FINANCIAL MARKET INTEGRATION, CONTAGION AND VOLATILITY TRANSMISSION: A CASE OF THE GLOBALLY DEVELOPED MARKETS AND DEVELOPING STOCK MARKETS IN AFRICA

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Financial Market Integration, Contagion and Volatility Transmission: A Case of the Globally Developed Markets and Developing Stock Markets in Africa

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DECLARATION

I, ANYIKWA IZUNNA CHIMA (210018623), hereby declare that the thesis for Doctor of Philosophy Economics is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another university or for another qualification.

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ABSTRACT

The widespread impact of the 2007 global financial crisis and the subsequent Eurozone sovereign debt crisis added new impetus to the on-going international discussions about the sustainability of a financial integration model. Moreover, the crisis revealed the complexity of the international transmission of financial shocks and the financial vulnerabilities of different financial markets. More so, it exposed the major weaknesses in our knowledge of how the forces that drive global financial systems operate. This is compounded by a failure to appreciate the scope of interdependencies that exist across markets and their potential to destabilise the global financial system in times of crises. At the heart of this weakness is the inability to accurately understand the various propagation mechanisms and channels through which a crisis from one market is transmitted to other markets.

It is against this background that this study is undertaken, in order to empirically investigate the role of financial market integration, contagion and volatility transmission, using weekly data between the period 3 January 2003 to 26 December 2014. The study covers 27 stock markets, comprising 13 African stock markets, 10 developed stock markets and four emerging stock markets. The study employed two empirical frameworks: the first framework focused on the short-run and long-run relationships between African stock markets and major global stock markets using the Johansen co-integration test, Granger causality test, GIRF and GFEVD. The second framework focused on testing evidence of contagion and volatility transmission using the DCC-GJRGARCH model and AS model.

The results show that the majority of African stock markets moved together in the long-run with the major global stock markets during the pre-crisis and Eurozone crisis periods. While the long-run relationship between African stock markets and the major global markets disappeared during the period of the global financial crisis, the relationship re-emerged during the Eurozone crisis period.

From the analysis of Granger causality test, the results show some differences exist in terms of the relative strength of the causal linkages across markets and periods. However, it was shown that strong causal linkages emerged during the global financial and Eurozone crisis periods relative to the pre-crisis period. Also, the leading role of the major developed markets, compared to the emerging markets, is demonstrated throughout the analysis of causality tests. Moreover, the sensitivity of African markets to shocks from the global

markets was clearly highlighted by analysis of the GIRF and GFEVD, especially during both crisis periods.

Furthermore, the results from the AS model confirm significant evidence of mean and volatility spill-over effects from the major global markets to African markets especially during the periods of both crises. In addition, the level of volatility was found to be more persistent and asymmetric during both crisis periods compared to the pre-crisis period.

The results confirm the existence of contagion effects through the analysis of the conditional correlation during both crisis periods. More importantly, the analysis of conditional correlation emphasised evidence of heightened co-movement between African markets and the major global markets during the periods of crisis. Consequently, the decoupling phenomenon is rejected in favour of synchronisation of business cycles between African stock markets and the major global markets.

The findings of this study have several important implications for the policymakers and investors in Africa and the world at large. The findings of this study not only provide some information about the level of financial integration but also the effect of growing financial linkages between African markets and the global markets, which is important for designing appropriate regulatory frameworks. Also, the knowledge about the dynamic interrelationship in terms of contagion and volatility transmission between African markets and the major global markets can be utilised by investors, and thereby help them to make better investment decisions.

Consequently, the findings of this study point to a need for policymakers in general and in Africa in particular, to monitor closely changes in financial development in other markets in order to reduce the vulnerability of domestic markets to external shocks. To mitigate the impact of the external shocks, greater co-operation and co-ordination, with proper supervision of different markets' fiscal and monetary policies, should be encouraged. Such policies need to be carefully aligned with the objective of external sustainability. This can be achieved through strategic partnerships and mergers, foreign institutional investments, cross market listing of shares, corporatisation of exchanges and the introduction of private ownership. Above all, effective regulation is needed to realise the benefits of financial market integration.

DEDICATION

I dedicate this thesis to the Almighty God and my Lord and Saviour Jesus Christ, who gave me the strength and health to see the logical conclusion of this thesis.

I dedicate this thesis to my lovely parents (Mr Dobinson E Anyikwa and Mrs Lois E Anyikwa) and all my siblings, Dr Anderson, Chinwendu, Ifeanyi, Chigekwu, Mmaduabuchi, Onyinye and Chiamaka.

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LIST OF ACRONYMS

ASEA	African Securities Exchange Association
AS	Aggregate Shock
APT	Arbitrage Pricing Theory
AR	Autoregression
ARCH	Autoregressive Conditional Heterskedasticity
ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
BEKK	Baba, Engle, Koraft and Kroner
BIS	Bank for International Settlement
BRVM	Bourse Regionale Des Valeurs Mobilieres
CAPM	Capital Asset Pricing Model
CIRP	Covered Interest Rate Parity
DCC	Dynamic Conditional Correlation
ECM	Error Correction Model
EGARCH	Exponential Generalised Autoregressive Conditional Heterskedasticity
FDI	Foreign Direct Investment
FIAPARCH	Fractionally Integrated Asymmetric Power Autoregressive Conditional Heterskedasticity
GARCH	Generalised Autoregressive Conditional Heterskedasticity
GFEVD	Generalised Forecast Error Variance Decomposition
GIRF	Generalised Impulse Response Function
GJR- GARCH	Glosten, Jagannthan and Runkle Generalised Autoregressive Conditional Heterskedasticity
ICAPM	International Asset Pricing Model
IFC	International Financial Corporation
IMF	International Monetary Fund
KPSS	Kwiatkowski, Phillips, Schmidt and Shin
MGI	McKinsey Global Institute
MGARCH	Multivariate Generalised Autoregressive Conditional Heterskedasticity
MSCI	Morgan Stanley Capital International
OECD	Organisation for Economic Co-operation and Development
PP	Phillips-Perron

PPP	Purchasing Power Parity
SAP	Structural Adjustment Programme
UIRP	Uncovered Interest Rate Parity
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
VAR	Vector Autoregression
VECM	Vector Error Correction Model
VIRF	Volatility Impulse Response Function
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The recent development in the African financial markets would be difficult to understand without considering the trends in the global financial markets. Considering how international financial markets have evolved not only helps to set the background of this study, but also to understand the degree to which domestic market developments are the result of changes in the international markets. Therefore, the main objective of this introductory chapter is to provide the background of the study against which the research problem and questions as well as the objectives of the study can be derived. Hence, this chapter encompasses the background of the study, problem statement and research questions, objectives of the study, relevance of the study, motivation for the study, contribution of the study and finally the structure of the thesis.

1.2 Background of the study

In the past few decades, global economic arrangements have evolved in ways that few experts would have predicted at the time. The global economic arrangements over this period have encompassed empires and colonial spheres, due to globalisation. This has created a global economic landscape, which is defined less by nationalism and regionalism, and more by a complex interaction of different economies, leading to competition between many countries. As a result, global economic relations have become deeper and more far-reaching, incorporating different components such as trade, finance, investment and regulations. These are clear-cut and reflect a growing trend towards integration in the global economy.

The increasingly outward-oriented business approach and inclusive global trade co-operation among different countries have supported this trend. This support has manifested itself through increasingly unilateral, bilateral, multilateral and regional trade arrangements. The end of the Second World War in particular, saw the gradual dismantling of the fixed exchange rate system and technological progress, as well as other innovations, which have helped to improve efficiency in the global flow of trade, investment and financial intermediation between countries (Schmukler, 2004 and Antoniou, Pescetto & Antonis, 2003). Consequently, integration and liberalisation policies have become a common practice and many countries have them as part of their economic policy strategies.

Following these developments, an increasing share of global economic activity involves cross-border transactions in goods, services and finances. For instance, the global cross-border flow of goods, services, and finances increased from $6.2 trillion in 1994, to $27.2 trillion in 2013. Over the same period, the share of global cross-border flow of economic activities relative to global gross domestic product (GDP) increased from 18.8% to 48.6%. This suggests that roughly one out of every two transactions across the globe involved a cross-border transaction, up from less than one out of every five transactions in the 1990s (IMF, 2015).

At the same time, McKinsey Global Institute (MGI) estimated that the total value of global financial assets – including equity market capitalisation, corporate and government bonds, and loans - grew from approximately $56 trillion in 1990 to $225 trillion in 2012. Also, the global financial depth as measured by the ratio of global financial assets to world GDP rose to 312 % from 263 % (MGI, 2013). In addition, the global stock of foreign investment assets grew from around $10 trillion in 1990 to roughly $96 trillion in 2010 (MGI, 2011).

Accompanying the growth in financial assets over this period was acceleration in the global cross-border capital flows - including foreign direct investment (FDI), purchases and sales of foreign equities and debt securities, and cross-border lending and deposits, which rose to $11 trillion in 2007 before the global financial crisis compared with just $815 billion in 1994. These cross-border flows not only reflect the degree of integration in the global economic system but also indicate growing financial linkages between lenders and investors, the real sector and the financial sector, as well as linkages between different national markets.

The global economy is becoming increasingly integrated through cross-border flows and the web of cross-border linkages is changing, thereby paving the way for a more open, loosely controlled and increasingly integrated financial system. One of the key aspects of financial integration is the reduction or removal of friction that impedes cross-border flow of goods, services and capital and enhances the potential for the growth of cross-border transactions. All things being equal, one would expect that the removal of restrictions would enhance the scope for volatility spillover and contagion. Moreover, there is growing evidence in the literature suggesting that integration provides a platform for transmission of adverse economic shock or crises across markets (IMF, 2007; Buttner & Hayo, 2011; ECB, 2012 and Farid, 2013). The existence of a large body of literature relating to financial integration, contagion and volatility transmission is therefore not surprising, given that these have far-reaching implications for stock pricing, hedging, portfolio management, asset allocation and framing regulatory policies.

Arguably, the growing cross-border capital flows are the main force behind increasing financial market integration, driven by the potential benefits associated with financial integration. Some studies have stressed the potential benefits of financial integration, which range from risk sharing to efficiency in resource allocation, which depends on the size, composition and quality of capital flows, to alleviation of capital scarcity, which in turn reduces the cost of capital (Rejeb & Boughrara, 2015; Gangadharan & Yoonus, 2012; and Buttner & Hayo, 2011). Also, financial integration enhances the development of the domestic financial market through competition, technological transfers, and corporate governance by imposing higher credit standards and ultimately, the overall economic growth and welfare (Wang, Yang & Bessler, 2003; ECB, 2012; and Farid, 2013).

