effect is negative and significant at 1% level. This indicates that investors in South African stock market react more to bad news than good news. The magnitude of volatility as measures by α reduces and is significant at 1% level.

Table 5.9 shows the results from an augmented EGARCH with sudden changes both in the mean and in the variance equations respectively. To obtain parsimonious results, the study eliminates insignificant dummies, and from the tables, it can be seen that only two dummies are statistically significant in the mean equation. Meanwhile, the only three breaks identified by the Bai and Perron (2003) algorithm in conditional variance remains consistently statistically significant at 1% and 5% level respectively. Overall, all the dummies in both mean and conditional variance equations are statistically significant. The volatility persistence although remaining high, reduces by 5% from 97% to 92% and this is consistent with the findings of Aggarwal et al. (1999) and Demandis (2008). The leverage effect has a negative sign and is statistically significant.

As indicated in both tables 5.8 and 5.9, all the diagnostics tests show that at lag 12, there is evidence of no autocorrelation both at levels and squares respectively and there is equally no ARCH effect as indicated by the ARCH LM test. It should however be noted that no single significant break is detected both in the return and in the conditional variance series for South African monthly data.

Table 5.8: Estimation of Egarch Model for South Africa (daily data) with breaks in returns series

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.00028	C -0.0004***
(0.1322)	(-1.270)
Rt(-1) 0.17008***	Rt(-1) 0.0982***
(6.929)	(5.5217)
-	Dm 1 0.0012**
	(3.553)
-	Dm2 -0.0007***
	(-2.631)
-	Dm4 0.0013***
	(4.046)
-	Dm5 -0.0008***
	(-2.218)
-	Dm6 -0.0055***
	(2.984)
Variance equation	*Variance equation*
ω -0.391***	ω -0.1419***
(-45.22)	(-16.60)
α 0.2109***	α 0.0899***
(7.082)	(16.57)
γ -0.0502***	γ -0.0395***
(-2.969)	(6.427)
β 0.976**	β 0.9928***
(387.69)	(1144.8)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
11.476 (0.489)	10.556 (0.567)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
11.721 (0.468)	16.833 (0.156)
ARCH LM Test	ARCH LM Test
(0.6463)	(0.0012)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively.DM indicates dummies for the mean equation.

Table 5.9: Estimation of Egarch Model for South Africa (daily data) with breaks in stock returns and conditional variance

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.00028 (0.1322) Rt(-1) 0.17008*** (6.929) - - -	C 0.00127*** (3.0835) Rt(-1) 0.0789*** (4.8518) Rt(-2) 0.0319** (2.009) Rt(-3) -0.0342** (-2.169) Dm 1 -0.0009** (-2.116) Dm4 0.00057* (1.936)
Variance equation	*Variance equation*
ω -0.391*** (-45.22) α 0.2109*** (7.082) γ -0.0502*** (-2.969) β 0.976** (387.69) - - -	ω -0.7183*** (-3.2004) α 0.1921*** (4.227) γ -0.0945*** (-3.986) β 0.924*** (50.276) DV 1 -0.1926** (-2.314) DV2 0.1459*** (3.156) DV3 -0.0625** (-2.029)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels 11.476 (0.489) Ljung Box (12) Q stat-squares 11.721 (0.468) ARCH LM Test (0.6463)	Ljung Box (12) Q stat- levels 13.599 (0.327) Ljung Box (12) Q stat-squares 10.173 (0.601) ARCH LM Test (0.8521)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) (**) (*) indicate statistical level of significance at 1%, 5% and 10% respectively. DM and DV indicate dummies for mean and conditional variance equations respectively.

5.3.3.3 Results from Nigerian Daily and Monthly Series (without breaks)

Tables 5.10 and 5.11 present the EGARCH model estimates for Nigerian stock returns using daily and monthly data respectively without any sudden change. Table 5.10 presents the estimates for the post-liberalisation period only and it shows a statistically significant mean return. The level of persistence is quite high at about 98% and it is statistically significant. Although the asymmetric or leverage effect is statistically significant at 1% level, it has positive sign indicating that investors react more to positive news than to negative news, and this is at odds with some theoretical and empirical findings.

Meanwhile, table 5.11 presents the results for monthly data without a sudden change. It shows a decrease in volatility of 10% following financial liberalisation from 88% in the pre-liberalisation period to 78% in the post-liberalisation period. The persistence is statistically significant at 1% level. The volatility magnitude of the shock also reduces as shown by α. In both periods, asymmetric effects are not statistically significant. The diagnostic tests from the two tables show no evidence of autocorrelation and ARCH effects.

Table 5.10: Estimation of Egarch Model for Nigeria (daily) without breaks (Post-liberalisation)

Mean Equation	
C	0.000202***
	(4.317)
Rt(-1)	0.33346***
	(20.94)
Rt(-2)	0.12139***
	(7.529)
Variance equation	
ω	-0.4636***
	(-11.4006)
α	0.3512***
	(15.1806)
γ	0.0376***
	(2.732)
β	0.09796***
	(305.3)
Diagnostics tests	
Ljung Box (12) Q stat- levels	18.264 (0.312)
Ljung Box (12) Q stat-squares	5.2119 (0.904)
ARCH LM Test	0.2508

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) indicates statistical level of significance at 1% level.

Table 5.11: Estimation of Egarch Model for Nigeria (Monthly data) without breaks

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.0227***	C 0.0118**
(5.302)	(2.619)
Rt(-1) 0.2663**	Rt (-1) 0.4029***
(2.577)	(7.752)
Rt(-2) 0.0234	-
(0.239)	-
Rt(-3) -0.1179	
(-1.509)	
Variance equation	*Variance equation*
ω -1.388**	ω -1.6359***
(-2.241)	(-3.666)
α 0.782**	α 0.6663***
(2.578)	(3.470)
γ -0.110	γ -0.0274
(-0.583)	(-0.159)
β 0.887***	β 0.7896***
(8.571)	(10.99)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
15.128 (0.235)	5.447 (0.941)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
10.148 (0.603)	2.935 (0.996)
ARCH LM Test	ARCH LM Test
(0.8331)	(0.8049)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively.

5.3.3.4 Results from Nigerian Daily and Monthly Series (with breaks)

Table 5.12 presents the results from the augmented EGARCH model. The first part of the table presents the estimates with sudden changes in the mean equation only. The mean of the return and the two dummies in the mean equation are statistically significant at 1% level .The level of volatility persistence however remained the same at 97%. Also, the magnitude of the shock and asymmetric effect remained the same and statistically significant as shown in table 5.10.

The second part of table 5.12 shows the incorporation of sudden changes both in the mean and in the variance equations. It shows that volatility persistence although remaining high, has reduced from about 98% with sudden changes in the mean equation only to about 94% when dummies are introduced both in the mean and in the variance equations and it is statistically significant at 1% level. All the dummies in both equations remain consistently and statistically significant at 1% level. The leverage effect still has a positive sign but is significant at 5% level. The diagnostics tests from the table indicate no evidence of autocorrelation and ARCH effect.