Financial integration plays an important role in promoting economic development by facilitating and diversifying firms' access to tap large international pools of savings in order to finance investment needs. In performing this function, financial integration facilitates a deepening capital market, with ample liquidity and well-developed secondary markets, which not only provide an exit route for investors but also an opportunity to cash-in on market appreciation and to change investments (ACCA, 2012). There is also a strong connection between financial market development and financial integration. These benefits are likely to lead to a more financially interconnected world and deeper financial integration.

Conversely, there are growing concerns over the downside risk of financial integration, because certain levels of risk go hand-in-hand with integration of markets (Farid, 2013 and Buttner & Hayo, 2011). A financially integrated market is likely to be sensitive to a host of market conditions, including competition, increasing co-movement of asset returns and synchronised business cycles. Moreover, there is evidence to suggest that in the presence of financial dislocation, increasing financial integration can destabilise the financial system and lead to financial crisis (Bernanke, 1983; Schmukler, 2004, and Alberola, Erce & Serena, 2012).

In addition, there is risk associated with increasing capital flows that accompany integration. Capital flow which is in excess of the economy's absorptive capacity or which is highly speculative in nature carries the risk of financial and economic instability. Also, portfolio equity and bond flows are subject to both short- and medium-term volatilities, indicating both optimism and pessimism in the financial market, which could lead to exchange rate overshooting, credit and asset price bubbles (Kaminsky & Schmukler, 2008).

Furthermore, a sudden fall in asset prices in one market could expose vulnerabilities of other financial markets, especially when asset markets are supported by high leverages and assets are widely held across borders (IMF, 2007). With greater leverage in the economy, a crisis may be transmitted to other markets due to sudden withdrawal, thereby causing asset prices to be correlated across markets. Moreover, studies have shown that financial integration may result in increased co-movement of financial asset prices across markets, because investors in one market may well be exposed to other markets (Rose & Spiegel, 2009 and IMF, 2007). There is a particularly high risk of sudden stops and withdrawals of international capital during the period of heightened financial tension, which could contribute to the spread of a financial crisis. This view seems to have been substantiated by the global financial crisis of 2007.

The global financial crisis, which unfolded in 2007, had effects extending well beyond borders and deep into the real economy and is a stark reminder of the fierce revolution witnessed in the global financial services sector over the past three decades. It has also clearly identified the influence of financial integration and economic interdependence, as well as the consequences and challenges they pose to investors, policymakers and the broader international community. Besides, the 2007 global financial crisis is not the first of its kind following the wave of financial globalisation. Different crisis episodes have been witnessed since the 1980s, notably the US stock market crash of 1987, the Mexican peso crisis of 1994, the Asian currency crisis of 1997, the Russian default of 1998, the Brazilian crisis of 1999, the Turkish crisis 2000/2001, the Argentinian crisis of 2001 (Asongu, 2012 and Das, 2010) and the aftermath of the 2007 crisis that led to the Eurozone sovereign debt crisis.

In view of the recent streams of financial crises, there is growing concern about financial market integration model. At the heart of it lies the focus on the contagion, volatility spillover and business cycle synchronisation. The 2007 global financial crisis has revealed the complexity of the international transmission of financial shocks and the financial vulnerabilities, which may be associated with increasing international financial integration. However, the role of financial integration in this regard is still largely an open question. Against this background, an examination of the integration of different financial markets could provide evidence as to why a crisis in one market can be transmitted to other markets. By comparing the integration process of financial markets in Africa with those of the major global markets, this study seeks to shed light on the role of financial market integration and contagion in transmission of volatility across markets.

1.3 Statement of the problem and research questions

The 2007 global financial crisis, specifically the severity with which the crisis engulfed different markets and economies around the globe, has emerged as a key event in the world economy in the past few years. The manner in which the crisis vibrated across financial markets has created considerable interest in public debate and economic research on financial integration, contagion and volatility transmissions among different financial markets. Of particular concern at the early stage of the crisis was whether the crisis in the U.S. housing sector would have a broader impact on the global economy. However, the common view among analysts and researchers was that the development in the U.S. housing market would not have a major spillover effect. This view was rooted in the belief that the crisis was a U.S.-specific sectoral development (given that the housing market has a relatively low imported component) rather than common shocks, which affect all markets (IMF, 2007). Meanwhile, from an African perspective, there is a general perception that financial markets in Africa are largely segmented and less integrated with the global markets, given their relatively small size and illiquid status (Alagidede, 2009 and Boamah, 2014).

Surprisingly, many regions experienced a sharper fall in their economic growth, as well as on their market stock returns than the United States, which was at the centre of the crisis. For instance, the global real GDP fell from 4.0% in 2007 to 1.5% and -2.1% in 2008 and 2009 respectively. Regionally, growth in developed economies declined from 2.5 % in 2007 to -3.7% by the end of 2009. At the same time, European Union countries recorded a huge decline from 3.2% in 2007 to -4.5% at the end of the 2009 financial year. Although growth in the developing economies was positive, growth actually decelerated from 8.0% in 2007 to 2.8% in 2009. Growth within developing countries in Asia declined from 9.1% to 4.4% and African growth declined from 6.1% to 2.6% over the same period (UNCTAD, 2014).

On the other hand, during the most turbulent phase of the crisis (from December 2007 to December 2008) the stock market returns around the globe declined significantly. For instance, the stock market return in the U.S. declined by 38.5%, United Kingdom by 31.3%, Japan 42.1%, France 42.7%, Germany 40.4%, China 65.4% and Russia 67.2%. Like other stock markets around the globe, the stock markets in Africa experienced a significant tumble during the period of the crisis. The Nigeria Stock All Share Index, for example, fell by 45.8% in December 2008 relative to December 2007. Other stock markets in Africa that witnessed a significant fall in stock market returns over the same period are: Egypt 56.4%, Namibia, 40.1%, Mauritius 36.1%, Kenya 35.3%, Zambia 29.7%, Uganda 25.9%, South Africa 25.7%, Botswana 16.5%, Morocco 13.5% and Bourse Regionale des Valeurs Mobilieres (BRVM) 10.7%.

Following the dramatic decline in growth and stock market returns around the globe, the focus is now on why the markets around the globe fell simultaneously and with such surprising uniformity during the crisis period, despite their widely differing levels of economic development. Most empirical studies to date on this issue have concentrated mainly on the major developed and emerging stock markets in other regions (Europe, Asia, and America), although there has also been some work on the smaller developing markets (see among others Hemche, Jawadi, Maliki and Cheffou, 2016; Mollah, Quoreshi and Zafirov, 2016; Morales & Andresso-O'Callaghan, 2014; Grangadharan & Yoonus, 2012; Gupta & Guidi, 2012; Min & Hwang, 2012; Kenourgios & Padhi, 2012; Syllignakis & Kouretas, 2011; and Yiu, Ho and Choi, 2010). However, there is less empirical evidence as to why African stock markets were affected by the crisis. Existing studies in Africa are mainly focusing on the integration of African stock markets with other markets without much reference as to why African markets were affected by the global financial crisis (see Boamah, 2017; Boamah, Watts and Loudon 2016; Boako & Alagidede, 2016; and Piesse & Hearn, 2012).

From an African perspective, the key research questions at the heart of this study are: is the simultaneous decline in economic growth and stock market returns directly connected with the level of integration of African financial markets with the major global markets? Do the African stock markets share any common trend with the major global markets? Since economies and their financial markets are at different levels of development, does financial integration matter in the international transmission of volatility? What impact did the 2007 global financial crisis have on the relationship between African markets and the major global markets? Did it cause a permanent or temporal effect on their relationship? Is there any evidence of co-movement in stock market returns to suggest synchronisation of business cycles, or otherwise decoupling? Is it appropriate to talk about financial contagion or to simply refer to the interdependence between markets? How much of the volatility can be attributed to a specific market and to what extent does a specific African market receive volatility from the global markets? What are the implications of stock market integration for the international portfolio diversification?

Ultimately, answers to these questions could provide useful guidance for policy actions that aim at systemic risk identification and financial stability preservation. Financial market integration, volatility transmission and contagion are central to these questions. The fact that stock markets in different countries declined simultaneously is not surprising, given that these economies might have been connected through trade and finance, in such a way that any shock in one country was likely to affect the other countries. Moreover, the correlation of markets that share common economic linkages can be rationalised on the basis of economic theory. However, such an economic theory is not that convincing in accounting for the increased volatility and co-movement among financial markets that are weakly linked - such as those in Africa.

Against the background of the 2007 global financial crisis, this study explores the role of financial integration of African stock markets with the emerging and developed stock markets at the centre of the current financial crisis, in the transmission of the crisis. Specifically, it explores the fundamental relationship between stock markets in Africa, emerging and developed markets on one the hand and the contagion effects from the international financial market on the other hand. The main focus, therefore, is to identify the extent to which African stock markets are related to larger international financial markets and to ascertain whether there is any evidence of contagion effect and synchronisation of business cycles. Furthermore, this study anchors the dynamic integration or desynchronisation of these markets with the 2007 global financial crisis.

1.4 Objectives of the study

Following the research questions posed above, the general objective of the study is to investigate the international integration of stock markets in Africa with the globally emerging and developed markets. However, other specific objectives of this study are as follows:

(a) To examine the performance of stock markets in Africa before, during and after the crisis;
(b) To examine the relationship between African and major global stock markets;
(c) To examine the effect of the global financial crisis on the relationship between African and major global stock markets;
(d) To examine the dynamic lead-lag relationship between stock markets in Africa and major global markets;
(e) To examine the nature of co-movements between African markets and major global stock markets;
(f) To examine whether there is evidence of financial contagion or otherwise;
(g) To examine whether there is evidence of decoupling or synchronisation of African stock markets with the global markets;
(h) To examine the level of volatility before, during and after the crisis;
(i) To examine the behaviour of volatility spillover effects during the crisis; and
(j) To make policy recommendations based on these findings.

1.5 Relevance of the study

This study is relevant to all market participants to understand the opportunities and challenges inherent in the current global financial landscape, particularly, in an environment where movements towards greater financial market integration are being promoted. The 2007 global financial crisis inevitably opened a window of opportunity to revisit all economic models of integration. An understanding of the financial crisis is vital, in that such an event elevates the cost of intermediaries and restricts credit, which in turn restrains the level of activity in the real sector and can ultimately lead to periods of low economic growth and recession. As a result, policymakers, professionals and investors can learn lessons and become better equipped to deal with these events, which have implications for the future. Also, factors that gave rise to the crisis can be examined and the resultant appropriate regulatory and supervisory response can be learned.

Moreover, an understanding of financial market integration and, in particular, which countries are integrated can be an important component for implementing countercyclical policy. Additionally, the knowledge of the direction of interdependence and volatility spillover can provide valuable information to the policymakers. For instance, downturns in one country that is integrated with other countries can help forecast domestic downturns, leading to a more timely policy response. Understanding financial integration can also provide insight into the impact of portfolio diversification, of the increase in financial flows and of regional trade agreements, all of which have helped to reshape the global financial landscape.

More so, investors and policymakers must understand how each market responds to dynamics in the financial system. Hence, there is a need to help investors and policymakers to improve their capacity to anticipate, avoid and manage the contagious crises of volatility that can accompany economic globalisation and financial integration. The need for vigilance is especially re-echoed by the recent global financial crisis, because markets can continue to grow and attract liquidity even as institutions are being eroded away from underneath.

1.6 Motivation for the study

Developments in the financial markets are of great interest to financial and investment professionals, policymakers, academic researchers and individual investors around the world. Accordingly, they are subject to continuous coverage and research. However, since the wave of globalisation, the stylised facts and trends around the long-term evolution of financial market integration across regions and asset classes are neither readily available nor are their implications fully understood. The recent turbulence in the global financial system and subsequent rise in systemic risk has compelled researchers to rethink the very foundation of financial integration models. Therefore, the current study is motivated by the following reasons:

First, at the beginning of the 2007 global financial crisis, there was a growing debate among researchers as to whether or not developing market economies would be insulated from financial crises emanating from the developed markets, given their growing integration. One popular view endorses the decoupling phenomenon. Decoupling is based on the belief that developing market economies, like those in Africa with limited exposure to international financial markets, would be isolated from the effects of a financial crisis in developed financial markets. The notion of decoupling is built on the idea that business cycles in developing market economies are independent from business cycles in developed economies (Wälti, 2012).

The proponents of decoupling highlight the fact that, because of diversification in their source of economic growth due to globalisation, developing economies have managed to strengthen their domestic policy framework (Trancoso, 2014; Levy Yeyati & Williams, 2012 and

Olivero & Madak, 2013). In particular, they stress that the global trade linkages with the United States, which were at the centre of the crisis, have become less important for many countries (IMF, 2007). Also, strong domestic demand within other developed economies and developing economies means that their business cycles are expected to decouple.

In contrast to the idea of decoupling, another view argues that business cycles are expected to be more synchronised across countries due to globalisation and integration of markets (IMF, 2007). The synchronisation of markets is viewed as interdependency among markets (Cooke, Kose, Otrok & Owyang, 2015). Accordingly, this view suggests that opening up economies not only boosts trade and financial linkages but also facilitates international transmission of shocks. The relative decline in the global trade linkages with the United States should be balanced against increasing cross-border financial linkages, given the fact that the United States remains at the centre of the global financial system (IMF, 2007).

Moreover, strong domestic macroeconomic policy reforms may result in increased co-movement of domestic prices with the international markets. This is because improvement in policies and greater monetary policy transparency can attract foreign investors and at the same time, increase sensitivity to shocks from international financial markets (Felices & Wieladek, 2012). Besides, as developing market economies are opening up their economies as well as becoming integrated into the global financial system, any decoupling benefits may well be offset by economic integration. According to this view, business cycles are expected to be synchronised across markets.

Therefore, investigating whether financial integration fosters business cycle synchronisation is relevant in the sense that synchronised business cycles would perhaps mean a stronger and faster transmission of shocks across countries and markets. In particular, in the light of the recent global financial crisis, it is important to examine the role of financial market integration in spreading the crisis. To this end, the current study is motivated to shed more light on this debate.

Second, while there are many economic and financial benefits associated with financial integration, the issue of financial market integration is of particular interest to market participants due to its implications for stock pricing, hedging, portfolio management, asset allocation and for framing regulatory policies (Joshi, 2011 and Brailsford, 1996). Financial integration allows investors access to other markets as well as providing them with a more diverse menu of investment opportunities (Joshi, 2011 and Al-Deehani & Moosa, 2006). Free movement of capital benefits the borrowers and consumers in the recipient countries by reducing the cost of capital. It also allows for cross-border sharing of risk through international portfolio diversification.

It is a well-known fact that international portfolio diversification allows investors to reduce the risk of their investment, while maintaining a constant expected return on their investment (Jorion, 1985 and Shawky, Kuenzel & Mikhail, 1997). However, from the perspective of portfolio rebalancing and adjustment, financial market integration can actually undermine the benefits of international portfolio diversification. Joshi (2011) points out that the gains from international portfolio diversification are only possible in a weakly integrated market, where returns from investing in different national stock markets are not perfectly correlated. But, in a fully integrated market, co-movement in returns eliminates the effectiveness of cross-market diversification.

Ultimately, the foregoing discussion is an empirical issue, which a growing body of researchers on integration is attempting to explore. As a result, this study hopes to ascertain whether or not stock markets in Africa can offer such diversification benefits to international investors.

Third, an empirical understanding of the theory and practice of finance is central to our understanding of how the global financial system emerges and evolves across developed and developing markets. The recent global financial crisis has exposed the major weaknesses in our knowledge of how the forces that drive global financial systems operate. At the heart of the failure is the inability to accurately understand the various propagation mechanisms and channels through which shocks from one market are transmitted to other markets. Arguably, increased domestic stock market volatility may be related to higher sensitivity to the stochastic process that drives the world market caused by the increased financial integration. Our understanding is limited with regard to the distortions that may produce contagion and the way in which they may interact with integrated financial markets. Furthermore, the magnitude of contagion across markets around the globe, as well as the change in the structure of interdependence between Africa, and emerging and developed markets is still largely under investigation. At present, little is known about the level and degree of interdependence and contagion between the African markets and the major global markets during the recent global financial crisis.

Finally, the extreme volatility of speculative capital flows and the costly economic crises that accompanied the recent global financial crisis, have led researchers and policymakers to reconsider the merit of the trend towards liberalised financial market policies that have prevailed over the last three decades. Consequently, one must remain skeptical about the effectiveness and desirability of these policies. Moreover, maintaining financial stability includes avoiding the buildup of financial vulnerabilities over the course of the economic cycle. Policy frameworks therefore need to fully internalise the notion that the financial system and the broader economy are each part of an integrated whole, and to recognise the linkages between them and the rest of the world. There is also a need to better incorporate the linkages between the economy and the financial system. More so, it is important to be more aware of linkages across borders, as well as the impact that policies and developments in other economies can have on domestic financial systems.

1.7 Contributions of the study

Flowing from the above discussions on the relevance and motivations of the study, the major contributions of this study to the existing literature can be summarised as follows:

First, the study contributes to the literature on international financial market integration, contagion and volatility transmission by providing an African perspective on these issues, which has received little attention in the previous empirical studies. This study investigates the financial integration between the African, emerging and developed markets through the analysis of their stock market integration.

Second, the study intends to provide new evidence on financial contagion theory by examining the transmission of the 2007 global financial crisis and Eurozone crisis to African markets. This calls for an examination of the effects of both crises on African markets, and to ascertain whether the effects on African markets were due to their integration with the global markets (interdependence), or contagion. Moreover, many of the empirical studies on financial crises still consider the issue of integration, contagion and volatility transmission in isolation and thereby, ignore, or at least underestimate, the importance of integration in the propagation of a crisis (see Boamah, 2017; Collins & Biekpe, 2003; Fowowe & Shuaibu, 2016; and Heymans & da Camara, 2013). In this study, the role of financial integration in the transmission of contagion and volatility is emphasised. Following this line of thinking, the study intends to open a new line of thought that would allow a better definition of contagion, which has been a subject of controversy in the literature.

Third, the study also contributes to the knowledge of the direction of interdependence, contagion and volatility spillover between African, emerging and developed markets before, during and after the global financial crisis. It is arguably even more important to understand the direction of interdependence, contagion and volatility than to know whether they do exist. This is because downturns in a foreign market, which is integrated with the domestic market, can help forecast domestic downturns, leading to more timely policy intervention. In this regard, the study will identify African markets that are more prone to financial shocks from the global markets.

Lastly, beyond the financial integration of African markets, the present study adds an African perspective to the debate on the so-called decoupling phenomenon. Hence, examining the differences in the crises dynamics will help to contribute to the debate regarding the decoupling and co-movement of African market with the major global markets.

1.8 Structure of the thesis

The rest of this thesis is organised as follows: Chapter Two provides a historical overview of stock market development in Africa and also discusses the key features of African stock markets as well as their performance during the recent global financial crisis. Chapter Three presents an overview on global integration and the transmission channels of the 2007 global financial crisis. Chapter Four reviews both the theoretical and empirical literature on financial market integration, contagion and volatility transmission. Chapter Five outlines the empirical frameworks for investigating financial markets integration, contagion and volatility transmission. The chapter also gives a description and sources of the data, time frames, as well as the scope of the study. Chapter Six empirically analyses the degree of stock market integration by examining the dynamic relationship between African stock markets, and emerging and developed stock markets. Chapter Seven investigates evidence of contagion and volatility transmission. Finally, Chapter Eight summarises the findings of the study by providing conclusions and recommendations as well as suggestions for further studies.

CHAPTER TWO

STOCK MARKET DEVELOPMENT IN AFRICA

2.1 Introduction

The main objective of this chapter is to provide some historical background of stock market development in Africa and to consider the structure and characteristics as well as the performance of stock markets in Africa before, during and after the 2007 global financial crisis. The examination of the development of stock markets in Africa and their performance not only helps to understand the progress of African stock markets but also in identifying the impact of the global financial crisis on these markets. Equally, it helps to understand the state of African stock markets before and during the crisis. To this end, this chapter will focus on key stock market indicators in order to ascertain their behaviour before and during the crisis. It will also provide a comparative analysis of stock market performance in Africa against the major international markets over the crisis period.

However, the analysis in this chapter is preceded by a brief presentation of the historical background of stock market development in Africa. The purpose of the analysis is to facilitate a good understanding of past developments in African stock markets. Thereafter, the chapter considers the structure and characteristics of African stock markets, followed by an in-depth review of major stock markets in Africa. Lastly, it looks at the performance of African stock markets relative to major international markets.

2.2 History of stock market development in Africa

The stock market plays an important role in facilitating smooth and efficient operations in the economy. One primary function of the stock market, and by extension the financial system, is to channel resources from individuals and corporations with surplus resources to those with resource deficits. In doing so, the stock market not only satisfies the savings needs of the economy but also facilitates the accumulation of investment that is vital for economic growth and development. However, the role of the stock market extends well beyond this primary function to include risk sharing. In an environment characterised by high levels of uncertainty, stock markets provide efficient risk sharing and diversification opportunities. Such functions are vital as they allow high-risk combined with high-return investment projects to be undertaken (World Bank, 2002).