Table 5.13 presents the results of the monthly data from the augmented EGARCH model with a sudden change in the stock returns which are incorporated into the mean only. The break in mean level occurs only in the pre-liberalisation period and the dummy is significant at 1% level. The volatility persistence increases by 2% in this period from 88% to 90%. However, the persistence in the post-liberalisation period remained low at about 79%; in fact the reduction in volatility is 11%. Although the asymmetric effect has expected sign of negative, it remains statistically insignificant.

Table 5.14 on the other hand shows the augmented EGARCH model with sudden changes introduced both in the mean and in the variance equations. Both dummies are statistically significant at 1% level, thereby capturing the time varying shown by Nigerian stock market. The persistence in the pre-liberalisation period further increases by 2% but since there is no single break in the post-liberalisation period, the persistence still remains low at about 79% when compared with the pre-liberalisation period of 92%. All diagnostics tests autocorrelation at lag 12 indicate no autocorrelation. Also there is no ARCH effect.

Table 5.12: Breaks in stock returns and conditional variances for Nigeria (Daily)

Break in the stock returns only	Breaks(both in stock returns and conditional variance
Mean Equation	*Mean Equation*
C 0.00028***	C 0.00030***
(5.345)	(4.299)
Rt(-1) 0.3248***	Rt(-1) 0.3276***
(20.26)	(19.69)
Rt(-2) 0.1143***	Rt(-2) 0.1170***
(7.042)	(7.009)
DM 1 -0.00056***	DM 1 -0.0006***
(-4.604)	(-5.102)
DM2 0.00056***	DM2 0.0006***
(3.406)	(3.731)
Variance equation	*Variance equation*
ω -0.4654***	ω -1.0321***
(-11.82)	(-9.412)
α 0.3533***	α 0.3811***
(15.27)	(13.37)
γ 0.0374***	γ 0.0407**
(2.591)	(2.294)
β 0.0979***	β 0.9362***
(315.8)	(115.35)
	DV1 0.1390***
	(5.648)
	DV2 0.1588***
	(5.504)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
6.8175 (0.448)	6.601 (0.472)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
4.5080 (0.972)	4.893 (0.961)
ARCH LM Test	ARCH LM Test
0.3039	0.4148

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, 5% respectively. DM and DV indicate dummies for the mean and variance equations respectively.

Table 5.13: Estimation of Egarch Model for Nigeria (Monthly data) with breaks in stock returns

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.01916*** (4.518)	C 0.0118** (2.619)
Rt(-1) 0.2739** (2.221)	Rt (-1) 0.4029*** (7.752)
DM 1 0.0866*** (4.046)	-
Variance equation	*Variance equation*
ω -1.1492*** (-2.877)	ω -1.6359 *** (-3.666)
α 0.5531** (2.017)	α 0.6663*** (3.470)
γ -0.2364 (-1.324)	γ -0.0274 (-0.159)
β 0.9012*** (13.67)	β 0.7896*** (10.99)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels 7.8244 (0.799)	Ljung Box (12) Q stat- levels 5.447 (0.941)
Ljung Box (12) Q stat-squares 8.4835 (0.746)	Ljung Box (12) Q stat-squares 2.935 (0.996)
ARCH LM Test (0.9160)	ARCH LM Test (0.8049)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively. DM and DV indicate dummies for the mean and variance equations respectively.

Table 5.14: Estimation of Egarch Model for Nigeria (Monthly data) with breaks in stock returns and conditional variance

Pre-liberalisation	Post-liberalisation
Mean Equation	*Mean Equation*
C 0.02025*** (5.391)	C 0.0118** (2.619)
Rt(-1) 0.2703** (2.244)	Rt (-1) 0.4029*** (7.752)
DM 1 0.0514*** (9.648)	-
Variance equation	*Variance equation*
ω -1.1647** (-2.965)	ω -1.6359*** (-3.666)
α 0.585** (2.093)	α 0.6663*** (3.470)
γ -0.2309 (-1.271)	γ -0.0274 (-0.159)
β 0.9211 (13.89)***	β 0.7896*** (10.99)
DV1 1.377*** (4.901)	-
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels 11.600 (0.478)	Ljung Box (12) Q stat- levels 5.447 (0.941)
Ljung Box (12) Q stat-squares 8.4391 (0.750)	Ljung Box (12) Q stat-squares 2.935 (0.996)
ARCH LM Test (0.8591)	ARCH LM Test (0.8049)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively. DM and DV indicate dummies for the mean and variance equations respectively.

5.3.3.5 Discussion of the Possible Events

This study discusses only those break points that are significant simultaneously both in the mean and in the variance equations respectively. It should be noted that for South Africa, six breaks in stock returns are used but after estimating them in the mean equation, five are found statistically significant while three breaks are statistically significant in the conditional variance. After estimating the augmented EGARCH model with breaks both in the mean and in the variance equations, the significant breaks in the mean equation reduce from five to two significant break points while the breaks in conditional variance consistently remain three. This means that after obtaining the parsimonious results, spurious breaks in the returns series disappear.

South Africa: breaks in stock returns: For South Africa, the two significant break points in the mean equation are DM1 and DM4 which correspond to 3 July 1990 and 17 July 2003 respectively. The first significant break, DM1, corresponds to the apartheid regime, which was characterised by political instability, rigid exchange control mechanisms and international economic sanctions.

The second significant dummy is DM4. During this period, global markets continued to experience bull market conditions especially from April 2003 and this movement in share prices matched the development in the global financial markets. Also in this regime, the Johannesburg Stock Exchange (JSE) launched the first alternative exchange in Africa, named ALTx, which listed small and medium-sized companies specifically targeting black empowerment and junior mining companies.

South Africa: breaks in conditional variance: Three significant breaks are detected using the Bai and Perron algorithm and these are: DVI (23/10/1997), DV2 (04/04/2003) and DV3 (08/02/2006) respectively.

DV1: During this regime, the market responded to the South East Asia financial crisis. There was a sudden and sharp decline in share prices caused by a flurry of trading activity that swept away the value of the equity market. The crisis also resulted in widening the rate of differentials between foreign currency denominated bonds of the South Africa government and bonds of equal outstanding maturity of the United States. These caused non-resident investors to change their behaviour due to high risk and uncertainty about the stability of the exchange rate of the rand and the contagion effect on domestic financial markets.

DV2: This corresponds to the break in the stock returns; therefore both breaks occurred on almost the same date.

DV3: This is the period of global financial crisis that affects all developed and emerging markets. It started in United States housing markets.

Nigeria: breaks in stock returns and conditional variance: Algorithm detects two significant break points in the stock returns for Nigeria and these are: DM1 (05/08/1997) and DM2 (17/09/1999) and also two significant break points in the conditional variance: DV1 (28/04/1997) and DV2 (24/07/2006).

DM1: During this period, the Nigeria Stock Exchange launched the Central Security Clearing System (CSCS). This was done to enhance market efficiency especially in the delivery and settlement process of exchanges in accordance with the global financial market.

DM2: This period was characterised by political activities especially the new democratic government after several years of military rule.

DV1: This period was characterised by the same factor as observed in DM1.

DV2: Bank consolidation programme (2004-2006) under which banks were required to increase their capital base to N25billion from N2billion. The global financial crisis has impacted negatively on the Nigerian Stock Exchange by reducing the market capitalisation from about N13 trillion in March 2008 to N6trillion in December 2008.