Also, stock market returns are a unique measure of market performance across countries. This is because stock market returns are forward-looking and incorporate expectations about future cash flows and economic outlook. Moreover, the positive link between stock market development and economic growth provides a strong case for the development of the stock market (Adjasi & Biekpe, 2006).

Despite these merits, stock market culture is still relatively new and somewhat under-developed in some parts of Africa. However, over the course of the past few decades, the economic development paradigm has increasingly shifted towards establishing stock markets in different countries in Africa. Although the history of stock markets in Africa dates back to the 19th century, the period 1980 to 1990 marked the turning point in the history of stock market development in the region. The development of stock markets in Africa over this period was the result of extensive economic and financial sector reforms in many countries in the region, introduced by the Structural Adjustment Programmes (SAPs) promoted by the World Banks and the IMF (Singh, 1999).

The SAP initiative reflects the neo-liberal sentiment or ideology of a market-based economy, which aims to achieve long-term economic growth in developing countries through economic reforms. This initiative was based on the understanding that promoting long-term economic growth driven by the private sector requires the creation of an enabling environment within which the private sector can flourish. The reform package includes currency devaluation, managed balance of payments, reduction of government services through public spending cuts/budget deficit cuts, reducing inflation, privatisation of state-owned firms, lower tariffs on imports, increased free trade, business deregulation and opening up economies to foreign competition (WHO, 2015).

One of the key pillars of the SAP initiative was the reform of the financial sector. Within the SAP, the financial sector reforms were recognised as the key drivers of long-term economic growth by granting private sector access to investment finances through banks, stock exchanges and other financial intermediaries. However, in most developing countries like those in Africa, banks remain the most developed financial intermediaries, but they are not reliable sources of long-term financing (Ziorklui, 2001; and Paulais, 2012). This is because of the short-term nature of banking assets and liabilities combined with the regulatory requirements that constrain banks' ability to supply long-term capital required for long-term investments. Also, in most developing countries, the non-banking financial institutions, which are regarded as the sources of long-term financing, are generally underdeveloped (Ziorklui, 2001).

In this regard, a well-functioning stock market is considered by many to be a core component of the financial sector. Arguably, stock markets are better placed to realise long-term investment needs through the mobilisation of domestic and international capital by floating of shares to the general public. Also, they offer a wide-range of financial instruments to investors which might better meet their liquidity requirements as well as their time preferences. Nevertheless, a multi-faceted financial sector, which includes a well-developed banking and capital market, is considered more efficient in the achievement of long-term economic growth (World Bank, 2002).

Basically, liberalisation and privatisation were the dominant strategies of the SAP initiative. Consequently, the financial sector and in particular, the development of stock markets was considered to be an essential aspect of a developing economy. As a result, many developing countries embarked on reforms to deepen their financial sector. Capital markets were expanded in order to improve their ability to mobilise both domestic and international pools of resources, and to efficiently allocate them to the most productive sectors. This led to a policy shift towards liberalisation and privatisation, which facilitated a reduction in public debt, improved incentives and efficiency in the operations of the private sector (Kibuthu, 2005).

Like other developing countries, African countries also embarked on financial sector reforms. Particularly in the 1990s, a number of African countries witnessed a gradual policy shift towards a market-based economy driven by implementing reforms (UNDP, 2003). Exchange rate and interest rate liberalisation, restructuring and privatisation of state-owned banks and introduction of measures to promote capital market development were among the major policy reforms in the region (Bourguignon & Pleskovic, 2006). Despite the imbalance in the extent of policy reforms across sectors and countries in the region, these reforms led to a more liberalised financial environment. To most African countries, stock market development was seen as a central component of domestic financial sector liberalisation programmes (Yartey & Adjasi, 2007). In line with this development, Senbet (2009) acknowledges that the development of stock markets was a way of reinforcing Africa's commitment to financial sector reforms.

The outcome of these economic and financial reforms led to a growing interest in the establishment of stock markets and their rapid proliferation across African countries (Allen, Otchere and Senbet, 2011). In line with the SAP initiative, many stock exchanges were established in Africa as a way of enabling countries to adopt a more market-based economy. For instance, there were a total of seven stock exchanges in Africa (Egypt, Kenya, Morocco, Nigeria, South Africa, Tunisia and Zimbabwe) prior to 1980. Out of this number, four were from the Sub-Saharan region, while the other three were from North Africa. Stock exchanges in South Africa and Egypt were established in the 19^{th} century and are thus the oldest stock markets on the continent. However, between 1980 and 2000, the number of stock exchanges in the region increased to twenty. The decade from 1990 and 2000 witnessed a particularly significant surge in the number of stock exchanges established in Africa, as 10 stock exchanges were established over this period.

Currently, there are 27 stock exchanges in Africa including two regional stock exchanges. The Bourse Regionale des Valeurs Mobilieres (BRVM), established in 1998, is a regional stock exchange covering eight French-speaking West African countries, while the Bourse Regionale des Valeur Mobilieres d'Africa Centrale (BVMAC) which was established in Gabon, is a regional stock exchange for five countries within the Economic and Monetary Community of Central Africa (Communaute Economique et Monetaire de I'Afrique Centrale, or CEMAC). The 27 stock exchanges serve the interests of 38 countries (or 73.4% of the total number of countries in the region). Securities, commodities and currency exchanges also exist in forty African countries (Paulais, 2012). Table 2.1 below provides a snapshot of various stock exchanges in Africa and their year of establishment.

The movement towards the development of stock markets in Africa over the past few decades is also related to other developments in the global economy, particularly the globalisation and integration of markets. The financial sector reforms are reinforced by rapid improvement in global conditions and advancement in technology that connects Africa to the rest of the world (Senbet, 2009). Also, with the collapse of the Soviet Union and decline in the number of centrally planned economies around the globe during the 1990s, most developing countries joined the global movement towards a free market economy. This was an attempt to incorporate a market-based element into their domestic markets as well as to broaden their capacity to attract international capital beyond the constraints imposed by domestic savings (Kim & Singal, 2000).

As highlighted above, the evolution of stock markets in Africa in recent years has been rather dramatic, as countries have moved to mobilise domestic resources as well as foreign capital. African markets now offer investors access to a wide range of investment opportunities. Also, the development of stock markets and accelerated economic and financial reforms is essential for integrating African markets into the global financial system and promoting their attractiveness to international investors. Recent trends, according to the International financial Corporation (IFC), have shown a growing interest of international investors in African markets as an investment destination. The growing interest in the region is primarily anchored in the region's economic fundamentals and growth prospects as well as an environment that increasingly permits private sector initiative (IFC, 2011). Economic and financial reforms are an important channel for integrating markets into the global economic system as well as for keeping them aligned with the best international practices. As such, it would be misleading to view these reforms as a mere fashion of the day. Therefore, the establishment of stock markets across the continent can be considered a positive development in view of the significant role that financial markets play in the economic growth process.

However, their low liquidity and relatively small size by international standard remain a challenge to most stock markets in Africa (UNDP, 2003; Adjasi & Biekpe, 2006 and Alagidede, 2009). Other barriers include contractual and legal frameworks, accounting and disclosure rules, and regulatory and supervisory mechanisms as well as infrastructural bottlenecks (Bourguignon & Pleskovic, 2006; Adjasi & Biekpe, 2006 and IFC, 2011). The regional integration of stock markets is generally considered an effective means of improving the size and liquidity problems of these markets (Paulais, 2012; Adelagan & Radzewicz-Bak, 2009 and Adelagan 2008). The regional integration approach can take the form of an outright merger of different national stock markets or cross-market listings. Many countries in the region have already taken this initiative as exemplified by the existence of the BRVM and BVMAC.

Also, with the exception of the South African market and Egyptian markets, stock markets in the African region are described as "frontier markets." Consequently, most of these markets are excluded from the main regional equity market indices (UNDP, 2003)[1]. Also, the

[1] For instance, in the Morgan Stanley Capital International all country index (MSCI ACWI), which consists of 46 country indices comprising 23 developed and 23 emerging market country indices- apart from South Africa and Egypt- other African markets are not included in the index. Also, countries like Kenya, Mauritius, Morocco, Nigeria and Tunisia are classified as frontier markets and they are part of the MSCI global frontier markets

underdeveloped nature of most stock markets in the region impede on their ability to fully mobilise both international and domestic resources. As a result, markets in Africa have been bypassed by massive international capital flowing to other developing economies (Bourguignon & Pleskovic, 2006). The next section will provide a perspective on the trends and characteristics of African stock markets.

Table 2. 1: List of stock exchanges in Africa

Number	Country	Exchange	Year	Acronym
1.	Algeria	Algiers Stock Exchange	1993	SGBV
2.	Botswana	Botswana Stock Exchange	1989	BSE
3.	BRVM	Bourse Regionale des Valeurs Mobilieres	1998	BRVM
4.	Cameroon	Douala Stock Exchange	2001	DSX
5.	Cape Verde	Bolsa de Valores de Carbo Verde	2005	BVC
6.	Central Africa	Bourse Regionale des Valeur Mobilieres d'Africa Centrale	2006	BVMAC
7.	Egypt	Egyptian Exchange	1888	EGX
8.	Ghana	Ghana Stock Exchange	1989	GSE
9.	Kenya	Nairobi Securities Exchange	1954	NSE
10.	Libya	Libyan Stock Exchange	2006	LSM
11.	Malawi	Malawi Stock Exchange	1994	MSE
12.	Mauritius	Stock Exchange of Mauritius	1989	SEM
13.	Morocco	Casablanca Stock Exchange	1929	CSE
14.	Mozambique	Mozambique Stock Exchange	1997	BVM
15.	Namibia	Namibian Stock Exchange	1992	NSX
16.	Nigeria	Nigerian Stock Exchange	1960	NSE
17.	Rwanda	Rwanda Stock Exchange	2005	RSE
18.	Seychelles	Seychelles Securities Exchange	2011	SSE
19.	Sierra Leone	Sierra Leone Stock Exchange	2001	SSE
20.	South Africa	Johannesburg Stock Exchange	1887	JSE
21.	Sudan	Khartoum Stock Exchange	1994	KSE
22.	Swaziland	Swaziland Stock Exchange	1990	SSX
23.	Tanzania	Dar es Salam Stock Exchange	1996	DSE
24.	Tunisia	Bourse de Tunis	1969	TSE
25.	Uganda	Uganda Securities Exchange	1997	USE
26.	Zambia	Lusaka Stock Exchange	1994	LuSE
27.	Zimbabwe	Zimbabwe Stock Exchange	1948	ZSE

Note: The BRVM comprises the Ivory Coast, Benin Republic, Burkina Faso, Mali, Niger, Senegal, Togo and Guinea-Bissau. The Central African stock exchange includes Central African Republic, Chad, Republic of Congo, Equatorial Guinea and Gabon.

Source: UNDP and African Securities Exchange Association (ASEA) and Paulais (2012).

index which comprises 24 countries. Although countries like Botswana, Ghana and Zimbabwe are classified as frontier markets, they are not yet part of the MSCI global frontier market index (MSCI, 2015).

2.3 Structure and characteristics of African stock markets

African stock markets have gradually evolved over the past two decades following financial sector reforms which led to a growing number of stock markets in the continent. Despite this development, there are still many challenges facing African stock markets. The financial development gap remains enormous relative to other developing and developed regions of the world. As a result, this section provides a perspective on the structure and characteristics of African stock markets relative to other developing and emerging markets. For the purpose of comparison, certain leading developing markets which spread across other regions[2] are considered. These markets include: China, Malaysia, Indonesia, Thailand, Hungary, Russia, Turkey, Argentina, Brazil, Mexico, India, Pakistan and Bangladesh.

Although some of these countries are bigger in terms of GDP, some of them share similar characteristics with African countries in terms of economic and institutional structures as well as being rich in commodities (Afego, 2015). To obtain a global perspective, aggregate world data are considered as well. The analysis in this section is based on the indicators of financial development which range from stock market size and liquidity to market microstructures. The section below will consider each of these indicators in turn.

2.3.1 The size of African stock markets

To ascertain the size of African stock markets, three standard measures of market size are considered; namely, the number of listed companies, stock market capitalisation and stock market capitalisation as a percentage of GDP. These indicators provide a useful way of characterising the actual size of African stock markets.

a) Number of listed companies

The number of listed companies in any given stock exchange provides an indication of the relative size of the market. In essence, it indicates the number of companies whose shares are publicly traded on the exchange, with potential effects on the liquidity and investment opportunities. All things being equal, the existence of a small number of listed companies offers a limited number of investment opportunities as there are only a few available shares in

[2] Developing regions considered in this chapter are based on the World Bank classification where economies are classified according to income groups. Developing regions according to this classification include those economies that fall within the low and middle-income sector in these regions; namely: East Asia & the Pacific, Europe & Central Asia, Latin America & the Caribbean, the Middle East & North Africa, South Asia and Sub-Saharan Africa (World Bank, 2015).

which to trade. Table 2.2 provides an overview of the number of listed companies on each stock exchange in Africa over the period 2002 – 2012.

African stock markets are relatively small in terms of the number of listed companies. The number of listed companies on each exchange in the majority of the countries in the region is well below 50, with the exception of Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Sudan, Tunisia and Zimbabwe. Between 2002 and 2012, the average number of listed companies on the continent was 1652. The top nine stock exchanges in terms of the number of listings, namely Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Sudan, Tunisia and Zimbabwe account for an average of 91.6% of the total average listed companies in the region. Among these countries, Egypt, South Africa and Nigeria topped the list with a share of 33.3%, 23.6% and 12.4% respectively or a combined share of 69.3%.

Table 2.2 shows that the number of listed companies in Africa has gradually declined over the period at an annual average rate of 4.7% or cumulatively by 38.3%. The well established markets of Egypt and South Africa account for the significant drop in the number of listed firms. For instance, the number of listed firms in the Egyptian Exchange fell from 1148 in 2002 to 234 by the end of 2012. This corresponds to a 79.6% decline. Similarly, the number of listed firms on the South African Stock Exchange or Johannesburg Securities Exchange (JSE) declined from 450 to 348 or by 22.7% over the same period.

On the global front, African markets accounted for approximately 3.3% of globally listed companies over the period 2002 to 2012. Predictably, the establishment of stock markets in Africa lagged behind that of other developing regions of the world. Relative to other developing regions of the world, the number of listed companies in Africa is lower except for Latin America and the Caribbean. On average, the total share of listed companies in other developing regions relative to global listings over the period was 8.6% for East Asia and the Pacific, 9.9% for Europe and Central Asia, 2.2% for Latin America and the Caribbean, and 12.8% for South Asia. Looking at individual countries within each of these regions, evidence from the table below shows that except for Hungary, the average number of listed companies over the period is well above 100.

This evidence points to limited investment opportunities in African markets relative to other developing regions. At the same time, it stands to reason that a small number of listed companies could well lead to a paucity of daily trading and the concomitant lack of liquidity within the stock markets. However, markets with a large number of listings are more likely to be attractive to investors since more listings could well mean more investment opportunities.

Table 2. 2: Number of listed domestic companies[3], 2002 - 2012

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Botswana	18	19	18	18	18	18	20	20	21	23	24
BRVM	38	38	39	39	40	38	38	38	38	33	37
Egypt	1148	967	792	744	603	435	373	305	213	231	234
Ghana	24	25	29	30	32	32	35	35	35	36	34
Kenya	57	51	47	47	51	51	53	55	55	58	57
Malawi	8	8	8	9	10	12	15	15	14	14	14
Mauritius	40	40	41	42	41	90	89	89	86	86	87
Morocco	55	53	52	56	65	74	77	78	73	75	76
Mozambique	NA	9	10	13	5	7	6	2	2	2	3
Namibia	13	13	13	13	9	9	7	7	7	7	7
Nigeria	195	200	207	214	202	212	213	214	215	196	192
South Africa	450	426	403	388	401	422	379	363	360	355	348
Sudan	NA	NA	NA	49	51	53	53	53	55	56	59
Swaziland	5	5	6	6	6	6	7	5	5	5	NA
Tanzania	5	6	6	6	6	10	14	15	11	17	17
Tunisia	47	46	44	46	48	50	49	52	56	57	59
Uganda	3	3	5	5	5	9	6	8	8	8	10
Zambia	11	12	13	15	14	16	19	19	19	20	20
Zimbabwe	76	81	79	79	80	82	78	76	76	75	76
Total Africa	**2193**	**2002**	**1812**	**1819**	**1687**	**1626**	**1531**	**1449**	**1349**	**1354**	**1354**
Other Developing Regions											
East Asia & Pacific	**3475**	**3629**	**3819**	**3931**	**4080**	**4196**	**4319**	**4420**	**4869**	**5198**	**5311**
China	1235	1296	1384	1387	1440	1530	1604	1700	2063	2342	2494
Malaysia	865	897	962	1020	1027	1036	977	960	957	941	921
Indonesia	331	333	331	335	344	383	396	398	420	440	459
Thailand	398	421	464	504	518	475	525	535	541	545	502
Europe & Central Asia	**6393**	**6749**	**5970**	**6180**	**5065**	**5273**	**3099**	**4730**	**4151**	**3976**	**2455**
Hungary	48	49	47	44	41	41	41	43	48	52	51
Russia	196	214	215	296	309	328	314	279	345	327	276
Turkey	288	284	296	302	314	319	317	315	337	362	405
Latin America & Caribbean	**1118**	**1083**	**1055**	**1092**	**1092**	**1132**	**1082**	**1056**	**1073**	**1065**	**1066**
Argentina	83	107	104	101	103	107	101	101	101	99	101
Brazil	399	367	357	381	392	442	432	377	373	366	353
Mexico	166	159	152	151	131	125	125	125	130	128	131
South Asia	**6937**	**6909**	**6001**	**6050**	**6089**	**6198**	**6247**	**6304**	**6271**	**6400**	**6496**
Bangladesh	239	247	250	262	269	278	290	302	209	216	229
India	5650	5644	4730	4763	4796	4887	4921	4955	4987	5112	5191
Pakistan	712	701	661	661	652	654	653	651	644	638	573
World	**50086**	**50554**	**49441**	**50936**	**50120**	**51388**	**49692**	**48732**	**48785**	**49558**	**47520**

Source: World Development Indicators, Africa Securities Exchanges Association (ASEA) website and author's calculations

[3] At this point, it is important to note that due to data limitation, African stock markets considered here are limited to those for which data are available. In other words, the missing countries in the table are due to data not being available.

b) Stock market capitalisation

Stock market capitalisation is one of the most significant indicators of market size and it is commonly used in stock valuation. It reflects the market value of all the listed companies. In other words, it represents an estimate of the net worth of all the listed firms based on their perceived future economic and market fundamentals. Market capitalisation is obtained by multiplying the total number of shares outstanding by the market price of shares.

Table 2.3 presents data on stock market capitalisation of African stock markets and other developing markets of the world. The average stock market capitalisation of all the listed companies in African stock exchanges over the period 2002 – 2012 stood at $746.6 billion. Over this period, total stock market capitalisation rose to approximately $855.2 billion by the end of 2012 from just $250.8 billion in 2002. This corresponds to an average annual growth of 13.1%. Stock market capitalisation in Africa is overwhelmingly dominated by the South African stock market capitalisation, with an average market capitalisation of $544.4 billion which accounts for 72.9% of the total market capitalisation in Africa over the period.

With an average market capitalisation of $69.9 billion, the Egyptian stock exchange accounts for approximately 9.4% of the total average stock market capitalisation in Africa. It therefore makes this exchange the second largest stock exchange in the continent. Morocco and Nigeria rank third and fourth respectively with a market capitalisation of $46.3 billion and $36.2 billion (or 6.2% and 4.8% of the total average stock market capitalisation). Together, these four markets have a combined average market capitalisation of $696.8 billion which corresponds to 93.3% of the continent's stock market capitalisation. However, the collective market capitalisation of the remaining stock markets in Africa accounts for an average of 6.7% over the period 2002-2012.

At the global level, the total global average stock market capitalisation over the period amounts to $44.6 trillion. African stock market capitalisation accounted for approximately 1.7% of this total. This figure is more in line with the development in other developing regions with the exception of East Asia and the Pacific region. Latin America and the Caribbean for instance, account for approximately 2.9% of world market capitalisation, South Asia for 2.1% and Europe and Central Asia for 0.6%. However, the size of market capitalisation of African markets is very low relative to individual market from other regions, with the exception of South Africa, Egypt, Morocco and Nigeria. Apart from the above mentioned countries, the African market has a market capitalisation that is well below $20 billion. Conversely, most of the emerging and developing markets in other regions presented in the Table 2.3 have a market capitalisation well above the $50 billion over the period 2002-2012.

c) Stock market capitalisation as a percentage of GDP

Generally, the ratio of stock market capitalisation to GDP is used to determine the depth of the stock market. It measures the size of the stock market relative to the size of the economy. In effect, the ratio reflects the amount of GDP financed through the stock market or its relative contribution to the economy. The data on this ratio is presented in Table 4.4. One observable trend from the table is the growing size of African stock markets, with average stock market capitalisation to GDP growing from 36.5% in 2002 to a peak of 63.4% in 2006 before declining to 35.0% at the end of 2012. Also, the evidence from the table shows that the average stock market capitalisation as a percentage of GDP in Africa over the period was 39.2% (or 29.7% excluding South Africa). However, this value is driven by the South African stock exchange with an average ratio of 201.7% and the Zimbabwean stock exchange with an average of 136.0%.