5.3.3.6 The Effects of Official Liberalisation Dates

The fundamental aim of this chapter is to build a good time-series model to analyse the impact of financial liberalisation on market volatility. This is achieved by using the augmented EGARCH model. The study starts with endogenous structural break tests both in stock returns and in conditional variance. The results however indicate that all the break points identified by algorithm do not coincide with the official liberalisation dates for the two countries. Therefore, to have a complete model and to capture the effect of official liberalisation dates, the study further adds liberalisation dummy using official liberalisation dates to the augmented EGARCH model. The study estimates the models for the two countries except for Nigerian daily data that cover only the post-liberalisation period.[45]

From tables 5.15 and 5.16 below, it is clearly shown that the liberalisation dummy based on the official dates does have negative effect and it is statistically significant both in the mean and in the variance equations respectively. Except for South African daily data where in the variance equation the effect although is negative but it is not statistically significant.

Table 5.15 indicates that the liberalisation dummy for Nigerian monthly data is negative statistically significant at 1% level in mean equation only. When the dummy is introduced both in mean and in conditional variance equations, they are still negative and statistically significant at 1% level. The Nigerian monthly data reveal a high level of persistence of 91% when the dummy is used for mean equation only; however, it reduces to 81% when the dummy is introduced both in mean and variance equations and they are both statistically significant at 1% level.

Table 5.16 depicts South African daily data, and to obtain parsimonious results, the insignificant dummies are dropped; it is found that only DM1 and LD are statistically significant. The LD effect is negative and statistically significant at 5%

[45] For the Nigerian daily data, the effect of official liberalisation cannot be observed due to dummy trap. It should be noted that using the endogenous structural breaks for the post-liberalisation period for the Nigerian daily data, two breaks are found as identified by Bai and Perron (2003) test. However, we could not test for the effect of financial liberalisation on market volatility. This is because there is no available daily data for the pre- liberalisation period. Therefore to avoid dummy trap, using official liberalisation date to test for the effect of financial liberalisation on market volatility could not be carried out as the sample date starts with the official liberalisation date. While in the case of South Africa monthly series, no endogenous break was found and in this situation, we have to rely on the result of the first hypothesis (without breaks) and check whether volatility has increased or decreased.

level for the mean equation only. However, when liberalisation dummy is introduced both in the mean and in the conditional variance equations, it is negative and statistically significant at 5% level but only in the mean equation. The level of volatility persistence remains the same at 97% when the liberalisation dummy is used and it is statistically significant at 1% level in both the mean and the variance equations.

Table 5.15: Egarch Model for Nigeria with official liberalisation dummy (monthly)

Mean equation only	Both mean and variance
Mean Equation	*Mean Equation*
C 0.0181***	C 0.0202***
(5.466)	(5.855)
Rt(-1) 0.3262***	Rt (-1) 0.2862***
(4.131)	(3.027)
DM1 0.0827**	DM1 0.0487***
(3.982)	(5.756)
LD -0.0889***	LD -0.0587***
(-4.112)	(-7.726)
Variance equation	*Variance equation*
ω -1.137***	ω -1.936**
(-4.619)	(-2.317)
α 0.824***	α 0.680***
(4.626)	(4.021)
γ -0.129	γ -0.1509
(-1.006)	(-1.238)
β 0.912***	β 0.811***
(28.43)	(7.459)
	DV1 1.482***
	(4.285)
	LD1 -1.074***
	(-2.856)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
8.8682 (0.714)	5.9245 (0.920)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
2.6927 (0.997)	2.5892 (0.998)
ARCH LM Test	ARCH LM Test
(0.6528)	(0.6534)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) and (**) indicate statistical level of significance at 1%, and 5% respectively. DM and DV indicate dummies for the mean and variance equations respectively. LD is the dummy for official financial liberalisation.

Table 5.16: Egarch Model for South Africa with official liberalisation dummy (daily)

Mean equation only	Both mean and variance
Mean Equation	*Mean Equation*
C 0.00037	C 0.00046**
(1.670)	(2.077)
Rt(-1) 0.1346***	Rt (-1) 0.1356***
(8.313)	(8.348)
Rt(-2) 0.0232	Rt(-2) 0.0228
(1.431)	(1.417)
DM1 0.0112**	DM1 0.0112**
(2.315)	(2.370)
LD -0.0109**	LD -0.0109**
(-2.261)	(-2.326)
Variance equation	*Variance equation*
ω -0.342***	ω -0.428***
(-5.976)	(-5.210)
α 0.196***	α 0.197***
(6.937)	(6.474)
γ -0.0324**	γ -0.0307*
(-1.908)	(-1.668)
β 0.978***	β 0.970***
(214.28)	(136.88)
	DV1 0.0195
	(1.375)
	DV2 -0.023**
	(-2.156)
	DV3 0.0216**
	(1.982)
	LD -0.0014
	(-0.119)
Diagnostics tests	*Diagnostics tests*
Ljung Box (12) Q stat- levels	Ljung Box (12) Q stat- levels
23.916 (0.021)	24.883 (0.015)
Ljung Box (12) Q stat-squares	Ljung Box (12) Q stat-squares
12.942 (0.373)	10.540 (0.569)
ARCH LM Test	ARCH LM Test
(0.1707)	(0.3044)

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) (**) (*) indicate statistical level of significance at 1%, 5% and 10% respectively. DM and DV indicate dummies for the mean and variance equations respectively. LD is the dummy variable for official financial liberalisation.

News Impact Curves

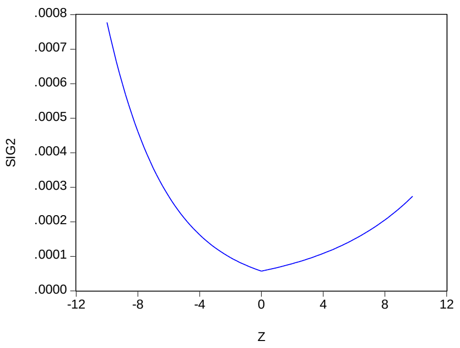
Figures 5.1 (a) to 5.1(g) present the news impact curves (NICs) for both the daily and monthly stock returns for South Africa. They usually plot the next period volatility (sig2) that would arise from various positive and negative values of the lagged residuals or shocks (Z). The vertical axis represents the level of current volatility while the horizontal axis represents the lagged residuals from the E-GARCH model. The curves confirm that negative news of the same magnitude resulted in more volatility for the two sample periods using both daily and monthly data respectively. However, the Nigerian daily data exhibit that investors react more to positive news than to negative news and this is at odds with the findings of Black (1976), Christie (1982) and Engle and Ng (1993).