Globally, the ratio of stock market capitalisation to GDP averaged 83.7% over the period. Relative to other developing regions, the average ratio in African stock markets was favourable in comparison with developing Europe & Central Asia (25.8%) but lower than East Asia & the Pacific (65.5%), Latin America & the Caribbean (43.0%), and South Asia (61.0%). At a country level – with the exception of Botswana (33.5%), Egypt (52.2%), Kenya (34.4%), Mauritius (51.3%), Morocco (58.9%), South Africa (201.7%) and Zimbabwe (136.0), the size of other African markets is relatively small compared to developing and emerging markets presented in Table 2.3. This suggests that the majority of African markets are small relative to the size of their economies. It also suggests that a relatively small proportion of domestic economic activities are financed through the stock market.

Table 2. 3: Stock market capitalisation, 2002 – 2012 ($ billion)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Botswana	1,7	2,1	2,5	2,4	3,9	5,9	3,6	4,3	4,1	4,1	4,6
BRVM	1,3	1,7	2,1	2,3	4,2	8,4	7,1	6,1	7,1	6,3	7,8
Egypt	26,1	27,1	38,5	79,7	93,5	139,3	85,9	90,0	82,5	48,7	58,0
Ghana	0,7	1,4	2,6	1,7	3,2	2,4	3,4	2,5	3,5	3,1	3,5
Kenya	1,4	4,2	3,9	6,4	11,4	13,4	10,9	10,8	14,5	10,2	14,8
Malawi	0,4	0,1	0,2	0,2	0,6	1,3	1,8	1,4	1,4	1,4	0,8
Mauritius	1,3	2,0	2,4	2,6	3,6	5,7	3,4	4,7	7,4	7,7	7,1
Morocco	8,6	13,2	25,1	27,2	49,4	75,5	65,7	62,9	69,2	60,1	52,6
Mozambique	NA	0,1	0,1	0,2	0,3	0,3	0,3	0,3	0,4	0,6	1,0
Namibia	0,2	0,3	0,4	0,4	0,5	0,7	0,6	0,8	1,2	1,2	1,3
Nigeria	5,7	9,5	14,5	19,4	32,8	86,3	49,8	33,3	50,9	39,3	56,4
South Africa	184,6	267,7	455,5	565,4	715,0	833,5	491,2	704,8	635,3	523,0	612,3
Sudan	NA	NA	NA	3,7	4,7	5,2	4,2	2,6	2,6	3,3	2,2
Swaziland	0,1	0,2	0,2	0,2	0,2	0,2	NA	NA	NA	NA	NA
Tanzania	0,7	0,7	0,7	0,6	0,5	2,8	1,3	3,8	1,3	1,5	1,8
Tunisia	2,1	2,5	2,6	2,9	4,4	5,4	6,4	9,1	10,7	9,7	8,9
Uganda	0,1	0,1	0,1	0,1	0,1	3,5	3,1	3,7	1,8	7,7	7,3
Zambia	0,2	0,7	0,5	1,0	1,2	2,3	4,1	2,8	2,8	4,0	3,0
Zimbabwe	15,6	5,0	1,9	2,4	26,6	5,3	NA	3,8	11,5	10,9	11,8
Total Africa	**250,8**	**338,5**	**553,8**	**718,8**	**956,1**	**1197,4**	**742,8**	**947,7**	**908,2**	**742,8**	**855,2**
Other Developing Regions											
East Asia & Pacific	**704,0**	**1052,0**	**1052,4**	**1212,7**	**3026,5**	**7095,6**	**3254,9**	**5694,4**	**6000,4**	**4637,4**	**5263,0**
China	463,1	681,2	639,8	780,8	2426,3	6226,3	2793,6	5007,6	4762,8	3389,1	3697,4
Malaysia	123,9	168,4	190,0	181,2	235,4	325,7	187,1	256,0	410,5	395,1	476,3
Indonesia	30,0	54,7	73,3	81,4	138,9	211,7	98,8	178,2	360,4	390,1	396,8
Thailand	46,2	121,2	116,7	124,9	141,1	196,0	102,6	138,2	277,7	268,5	383,0
Europe & Central Asia	**44,8**	**84,5**	**132,9**	**230,3**	**307,4**	**538,4**	**218,6**	**355,3**	**461,8**	**313,5**	**388,6**
Hungary	13,1	16,7	28,7	32,6	41,9	47,7	18,6	28,3	27,7	18,8	21,1
Russia	124,2	230,8	268,0	548,6	1057,2	1503,0	397,2	861,4	1004,5	796,4	874,7
Turkey	34,0	68,4	98,3	161,5	162,4	286,6	117,9	225,7	306,7	201,8	308,8
Latin America & Caribbean	**266,2**	**407,0**	**574,4**	**824,8**	**1207,6**	**2010,1**	**992,8**	**1738,4**	**2337,9**	**1954,4**	**2157,5**
Argentina	103,4	38,9	46,4	61,5	79,7	86,7	52,3	48,9	63,9	43,6	34,2
Brazil	123,8	234,6	330,3	474,6	711,1	1370,4	589,4	1167,3	1545,6	1229,0	1229,8
Mexico	103,1	122,5	171,9	239,1	348,3	397,7	232,6	340,6	454,3	408,7	525,1
South Asia	**144,5**	**300,5**	**424,7**	**609,1**	**877,6**	**1908,6**	**684,9**	**1233,2**	**1694,9**	**1095,0**	**1345,7**
Bangladesh	1,2	1,6	3,3	3,0	3,6	6,8	6,7	7,1	15,7	23,5	17,5
India	131,0	279,1	387,9	553,1	818,9	1819,1	645,5	1179,2	1615,7	1015,4	1263,3
Pakistan	10,2	16,6	29,0	45,9	45,5	70,3	23,5	33,2	38,2	32,8	43,8
World (trillion)	**23,5**	**32,0**	**38,1**	**43,2**	**53,3**	**64,5**	**34,9**	**47,4**	**54,2**	**46,5**	**53,2**

Source: World Development Indicators, ASEA website and author’s calculations.

Table 2. 4: Market capitalisation of listed companies (% of GDP), 2002 – 2012

Country	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Botswana	31,7	28,4	28,4	24,5	39,0	53,8	32,0	42,3	29,7	26,9	31,6
BRVM	11,6	12,0	13,5	14,2	23,9	42,2	30,2	26,7	31,0	26,1	31,7
Egypt	29,7	32,6	48,9	88,8	87,0	106,8	52,7	47,6	37,7	20,6	22,1
Ghana	12,0	18,7	29,8	15,5	15,8	9,6	11,9	9,7	11,0	7,8	8,3
Kenya	10,8	28,0	24,2	34,1	50,6	49,1	35,8	35,0	44,6	29,7	36,7
Malawi	14,3	3,6	6,1	8,4	18,8	48,7	41,4	27,5	25,2	24,6	17,8
Mauritius	27,9	34,9	37,3	41,7	53,5	72,7	35,7	53,6	76,6	68,1	62,0
Morocco	21,3	26,4	44,0	45,7	75,2	100,4	74,0	69,2	76,2	60,6	54,8
Mozambique	NA	5,5	7,0	3,7	4,2	3,8	2,9	3,3	3,8	5,0	7,0
Namibia	5,1	6,2	6,7	5,7	6,8	7,9	7,3	9,7	10,6	9,3	9,7
Nigeria	9,7	14,0	16,5	17,2	22,6	51,9	23,9	19,7	13,8	9,5	12,2
South Africa	166,2	159,2	207,9	228,9	273,9	291,3	179,9	248,0	174,0	129,5	160,1
Sudan	NA	NA	NA	NA	9,9	8,4	6,8	4,0	4,0	4,7	4,0
Swaziland	11,7	9,3	9,3	7,6	6,8	6,7	NA	NA	NA	NA	NA
Tanzania	6,5	5,7	5,2	4,2	3,8	15,1	6,2	17,9	5,5	6,4	6,4
Tunisia	9,2	9,0	8,5	8,9	12,9	13,8	14,2	21,0	24,2	21,0	19,6
Uganda	0,8	0,7	1,2	1,1	1,2	30,0	21,6	25,3	11,2	49,9	36,4
Zambia	6,3	17,3	8,3	13,8	11,1	20,3	37,8	21,9	17,4	20,9	14,6
Zimbabwe	246,5	86,9	33,4	41,7	487,8	100,8	NA	47,0	121,4	99,5	94,7
Africa (Average)	**36,5**	**27,7**	**29,8**	**33,7**	**63,4**	**54,4**	**36,1**	**40,5**	**39,9**	**34,5**	**35,0**
Other Developing Regions											
East Asia & Pacific	**35,7**	**46,3**	**40,0**	**39,8**	**82,6**	**153,0**	**55,5**	**89,6**	**78,0**	**49,3**	**50,2**
China	31,7	41,3	32,9	34,4	88,9	176,7	61,3	99,0	78,9	45,2	43,7
Malaysia	122,8	152,8	152,3	126,3	144,7	168,3	81,0	126,5	165,8	136,6	156,2
Indonesia	15,3	23,3	28,5	28,5	38,1	49,0	19,4	33,0	47,7	43,7	43,2
Thailand	36,4	85,0	72,3	70,8	68,1	79,4	37,6	52,4	87,1	77,7	104,7
Europe & Central Asia	**11,2**	**16,6**	**20,2**	**28,2**	**32,4**	**45,5**	**15,7**	**31,1**	**35,3**	**21,5**	**26,3**
Hungary	19,5	19,7	27,8	29,1	36,7	34,4	11,9	21,9	21,4	13,5	16,6
Russia	36,0	53,6	45,3	71,8	106,8	115,6	23,9	70,5	65,9	41,8	43,4
Turkey	14,6	22,6	25,1	33,4	30,6	44,3	16,1	36,7	41,9	26,0	39,1
Latin America & Caribbean	**17,8**	**26,6**	**33,1**	**39,2**	**49,0**	**69,4**	**29,8**	**56,4**	**59,8**	**43,1**	**48,7**
Argentina	101,4	30,0	25,3	27,6	30,3	26,3	12,9	12,9	13,8	7,8	5,6
Brazil	24,3	42,0	49,3	53,2	64,2	98,2	34,8	70,1	70,0	47,0	51,0
Mexico	13,9	17,2	22,3	27,6	36,0	38,1	21,1	38,1	43,2	34,9	44,2
South Asia	**21,4**	**38,2**	**46,5**	**58,2**	**73,4**	**126,1**	**44,5**	**72,9**	**82,0**	**48,5**	**59,3**
Bangladesh	2,2	2,7	5,1	4,4	5,0	8,5	7,3	6,9	13,6	18,3	13,1
India	25,0	45,1	53,7	66,3	86,3	146,9	52,7	86,4	94,6	55,3	69,0
Pakistan	14,1	19,9	29,6	42,0	33,2	46,1	13,8	19,8	21,5	15,3	19,4
World	**69,7**	**84,4**	**89,2**	**93,6**	**106,7**	**115,2**	**57,0**	**81,3**	**84,7**	**65,6**	**73,7**

Source: World Development Indicators, ASEA website and author's calculations.

2.3.2 Liquidity of African stock markets

Besides market size, the extent of stock market liquidity is also important to investors in an analysis of the operational efficiency of a financial market. In other words, the operational efficiency of a stock market depends to some extent on the liquidity of the market. Odera (2012) contends that a liquid stock market has the potential of improving the allocation of capital as well as enhancing prospects for long-term economic growth. Senbet and Otchere (2006) argue that a stock market with little or no liquidity may not operate effectively. Investors would understandably be more attracted to invest in an asset when there is some assurance of a market to dispose of the asset at a future date in order to cash in on the market appreciation or to change the investment. In this light, a liquid stock market with active trading provides exit mechanisms for both investors and issuing firms. Conversely, illiquidity increases the cost of trading and limits the capacity of investors to unwind their positions on a particular asset, which may deter market entrants and in turn, perpetuates further the cycle of illiquidity (de la Torre & Schumukler, 2007). Consequently, liquidity is one of the requisite factors for judging the operational effectiveness of stock markets.

Liquidity in simple terms underscores the relative ease with which an investor can buy and sell an asset at an offered price (Allen et al., 2011). This section will thus employ the three standard measures of liquidity to gauge the level of liquidity of the African stock market relative to other developing regions and emerging markets. The analysis of stock market liquidity specifically considers the value traded, the ratio of shares traded compared to the GDP and the turnover ratio. These three indicators are widely used measures of liquidity, although they cannot predict the ease with which investors can either buy or sell an asset. However, they can be said to denote market liquidity in terms of the value of the share traded and the ratio of the total value of shares traded relative to the size of both the economy and the stock market. The next section analyses the operational efficiency of African stock markets in terms of the ease with which stock market transactions are completed using these indicators. Each of these indicators is considered in turn below.

a) The value of stock traded

The value of stock traded measures market liquidity by accounting for the value of the share traded for a given period. It is obtained by multiplying the volume of stocks traded by the market prices. This indicator provides some indication of the ease of trading within the market by valuing the number of stocks traded relative to their market price. Theoretically, a market with a high stock trading value indicates a high level of liquidity, while a lower value would suggest otherwise. Table 2.5 presents information on the value of shares traded over the period 2002 – 2012.

The evidence from the table shows that the liquidity of African stock markets is very low relative to other developing regions – except for Europe and Central Asia. African stock markets account for a very small proportion (approximately 0.52%) of the average value of total stock traded world-wide. Also, it is evident that the South African stock market accounts for the largest percentage of the average value of total stock trading in Africa over the period. This is followed by Egypt, Morocco and Nigeria. These countries collectively account for an average of $323.70 billion of the total value of stocks traded. This corresponds to a combined share of 98.8% of the average stock traded value in Africa over the period.

b) Stock traded as a percentage of GDP

The ratio of stocks traded to GDP is a measure of stock market liquidity that uses the market's trading activity relative to the size of that market's economy. This means that the total value of the share traded on the exchange is scaled by the GDP. More generally, it measures the general liquidity of the market. A high ratio of stock traded to GDP is an indication of a highly liquid market while a low value reflects an illiquid market.

Table 2.6 presents information on the liquidity of stock markets in Africa over the period 2002 – 2012. The table show that the ratio of stock traded to GDP in African stock markets is generally low, despite the rapid growth in the number of stock markets in Africa. With the exclusion of South Africa, the liquidity of stock markets in Africa based on this measure averaged about 3.9% of GDP (or 9.2% including South Africa). South Africa is by far the most liquid market on the continent with an average of 99.1% over the period. While the liquidity of African stock markets is generally low, it improved, gradually from 7.0% in 2002 to 15.1% in 2007. It declined progressively thereafter due to the global financial crisis.

By comparison with other developing regions and countries outside Africa, the level of liquidity in African markets is dismal. Looking at other developing regions, most of them have a ratio in excess of 20% (except for Latin America & the Caribbean with a ratio of 17.4%). The developing and emerging markets like India, Pakistan, Turkey, China, Malaysia and Thailand have an average ratio in excess of 40% over the period. At the global level, the average ratio of shares traded to global GDP averaged 116.2% over the period.

Table 2. 5: The value of stock traded ($ billion), 2002 – 2012

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Botswana	0,06	0,09	0,05	0,05	0,07	0,11	0,14	0,10	0,14	0,15	0,11
BRVM	0,02	0,02	0,05	0,03	0,11	0,16	0,32	0,13	0,13	0,12	0,16
Egypt	2,56	3,28	5,61	25,39	47,46	53,08	69,64	52,81	37,11	21,99	20,16
Ghana	0,01	0,05	0,07	0,07	0,05	0,10	0,15	0,06	0,10	0,14	0,05
Kenya	0,04	0,21	0,34	0,50	1,30	1,32	1,44	0,50	1,08	0,88	1,01
Malawi	0,00	0,01	0,01	0,01	0,01	0,04	0,06	0,02	0,02	0,05	0,02
Mauritius	0,06	0,10	0,10	0,15	0,14	0,37	0,40	0,33	0,36	0,52	0,30
Morocco	0,59	0,69	1,68	4,15	1,35	26,28	21,93	29,42	10,75	6,32	3,50
Mozambique	NA	0,48	0,04	0,03	0,01	0,00	0,01	0,01	0,02	0,02	0,06
Namibia	0,00	0,00	0,02	0,01	0,02	0,02	0,02	0,02	0,02	0,01	0,02
Nigeria	0,48	0,86	1,67	1,94	3,56	16,78	19,95	4,57	5,28	4,15	4,20
South Africa	78,83	102,81	162,83	200,72	312,44	425,75	401,49	342,50	340,03	372,18	311,78
Sudan	NA	NA	NA	0,61	1,03	0,90	0,94	1,00	0,90	0,96	0,70
Swaziland	0,00	0,00	0,00	0,00	0,00	NA	NA	NA	NA	NA	NA
Tanzania	0,02	0,02	0,02	0,01	0,01	0,03	0,03	0,05	0,03	0,03	0,03
Tunisia	0,22	0,16	0,23	0,46	0,52	0,65	1,49	1,26	1,70	1,12	1,25
Uganda	0,00	0,00	0,00	0,00	0,01	0,05	0,08	0,01	0,01	0,02	0,01
Zambia	0,00	0,01	0,01	0,01	0,02	0,07	0,12	0,05	0,12	0,10	0,20
Zimbabwe	2,49	1,34	0,14	0,33	0,90	0,81	NA	0,41	1,14	1,82	1,61
Total Africa	**85,38**	**110,12**	**172,87**	**234,47**	**369,01**	**526,52**	**518,21**	**433,25**	**398,94**	**410,58**	**345,17**
Other Developing Regions											
East Asia & Pacific	**424,75**	**640,95**	**948,56**	**774,53**	**1 864,00**	**8 204,70**	**5 807,04**	**9 318,38**	**8 511,70**	**8 211,01**	**6 310,26**
China	333,37	476,81	748,27	586,30	1 635,12	7 791,70	5 470,53	8 956,19	8 029,97	7 671,36	5 826,51
Malaysia	27,62	50,14	59,88	49,98	66,90	150,00	85,21	72,97	90,20	128,91	124,50
Indonesia	13,04	14,77	27,56	41,90	48,83	112,85	110,68	115,31	129,55	139,62	91,68
Thailand	47,61	96,57	109,11	89,29	100,80	108,21	116,77	134,94	217,95	232,44	229,46
Europe & Central Asia	**71,71**	**101,26**	**150,70**	**208,76**	**240,65**	**330,72**	**252,89**	**251,48**	**428,40**	**423,43**	**353,69**
Hungary	5,94	8,30	13,01	23,91	31,18	47,50	30,80	25,94	26,47	19,49	10,88
Russia	36,13	81,01	130,84	159,33	514,36	754,54	562,23	682,54	799,69	1 146,42	732,24
Turkey	70,67	99,61	147,43	201,26	227,62	302,40	239,71	243,53	421,59	413,70	348,51
Latin America & Caribbean	**78,18**	**85,52**	**140,18**	**216,10**	**351,16**	**718,93**	**854,45**	**743,39**	**1 037,19**	**1 105,96**	**984,28**
Argentina	1,35	4,91	7,64	16,43	4,53	8,25	13,42	2,73	2,58	2,56	1,46
Brazil	48,20	60,44	93,58	154,23	254,51	584,95	727,79	649,19	901,10	961,31	834,53
Mexico	27,73	23,49	42,84	52,74	80,10	115,62	108,20	77,06	108,53	111,98	118,16
South Asia	**224,15**	**352,52**	**454,49**	**577,08**	**767,06**	**1 213,99**	**1 114,74**	**1 128,13**	**1 087,82**	**773,50**	**648,72**
Bangladesh	0,67	0,33	0,89	1,00	0,94	4,80	9,24	14,60	14,69	18,16	12,55
India	197,12	284,80	379,08	433,90	638,48	1 107,55	1 049,75	1 088,89	1 056,81	740,18	622,48
Pakistan	26,03	66,60	73,87	141,00	126,56	100,45	54,36	23,53	12,92	10,14	11,97
World (trillion)	**37, 77**	**29, 85**	**39, 46**	**47, 39**	**67, 49**	**98, 82**	**108, 07**	**81, 33**	**65, 03**	**66, 41**	**49, 71**

Source: World Development Indicators, ASEA website and author's calculations.