From the below figures, it indicates that only figures A, B, D and E show evidence of asymmetric effect while C, F and G are not significant, indicating therefore no asymmetric effect. Figure (A) is the South African daily return series (pre-liberalisation period) and it indicates the lagged value of the shock or error ranging from -12 to 12. It further shows that the value of conditional variance is 0.0008 for a shock of -12 and 0.002 for a shock of 12. This clearly indicates that investors react more to negative news than positive news. Figure (B) on the other hand is the South African daily return series for post-liberalisation period and it shows a conditional variance of 0.0012 for a shock of -12 and 0.002 for a shock of 12. This also shows that investors react more to negative news than to positive news. Figure (D) is the South African monthly return series for post-liberalisation period. It also indicates that investors react more to negative news than positive news. The value of conditional variance is 0.25 for a shock of -12 and 0.15 for a shock of 12. Figure (E) depicts the Nigerian daily return series for post-liberalisation period with conditional variance of 0.00035 for a shock of

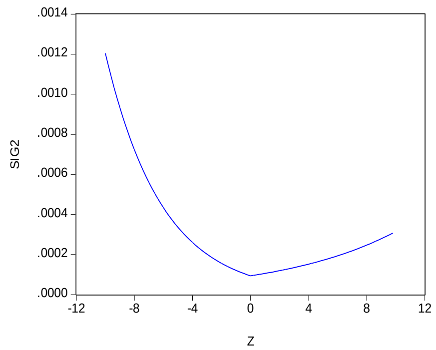
12. This indicates that investors in the Nigerian equity market react more to positive news than negative news. This is at odd with most empirical findings. Although the asymmetric effects for Figures (C) and (F) are not quite significant, they show a similar pattern where investors react more to negative news than to positive news. Figure (C) which is the South African monthly return series for the pre-liberalisation period indicates a conditional variance of 0.25 for a shock of -12 and 0.15 for a shock of 12. Figure (F) represents the Nigerian monthly return series for the pre-liberalisation period. It shows a conditional variance of 0.24 for a shock of -12 and a conditional variance for a shock of 12.

Figure 5.1: News Impact Curves

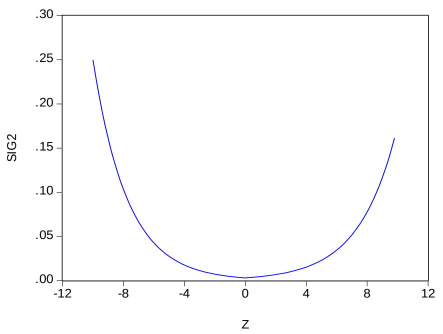
South Africa: pre-liberalisation(Daily) -A



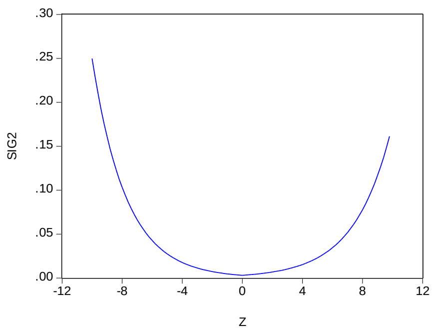
South Africa: post-liberalisation(Daily)-B



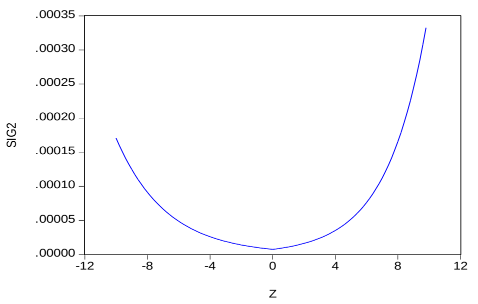
South Africa: pre-liberalisation(Monthly) -C



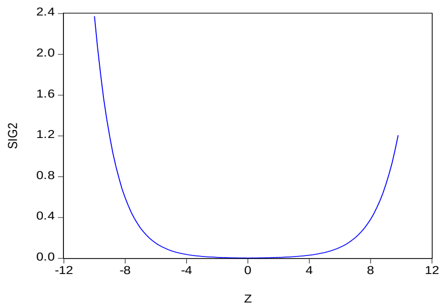
South Africa: post-liberalisation(Monthly) - D



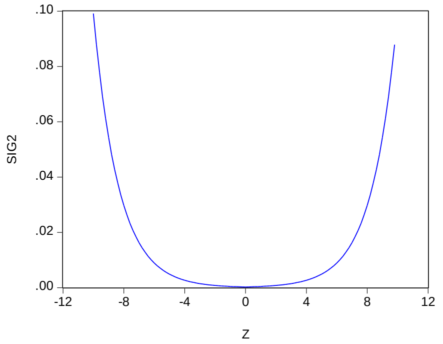
Nigeria: post-liberalisation(Daily) -E



Nigeria: post-liberalisation(Monthly) -F



Nigeria: pre-liberalisation(Monthly) -G



5.4 Conclusions

This study uses the exponential GARCH model to examine the effects of financial liberalisation on stock market volatility using South African and Nigerian equity markets as a case study. In line with Aggarwal et al. (1999) and Nguyen (2008) and other empirical works, the study examines the shifts in volatility and the events that cause such shifts. The main aim is to confirm whether taking structural shifts or breaks into account reduce volatility following financial liberalisation. However, this study departs from previous works that focus only on breaks in unconditional variances of stock returns and use them to analyse volatility persistence. This study - in addition to breaks in unconditional variance of stock returns - also endogenously tests for breaks in conditional variance. It is shown in this study that both the daily and monthly stock returns for the two countries are clearly non stationary since the unconditional volatilities changes over some intervals. The findings further reveal that none of the estimated break dates coincides with South African and Nigerian official liberalisation dates. It is also shown that after augmenting the EGARCH model with dummy variables, the volatility persistence reduces following financial liberalisation in both countries for both daily and monthly data respectively. This finding is consistent with the earlier works of Diebold (1986), Lastrapes (1989), Hamilton (1994), Lamoureux and Lastrapes (1990) and Aggarwal et al (1999). This confirms that without taking structural breaks into account, volatility persistence tends to be exaggerated. In order to have a complete model, the study further examines the overall effects of financial liberalisation using official liberalisation dates and the results indicate that the effect is negative and statistically significant. Also, from the parameters of EGARCH models, the study derives the news impact curves for both the daily and monthly data respectively; except for Nigerian daily data which exhibit positive impact curves, others exhibit negative impact curves.

Therefore, for South Africa and Nigeria to gain maximally from their stock markets liberalisation, it is recommended that they should maintain a stable macroeconomic environment. Sound and consistent macroeconomic policies are imperative for attracting foreign portfolio investments into the country. A stable environment helps reduce the level of uncertainty and volatility Therefore, for successful integration into global stock markets, it is necessary that domestic macroeconomic fundamentals should be strong and stable.

CHAPTER 6

SUMMARY AND CONCLUSIONS

This chapter consists of summary and conclusions of the main findings. It also evaluates the contribution of the thesis and offers suggestions for further research.

6.1 Summary and Conclusions

This thesis uses time-series data to examine financial development, economic growth and stock market volatility in Nigeria and South Africa. In the case of Nigeria, the thesis re-examines the common hypothesis in the finance-growth literature: the supply-leading and demand-following hypothesis. It applies the multivariate VAR and vector error correction model (VECM) to examine the long-run causal relationship between financial development and economic growth. It further applies the long-run structural modelling of Pesaran and Shin's (2002) identifying restrictions in cointegrating vectors. The study utilises three financial indicators: a measure of financial development index, bank credit to private sector (BCP) and liquid liabilities (LL). The study could not establish any cointegration using financial development index. To allow for robustness, two other financial indicators, bank credit to private sector and liquid liabilities are used and each exhibits one cointegrating vector. The findings from the causality tests suggest the existence of unidirectional causality from economic growth to financial development when bank credit to private sector (BCP) is used as a measure of financial development; while liquid liabilities (LL) indicates a bidirectional causality between financial development and economic growth.

For South Africa, the study examines the causal relationship between stock market development and economic growth using both bank and stock market variables. The study uses one measure of banking system represented by bank credit to private sector (BCP) and three measures of stock market system represented by market capitalisation (MC), turnover ratio (TR) and value of shares traded (VT). The study applies the Vector Error Correction model (VECM), Generalised impulse response function (GIRF) and variance decomposition (VDC).

Using the three models, we found one cointegration each in model A and B respectively but no cointegration in model C where market capitalisation is used. The long-run coefficients of the cointegrating vector after normalising on BCP for both models A and B indicate a positive relationship between financial development and economic growth.

The study performs three causality tests: short-run Granger non-causality, weak exogeneity and strong exogeneity tests respectively. The study establishes that in the short-run, there is evidence of unidirectional causality from stock market variables (TR and VT) to economic growth; while there is no causality between banking system and economic growth in the short-run. Meanwhile, in the long-run, there is evidence of bidirectional causality between financial development and economic growth using the banking system. However, when stock markets variables are used; that is, turnover ratio (TR) and value of shares traded (VT), the finding reveals unidirectional causality from economic growth to stock market system. The results show that generalised impulse response functions and variance decompositions indicate that financial development (BCP, TR, and VT) have a short-run impact on economic growth at the immediate year of initial shocks and VDC shows that all the indicators for financial development contain some useful information in predicting the future path of economic growth.

The study further analyses financial liberalisation, structural breaks and market volatility in South Africa and Nigeria using daily and monthly data respectively. It uses EGARCH model. The aim is to build a good time series model that would capture the effect of financial liberalisation on market volatility in these two countries. The study starts with endogenous structural break tests using Bai and Perron's (2003) OLS-type test and the CUSUM-type test of Inclan and Tiao (1994) and Sanso et al. (2004) respectively. These break tests are performed both at stock returns level and at conditional variance over pre- and post-liberalisation periods. Considering structural breaks in the stock returns and in the conditional variance is a major contribution of this study because it departs from previous studies that consider breaks in the unconditional variance of stock return only to analyse volatility. The significant break points identified through algorithm are incorporated into EGARCH models and possible events surrounding the break points are also discussed. The effect of financial liberalisation is obtained by adding the liberalisation dummy to the model using official liberalisation dates.

The results indicate that none of the estimated break dates coincides with the official liberalisation dates for the two countries. The analysis further shows that after taking structural breaks into account volatility declines following financial liberalisation. Also using official liberalisation dates, the results indicate that the effect of financial liberalisation on the stock markets is negative and statistically significant.

From the above summary of the findings, it can thus be concluded that for Nigeria, the long-run causality between financial development and economic growth is very weak. Therefore, adequate policy measures are required to ensure that financial intermediaries are properly linked to the real sector of the economy. In the case of South Africa, the findings suggest that stock market does promote economic growth in the short-run but in the long-run the link is very weak as causality runs from economic growth to financial development. It is further concluded based on the findings that although stock market volatility reduces once structural breaks are fully accounted for volatility tends to reduce but the reduction is quite marginal. It is also established that the effect of financial liberalisation on the stock markets is negative and statistically significant for the two countries.

6.2 Main Contribution of the Study

Most of the time series studies on finance-growth nexus in Sub-Saharan Africa are based on bivariate VAR models. For example, this can be seen in the works of Ghirmay (2004), Atindehou et al. (2005) and Odhiambo (2007). Only the work of Gries et al. (2009) has so far used the multivariate VAR approach that includes Nigeria. They add trade openness to financial development and growth variables for 16 Sub-Saharan Africa. However, this study departs from this and other previous works by not only using a high dimension system (using four variables: financial development, GDP, real interest rate and trade openness) but also using the long-run structural modelling of Pesaran and Shin (2002). The model is a theoretically-based identification of cointegrating vectors. This is a novel approach to the study of finance and growth in Nigeria. It also uses a new data set with longer period of observations (1961-2007). To further ensure stationarity of the data, the study uses four unit root tests in addition to a structural break test.

Another contribution of this thesis is the examination of the causal relationship between stock market development and economic growth using both bank and stock market variables. The theoretical framework for this study is based on the model of Boyd and Smith (1998) that considers banking system and stock market development as complements rather than substitutes. Earlier studies in this area are based on cross-country and panel estimation techniques like those of Levine and Zervos (1998), Rousseau and Wachtel (2000) and Beck and Levine (2004). However, the time-series work in this area is mainly based on advanced and European countries as can be seen in the work of Arestis et al. (2001) and Dritsaki and Dritsaki-Bargiota (2005). Only Enisan and Olufisayo (2009) have so far used annual data to examine the causal relationship between stock market and economic growth for 7 African countries including South Africa. This study however departs from their studies by using a longer period of quarterly observations. The study also solves the stock-flow problems by following the method of deflation suggested by Beck and Levine (2004), a process if ignored would result in a bias estimate. The study also uses generalised impulse response function (GIRF) and variance decomposition (VDC) to further analyse the relationship between stock market development and economic growth. This approach of Pesaran and Shin (1998) is invariant to the ordering of the variables in the VAR system which is one of the problems of cholesky decomposition. In this study, GIRF and VDC are performed both at unrestricted VAR level and at cointegrated or VEC level.

Another important contribution of this thesis can be found in chapter five. The chapter uses both daily and monthly data to assess the impact of financial liberalisation on South African and Nigerian equity markets' volatility. The thesis starts with endogenous structural break tests and to allow for robustness, three types of structural break tests are performed: Bai and Perron's (2003) OLS-type method and the two CUSUM-type tests of Inclan and Tiao (1994) and Sanso et al. (2004) respectively. The important contribution of this chapter to the literature is that unlike previous studies, that consider structural break tests at unconditional variance only, (as can be seen in the works of Aggarwal et al. 1999, Cunado et al. 2006 and Nguyen 2008) this chapter in addition to break tests in the unconditional variance of stock return, also carries out structural break tests in the conditional variance. The dummies of the stock returns are incorporated in the mean equation of the EGARCH model, while dummies from the conditional variance are incorporated in the variance equation of the model. To achieve parsimonious results, insignificant break points both in the stock return and the conditional variance are dropped. Therefore, significant break points identified by these structural break tests at both levels are incorporated into the augmented EGARCH model and estimated. Since from the findings, none of the break dates correspond with official dates, the study further adds the liberalisation dummy to the augmented EGARCH models using official liberalisation dates both at mean and at conditional variance equations. The ultimate goal is to obtain a complete model and analyse the overall effect of financial liberalisation on market volatility for South Africa and Nigeria respectively. To my knowledge, this is a new approach in the study of financial liberalisation and stock market volatility.

6.3 Implications for Further Research

This study uses time-series data to examine finance-growth nexus and stock market volatility in South Africa and Nigeria. The following areas are suggested for further research:

The endogenous growth models suggest that financial development influences economic growth through a number of channels particularly through investment, saving, and productivity. Since in the first empirical chapter, we examine financial development and economic growth using two channels (trade openness and real interest rate) for the case of Nigeria, further studies should examine other possible channels through which finance may influence economic growth in Nigeria.

Also in the first empirical chapter (i.e. chapter three), the study considers structural break tests at unit root level which is a univariate test. Therefore, a test of structural break at cointegrated level would be quite informative. Gregory et al. (1996) examine some of the problems associated with the cointegration test in the presence of structural breaks. They observe that the presence of a structural break often creates spurious unit root in the cointegrating system, leading to a low power of non-rejection of null hypothesis of no cointegration. That is, the presence of a structural break test makes it easy to conclude that there is no cointegration. Different types of tests exist for structural breaks at the cointegrated level. However for the VAR system, it is recommended that further studies could consider the use of Inoue (1999), Johansen et al. (2000) and Lutkepohl (2000) tests.

From the third empirical chapter, it shows that once the structural breaks are accounted for, volatility decreases but the level of decrease in this study is quite small. This may suggest that other factors like institutional quality could contribute to high level of volatility. Bekaert (1995) and Yartey (2007) have shown that institutional quality plays a great role in stock market development because it gives confidence to investors, which helps in stabilising the market and hence reducing the volatility. Jayasuriya (2005) also shows that where institutional quality is high volatility tends to be low and those with weak institutions tend to exhibit high volatility. Therefore, further studies could focus attention on stock market volatility and institutional quality such as law and order, bureaucracy and democratic accountability. These are important to the stability of equity markets in Sub-Saharan Africa.

This study uses only the EGARCH model to evaluate financial liberalisation and stock volatility. Future work should extend it to other GARCH models; for example, GARCH (1, 1), threshold GARCH and SWGARCH. Also, the current financial globalisation has indeed increased the level of financial markets integration especially through cross-border listings. Therefore, future studies could focus on market integration and volatility in Sub- Saharan Africa by using the application of several multivariate GARCH models.

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Appendix: Chapter 3

Table 3A: Selection of the order of the multivariate VAR and P-values for misspecification tests

Model A: Lag optimal (1)	LR	FPE	AIC	SC	LM-test Prob.
0 1 2	NA **154.127** 18.6597	0.02357 **0.000787** 0.000980	9.6585 **4.200035** 4.396493	7.7692 **5.027496** 5.885924	NA 0.2564 0.1144
Model B: Lag optimal (1)	LR	FPE	AIC	SC	LM-test
0 1 5	NA **152.1832** 21.59651	1.22e-05 **4.28e-07** 5.67e-07	0.033380 -3.317775 **-3.426681**	0.198873 **-2.490313** 0.048658	NA 0.6022 0.7674
Model C: Lag optimal (1)	LR	FPE	AIC	SC	LM-test
0 1 3	NA 147.4663 **30.25051**	2.52e-05 **9.97e-07** 1.06e-06	0.763444 -2.471456 **-2.489747**	0.928936 **-1.643994** -0.338347	NA 0.2021 0.9860

Appendix: Chapter 4

Table 4A: Model A: Variance Decompositions at VAR level

Time Horizon (quarter)	(RGDP)	(INV)	(BCP)	(TR)
1.Variance Decomposition of GDP				
	Explained by shocks in			
4	95.90	0.188	3.627	0.282
	(4.615)	(1.561)	(4.053)	(1.453)
8	91.68	1.107	6.694	0.513
	(8.919)	(4.243)	(7.525)	(2.972)
12	84.63	4.383	7.847	3.138
	(13.11)	(7.338)	(9.758)	(7.112)
16	75.03	9.013	8.748	7.212
	(16.11)	(9.861)	(11.82)	(11.29)
20	65.67	13.59	9.915	10.81
	17.60)	(11.70)	(13.71)	(14.27)
2. Variance Decomposition of Investment (INV)				
4	20.77	74.15	3.800	1.276
	(9.831)	(10.45)	(3.842)	(2.218)
8	40.094	51.49	5.544	2.870
	(12.93)	(13.78)	(6.652)	(4.403)
12	45.91	43.83	6.798	3.458
	(13.87)	(14.77)	(9.284)	(6.385)
16	48.25	40.70	7.431	3.612
	(14.24)	(15.12)	(11.21)	(8.079)
20	49.54	39.06	7.782	3.611
	(14.39)	(15.19)	(12.48)	(9.521)
3. Variance Decomposition of Bank credit (BCP)				
4	7.677	6.086	65.64	20.59
	(6.800)	(6.110)	(9.948)	(7.271)
8	9.510	5.495	54.69	30.30
	(8.893)	(7.231)	(13.11)	(10.66)
12	16.80	3.813	42.94	36.26
	(11.34)	(6.598)	(14.97)	(12.59)
16	26.61	2.961	33.72	36.71
	(12.93)	(6.131)	(15.35)	(13.25)
20	33.86	2.603	28.58	34.96
	(13.74)	(6.178)	(15.23)	(13.47)
4. Variance Decomposition of Value shares traded (TR)				
4	3.891	0.786	3.739	91.58
	(4.536)	(2.927)	(4.403)	(6.620)
8	3.318	1.122	2.655	92.90
	(4.980)	(3.845)	(4.168)	(7.214)
12	3.046	2.257	3.933	90.76
	(5.528)	(5.097)	(6.161)	(9.159)
16	2.742	3.536	7.094	86.63
	(6.147)	(6.179)	(9.324)	(11.87)
20	3.565	4.348	11.49	80.60
	(7.625)	(6.884)	(11.56	(14.41)

Table 4B: Model A: Variance Decompositions at VEC level

1.Variance Decomposition of RGDP					
		Explained by shocks in			
Time Horizon (quarter)	S.E.	RGDP	Investment (INV)	Bank credit (BCP)	Turnover Ratio (TR)
4	0.007	87.07	0.152	12.57	0.195
8	0.014	73.71	0.442	25.03	0.804
12	0.019	65.95	0.279	30.32	3.446
16	0.022	59.25	0.481	32.78	7.477
20	0.025	53.94	1.011	33.24	11.80
2. Variance Decomposition of Investment (INV)					
4	0.024	24.21	68.41	7.294	0.073
8	0.045	43.78	40.49	15.68	0.043
12	0.064	45.51	30.97	22.79	0.727
16	0.078	44.38	26.35	26.83	2.432
20	0.087	42.22	24.07	28.97	4.734
3. Variance Decomposition of Bank credit (BCP					
4	0.123	15.87	6.045	62.65	15.42
8	0.199	17.46	4.221	54.23	24.09
12	0.271	20.52	2.591	46.83	30.05
16	0.347	23.95	1.598	42.19	32.25
20	0.423	26.82	1.084	39.99	32.09
4. Variance Decomposition of Value shares traded (TR)					
4	0.521	1.506	1.127	1.658	95.708
8	0.707	1.056	0.858	1.589	96.50
12	0.848	0.829	0.813	1.364	96.99
16	0.972	0.678	0.706	1.243	97.37
20	1.083	0.621	0.612	1.217	97.55

Table 4C: Model B: Variance Decompositions at VAR level

Time Horizon (quarter)	(RGDP)	(INV)	(BCP)	(VT)
1.Variance Decomposition of GDP				
	Explained by shocks in			
4	98.01	0.275	1.181	0.530
	(3.604)	(1.720)	(2.711)	(1.897)
8	93.50	2.365	0.891	3.236
	(8.441)	(5.286)	(4.415)	(5.491)
12	84.08	8.347	0.893	6.675
	(13.83)	(9.301)	(6.925)	(8.687)
16	73.645	15.30	1.764	9.288
	(17.24)	(12.09)	(10.66)	(10.41)
20	64.99	21.07	3.061	10.87
	(19.05)	(13.82)	(14.13)	(11.29)
2. Variance Decomposition of Investment (INV)				
4	16.86	76.82	6.239	0.077
	(9.265)	(10.19)	(5.064)	(1.433)
8	34.50	56.75	8.303	0.445
	(13.08)	(13.67)	(8.267)	(3.236)
12	39.47	49.29	9.902	1.327
	(14.19)	(14.45)	(11.57)	(5.917)
16	40.75	45.75	11.26	2.230
	(14.55)	(14.66)	(14.600)	(7.776)
20	41.24	43.44	12.51	2.797
	(14.73)	(14.88)	(17.05)	(8.680)
3. Variance Decomposition of Bank credit (BCP)				
4	4.420	2.657	88.98	3.942
	(5.666)	(4.545)	(7.600)	(3.321)
8	4.273	2.180	89.48	4.059
	(6.917)	(5.566)	(9.455)	(4.833)
12	7.206	1.622	87.04	4.126
	(8.907)	(5.498)	(11.56)	(6.142)
16	13.01	1.614	81.711	3.660
	(10.95)	(5.601)	(13.57)	(6.697)
20	18.93	1.591	76.42	3.052
	(12.50)	(5.834)	(14.93)	(6.981)
4. Variance Decomposition of Value shares traded (VT)				
4	6.915	3.448	9.712	79.92
	(5.327)	(4.349)	(6.144)	(7.968)
8	11.14	2.871	14.45	71.53
	(7.025)	(4.424)	(7.986)	(9.708)
12	20.73	2.228	17.95	59.08
	(9.537)	(4.246)	(10.52)	(11.92)
16	31.03	1.760	19.21	47.99
	(11.68)	(4.278)	(12.83)	(13.65)
20	38.86	1.582	18.97	40.59
	(13.17)	(4.650)	(14.65)	(14.73)

Table 4D: Model B: Variance Decompositions for restricted VEC model

Time Horizon (quarter)	S.E.	GDP	Investment (LINV)	Bank credit (BCP)	Value shares traded (VT)
1.Variance Decomposition of RGDP					
Explained by shocks in					
4	0.007	89.27	0.370	5.262	5.095
8	0.017	73.23	0.151	7.476	19.13
12	0.019	63.21	0.492	6.484	29.81
16	0.023	55.99	1.159	5.297	37.55
20	0.026	51.08	1.996	4.393	42.52
2. Variance Decomposition of Investment (INV)					
4	0.023	19.45	70.66	6.447	3.431
8	0.043	40.30	38.05	8.838	12.80
12	0.062	40.72	26.30	9.086	23.89
16	0.076	38.33	20.76	8.127	32.78
20	0.085	35.53	18.14	7.12	39.20
3. Variance Decomposition of Bank credit (BCP					
4	0.127	12.90	4.408	81.44	1.248
8	0.209	14.84	2.832	80.93	1.386
12	0.287	18.36	1.565	78.48	1.588
16	0.368	22.55	0.975	75.14	1.330
20	0.448	26.01	0.708	72.33	0.942
4. Variance Decomposition of Value shares traded (VT)					
4	1.045	13.64	1.222	8.760	76.37
8	1.481	22.68	0.826	14.61	61.88
12	1.949	32.11	1.036	19.02	47.83
16	2.452	37.65	1.189	21.30	39.86
20	2.930	40.21	1.157	22.14	36.49

Table 4E: Selection of the order of the multivariate VAR and P-values for misspecification tests

Model A: Lag optimal(4)	LR	FPE	AIC	SC	LM-test	NORM	HETRO
1.	1048.9	8.29e-13	-16.47	**-15.91**	0.374	0.206	0.3163
2.	46.250	6.72e-13	-16.68	-15.69	0.383	0.902	Df.=320
3.	18.823	7.54e-13	-16.57	-15.13	0.459	0.099	$\chi 2$ =331.6
4.	**40.956**	**6.23e-13**	**-16.77**	-14.89	0.328	0.079 Joint-0.111	
Model B: Lag optimal(4)	**LR**	**FPE**	**AIC**	**SC**	**LM-test**	**NORM**	**HETRO**
1.	1024.2	3.45e-12	-15.04	**-14.49**	0.107	0.177	0.1598
2.	47.295	2.76e-12	-15.26	-14.27	0.238	0.931	df =320
3.	22.580	2.95e-12	-15.20	-13.77	0.574	0.812	$\chi 2$ =345.2
4.	**31.892**	**2.75e-12**	**-15.28**	-13.40	0.473	0.000 Joint-0.000	
Model C: Lag optimal(2)	**LR**	**FPE**	**AIC**	**SC**	**LM-test**	**NORM**	**HETRO**
1.	1166.08	3.59e-15	-21.908	-21.35	0.053	0.002	0.0003
2.	**133.379**	**1.01e-15**	**-23.183**	**-22.19**	0.601	0.845	Df=160
3.							$\chi 2$ =229.8
4.						Joint-0.048	

Appendix: Chapter 5

Breaks in the stock returns

Table 5A: Bai and perron (2003) test for Nigeria Daily Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
14.14*	20.92*	15.39*	11.50*	9.27*
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
20.92*	23.45*	24.86**	26.16**	27.5***
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
13.14*	4.40	0.685	0.34	
Number of Breaks Selected				
Sequential: 2				
LWZ: 0				
BIC: 0				
Confidence Intervals (95%)				
T1: 406 - 558				
T2: 157 - 1313				

Table 5B: Bai and perron (2003) test for Nigeria Monthly Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
4.528	2.325	2.723	2.621	3.110
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
4.528	6.309	6.825	7.295	7.785
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
2.658	5.053	5.053	5.053	
Number of Breaks Selected				
Sequential: 0				
LWZ: 0				
BIC: 0				
Confidence Intervals (95%)				

Table 5C: Bai and perron (2003) test for South Africa Daily Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
1.355	3.300	1.816	2.403	2.080
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
3.300	4.220	4.565	4.880	5.207
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
3.037	1.264	0.609	0.000	
Number of Breaks Selected				
Sequential: 0				
LWZ: 0				
BIC: 0				
Confidence Intervals (95%)				
-				

Table 5D: Bai and perron (2003) test for South Africa Monthly Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
5.317	3.179	3.867	3.461	2.248
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
5.317	5.525	5.951	6.394	6.872
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
1.343	2.539	2.539	0.000	
Number of Breaks Selected				
Sequential: 0				
LWZ: 0				
BIC: 0				
Confidence Intervals (95%)				

Breaks in the conditional variance

Table 5E: Bai and perron (2003) test for Nigeria Daily Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
40.58***	22.60**	14.96 **	12.05**	8.95
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
40.58***	40.58***	40.58***	40.58***	40.58***
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
1.42	0.90	0.25	0.00	
Number of Breaks Selected				
Sequential: 1				
LWZ: 2				
BIC: 4				
Confidence Intervals (95%)				
T1: 976 -977				
T2: 1130 -4674				

Table 5F: Bai and perron (2003) test for Nigeria Monthly Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
4.82	3.02	5.12	6.62	3.32
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
6.62	10.57**	11.39**	12.24**	13.15***
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
1.12	1.12	0.97	0.00	
Number of Breaks Selected				
Sequential: 0				
LWZ: 1				
BIC: 1				
Confidence Intervals (95%)				
T1: 123 -124				

Table 5G: Bai and perron (2003) test for South Africa Daily Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
5.92	8.19	5.95	5.23	4.41
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
8.19	9.19*	9.73*	10.35**	11.05**
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
7.94	7.59	2.18	2.04	
Number of Breaks Selected				
Sequential: 0				
LWZ: 3				
BIC: 3				
Confidence Intervals (95%)				
T1:333 -2133				
T2:3429 -4305				
T3:4018 -4207				

Table 5H: Bai and perron (2003) test for South Africa Monthly Data

Specification				
Zt=(1)	q =1	P =0	h =1	m =5
Tests				
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$
2.31	3.78	3.47	5.33	4.18
$UD\max$	$WD\max$	$WD\max$	$WD\max$	$WD\max$
5.33	8.51	9.18*	9.85*	10.58**
$SupF(2/1)$	$SupF(3/2)$	$SupF(4/3)$	$SupF(5/4)$	
2.95	6.94	4.41	0.000	
Number of Breaks Selected				
Sequential: 0				
LWZ: 0				
BIC: 3				
Confidence Intervals (95%)				

Table 5I: Day of the week effect (pre-liberalization period) for South Africa

Estimates of return equation	*Estimates of return and volatility equations*
Constant 0.0008**	Constant 0.00099**
(2.1715)	(2.1699)
Monday -0.0251**	Monday -0.00014**
(2.134)	(-2.079)
Tuesday -0.0008	Tuesday -0.00086
(1.574)	(-1.359)
Thursday 0.0001	Thursday 0.00009
(0.212)	(-0.147)
Friday -0.00083	Friday -0.00091
(-1.5024)	(-1.476)
Rt(-1) 0.1648	Rt(-1) 0.1767
(-6.687)***	(7.2705)***
Rt(-2) -0.0251	*Volatility*
(-1.027)	ω -0.0742
	(-0.446)
Volatility	α 0.9820***
ω -0.7326	(3.436)
(-38.35)***	γ 0.0028
α 0.2532	(0.0216)
(6.775)***	β 0.09849***
γ -0.0497	(124.18)
(-2.334)**	Monday 0.2395
β 0.9446	(1.1634)
(262.57)***	Tuesday -0.3776
	(-1.544)
Diagnostics tests	Thursday -0.0222
Ljung Box (12) Q stat.- levels	(-0.0904)
13.698 (0.320)	Friday -0.5565
Ljung Box (12) Q stat.-squares	(-2.644)**
9.924 (0.678)	*Diagnostics tests*
ARCH LM Test	Ljung Box (12) Q stat.- levels
0.8066	9.0930 (0.695)
	Ljung Box (12) Q stat.-squares
	14.284 (0.283)
	ARCH LM Test
	0.8251

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) (**) (*) indicate statistical level of significance at 1%, 5% and 10% respectively

Table5J: Day of the week effect (post-liberalisation period) for South Africa

Estimates of return equation	*Estimates of return and volatility equations*
Constant 0.000676 (1.240)	Constant 0.00059 (1.216)
Monday 0.0002 (0.274)	Monday 0.00035 (0.482)
Tuesday -0.00043 (-0.7279)	Tuesday -0.00037 (-0.665)
Thursday 0.0006 (1.246)	Thursday 0.0006 (1.294)
Friday -0.00014 (-0.219)	Friday -0.000013 (-0.024)
Rt(-1) 0.0961 (5.057)***	Rt(-1) 0.0977 (5.176)***
Volatility	*Volatility*
ω -0.5918 (-3.691)***	ω -0.5927 (-3.123)**
α 0.2088 (6.275)***	α 0.2017 (6.169)***
γ -0.0998 (-2.444)**	γ -0.0982 (-2.559)**
β 0.9518 (53.96)***	β 0.9554 (62.09)***
Diagnostics tests	Monday -0.0904 (-0.410)
Ljung Box (12) Q stat.- levels 13.695 (0.321)	Tuesday 0.0453 (0.283)
Ljung Box (12) Q stat.-squares 1.365 (1.00)	Thursday 0.0522 (0.307)
ARCH LM Test 0.8940	Friday 0.1841 (0.686)
	Diagnostics tests
	Ljung Box (12) Q stat.- levels 13.583 (0.328)
	Ljung Box (12) Q stat.-squares 1.952 (1.00)
	ARCH LM Test 0.9153

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) (**) (*) indicate statistical level of significance at 1%, 5% and 10% respectively

Table 5K: Day of the week effect (post-liberalisation period) for Nigeria

Estimates of return equation	*Estimates of return and volatility equations*
Constant 0.00017 (1.612) Monday- 0.00027 (-1.878)* Tuesday -0.00015 (1.013) Thursday 0.00014 (0.974) Friday 0.00014 (0.949) Rt(-1) 0.3366 (21.009)*** Rt(-1) 0.1252 (7.728)*** *Volatility* ω -0.4816 (-11.56)*** α 0.3631 (15.48)*** γ 0.0375 (2.659)** β 0.9788 (294.08)*** *Diagnostics tests* Ljung Box (8) Q stat.- levels 7.566 (0.372) Ljung Box (12) Q stat.-squares 6.409 (0.894) ARCH LM Test 0.2107	Constant 0.00017 (1.577) Monday -0.00026 (-1.864)* Tuesday 0.00014 (0.944) Thursday 0.00014 (0.964) Friday 0.00014 (0.946) Rt(-1) 0.3363 (20.95)*** Rt(-2) 0.1252 (7.782)*** *Volatility* ω -0.5499 (-5.383)*** α 0.3647 (15.37)*** γ 0.0369 (2.539)** β 0.9789 (284.05)*** Monday 0.0205 (0.1688) Tuesday 0.3164 (2.137)*** Thursday- 0.0534 (-0.365) Friday 0.0562 (0.462) *Diagnostics tests* Ljung Box (7) Q stat.- levels 7.667 (0.363) Ljung Box (12) Q stat.-squares 7.216 (0.843) ARCH LM Test 0.1885

Z-statistics and probabilities are in parentheses for the return and volatility estimation and diagnostics tests respectively. (***) (**) (*) indicate statistical level of significance at 1%, 5% and 10% respectively