Table 2. 6: Total value of stock traded (as % of GDP), 2002 – 2012

Country	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Botswana	1,0	1,2	0,6	0,5	0,7	1,0	1,3	1,0	1,0	1,0	0,8
BRVM	0,1	0,2	0,3	0,2	0,6	0,8	1,3	0,6	0,6	0,5	0,7
Egypt	2,9	4,0	7,1	28,3	44,2	40,7	42,8	27,9	17,0	9,3	7,7
Ghana	0,2	0,6	0,7	0,6	0,3	0,4	0,5	0,2	0,3	0,3	0,1
Kenya	0,3	1,4	2,1	2,7	5,8	4,8	4,7	1,6	3,3	2,6	2,5
Malawi	0,1	0,3	0,2	0,3	0,5	1,0	1,4	0,4	0,4	0,9	0,4
Mauritius	1,2	1,8	1,5	2,4	2,0	4,7	4,2	3,7	3,7	4,6	2,6
Morocco	1,5	1,4	2,9	7,0	20,6	34,9	24,7	32,4	11,8	6,4	3,6
Mozambique	NA	10,4	0,7	0,5	0,1	0,0	0,1	0,1	0,2	0,1	0,4
Namibia	0,0	0,0	0,3	0,1	0,2	0,3	0,2	0,3	0,2	0,1	0,2
Nigeria	0,8	1,3	1,9	1,7	2,4	10,1	9,6	2,7	1,4	1,0	0,9
South Africa	71,0	61,1	74,3	81,2	119,7	148,8	147,0	120,5	93,1	92,1	81,5
Sudan	NA	NA	NA	2,3	2,9	2,0	1,7	1,9	1,4	1,4	1,1
Swaziland	0,0	0,0	0,0	0,0	0,0	NA	NA	NA	NA	NA	NA
Tanzania	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,2	0,1	0,1	0,1
Tunisia	1,0	0,6	0,7	1,4	1,5	1,7	3,3	2,9	3,9	2,4	2,8
Uganda	0,0	2,7	2,0	0,0	0,1	4,1	0,5	0,1	0,1	0,1	0,1
Zambia	0,1	0,3	0,1	0,2	0,2	0,6	0,8	0,4	0,8	0,5	0,9
Zimbabwe	39,2	23,5	2,3	5,8	16,5	15,4	NA	5,1	12,1	16,6	12,9
Africa (Average)	**7,0**	**6,2**	**5,4**	**7,1**	**11,5**	**15,1**	**14,4**	**11,2**	**8,4**	**7,8**	**6,6**
Other Developing Regions											
East Asia & Pacific	**21,5**	**28,2**	**36,0**	**25,4**	**50,9**	**177,0**	**99,1**	**146,6**	**110,6**	**87,3**	**60,3**
China	22,8	28,9	38,5	25,8	59,9	221,2	120,0	177,0	133,0	102,4	68,9
Malaysia	27,4	45,5	48,0	34,8	41,1	77,5	36,9	36,1	36,4	44,6	40,8
Indonesia	6,7	6,3	10,7	14,7	13,4	26,1	21,7	21,4	17,2	15,6	10,0
Thailand	37,5	67,7	67,6	50,6	48,7	43,8	42,8	51,2	68,3	67,2	62,7
Europe & Central Asia	**17,9**	**19,7**	**22,8**	**25,4**	**25,2**	**27,3**	**17,7**	**21,3**	**32,0**	**28,2**	**23,9**
Hungary	8,8	9,8	12,6	21,4	27,3	34,3	19,7	20,1	20,4	14,0	8,6
Russia	10,5	18,8	22,1	20,9	52,0	58,1	33,9	55,8	52,4	60,2	36,3
Turkey	30,4	32,9	37,6	41,7	42,9	46,7	32,8	39,6	57,7	53,4	44,2
Latin America & Caribbean	**5,2**	**5,6**	**8,1**	**10,3**	**14,2**	**25,2**	**25,7**	**24,0**	**26,6**	**24,4**	**22,3**
Argentina	1,3	3,8	4,2	7,4	1,7	2,5	3,3	0,7	0,6	0,5	0,2
Brazil	9,5	10,8	14,0	17,3	23,0	41,9	42,9	39,0	40,8	36,8	34,6
Mexico	3,7	3,3	5,6	6,1	8,3	11,1	9,8	8,6	10,3	9,6	10,0
South Asia	**33,2**	**44,8**	**49,8**	**55,2**	**64,2**	**80,2**	**72,4**	**66,7**	**52,6**	**34,3**	**28,6**
Bangladesh	1,2	0,5	1,4	1,4	1,3	6,0	10,1	14,2	12,7	14,1	9,4
India	37,6	46,1	52,5	52,0	67,3	89,4	85,8	79,8	61,9	40,3	34,0
Pakistan	36,0	80,0	75,4	128,8	92,2	65,9	32,0	14,0	7,3	4,7	5,3
World	**112,0**	**78,7**	**92,3**	**102,6**	**135,0**	**176,7**	**176,7**	**139,4**	**101,7**	**93,7**	**68,9**

Source: World Development Indicators, ASEA website and author's calculations.

c) Stock turnover ratio

Another common measure of liquidity is the turnover ratio. It measures the value of shares traded as a percentage of the stock market capitalisation. The ratio simply indicates how frequently shares are traded in the markets. It shows how quickly shares are converted to cash and from cash back to shares. A higher stock turnover ratio suggests a more liquid market and a more frequent trading of shares. By the same token, a lower stock turnover ratio indicates a less liquid market and infrequent trading of shares. Table 2.7 compares the level of liquidity in African stock markets with other developing regions.

Table 2.7 shows that the average turnover ratio of African stock markets over the period was 10.6%. Among the stock markets in the region, only a few markets posted an average ratio higher than the regional average over the period. These countries include South Africa (51.8%), Egypt (38.1%), Morocco (20.4%), Nigeria (14.3%), Tunisia (13.9%) and Zimbabwe (12.1%). With the exception of South Africa and to some extent Egypt and Morocco, the liquidity of African markets based on this measure is dismally low relative to comparable figures from other developing regions and emerging markets.

Indeed, most of the developing regions have an average turnover ratio in excess of 100% (except for Latin America & the Caribbean region with a ratio of 41.0%, which is still very high compared with the same figure for African stock markets). Also, most liquid emerging markets have turnover ratios in excess of 80%. For instance, Pakistan has a ratio of 207.9%, Turkey 154.0%, China 136.1%, India 97.8%, Thailand 89.7% and Bangladesh 81.9%. Globally, the average world stock markets' turnover ratio over the period stood at 142.4%.

The preceding discussion concerning the liquidity of African stock markets using the three standard measures of liquidity suggests a very low trading activity in most stock exchanges in the region. Specifically, they suggest a very low level of liquidity in African stock exchanges. Moreover, Jefferis and Smith (2005) observe that the turnover ratio in liquid markets is usually above 100%. In Africa, however, the most liquid market has an average turnover ratio of 44.5%. The lack of liquidity of African stock markets could be due to the fact that most listed shares are held by controlling interest groups, which leaves a relatively small proportion for trading (Jefferis & Smith, 2005). Moreover, the level of liquidity in any given market is, among other things, dependent on the size of the markets, the number of free floating shares and transaction costs. In addition, variations in stock market culture could also explain a significant proportion of the differences in the turnover ratio between a liquid market and less liquid market.

While a market's high turnover ratio may be associated with greater liquidity, trading activity and operational efficiency – it may also be associated with high volatility. This is because any sudden change in market sentiment can have a significant effect on stock price volatility. Investors can easily switch from one share to another or even opt out of the market. Also, prices change quickly in response to a variety of information that influences market expectations. Therefore, stock prices tend to be highly volatile in a liquid market. On the other hand, a lower turnover rate indicates that a sudden change in market sentiment will produce a smaller effect. Studies have shown that markets with low levels of liquidity offer higher returns as investors expect higher returns from less liquid markets (Assefa & Mollick, 2014; Brennan, Chordia & Subrahmanyam, 1998; Eleswarapu, 1997 and Brennan & Subrahmanyam, 1996).

2.3.3 The market microstructure

The earlier discussion focused on the size and liquidity of the African stock markets, but investors and other market participants are also interested in the design and the functioning of stock exchanges as indicated by the market microstructure. The market microstructure is of particular interest since it affects the trading costs, asset prices, return volatility, and the price discovery process (Alagidede, 2009). This is due to the fact that stock markets are organised within a defined set of trading rules and structures which affect the ways in which prices are formed and trades executed. The organisation and design of the stock market also affects the scope for asymmetric information or strategic behaviour, which can result in friction and higher transaction costs (Biais, Glosten & Spatt, 2005).

Market microstructure encompasses the actual transaction process, the structure of the market, the trading rules, and fundamental economic decisions. Therefore, this section aims to present some basic microstructural features of African stock exchanges. These features are grouped into three; namely the operational features, the type of market and products traded in the exchange and the institutional features. The essence of the grouping is to facilitate a better understanding of the structure and design issues that are vital for the efficient operation of stock markets.

Table 2. 7: Stock turnover ratio (%), 2002 – 2012

Country	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Botswana	3,7	4,5	2,1	1,8	2,3	2,2	3,1	2,6	3,4	3,6	2,6
BRVM	1,3	1,6	2,5	1,4	3,3	2,5	4,1	2,0	2,0	1,8	2,3
Egypt	10,1	12,3	17,1	43,0	54,8	45,6	61,9	60,1	43,0	33,5	37,8
Ghana	1,8	4,2	3,2	3,2	2,1	3,9	5,2	2,0	3,4	4,1	1,6
Kenya	2,9	7,5	8,5	9,8	14,6	10,6	11,8	4,6	8,6	7,1	8,1
Malawi	0,8	7,9	5,1	4,1	3,5	2,9	3,3	1,2	1,5	3,9	1,5
Mauritius	4,8	6,0	4,4	6,0	4,4	8,0	8,9	8,1	5,9	6,9	4,0
Morocco	6,6	6,4	8,8	15,9	35,3	42,1	31,1	45,7	16,3	9,8	6,2
Mozambique	NA	4,6	0,3	0,1	1,9	1,2	3,3	0,0	0,1	0,0	0,1
Namibia	0,9	0,7	4,7	1,5	3,8	3,7	2,8	3,0	1,8	1,2	1,7
Nigeria	8,5	11,3	13,9	11,5	13,6	28,2	29,3	11,0	12,5	9,2	8,8
South Africa	48,6	45,5	45,0	39,3	48,8	55,0	60,6	57,3	50,7	64,3	54,9
Sudan	NA	NA	NA	6,6	5,0	12,3	5,0	4,6	9,5	8,9	9,5
Swaziland	0,1	0,0	0,0	0,0	0,0	NA	NA	NA	NA	NA	NA
Tanzania	3,4	2,9	2,5	2,3	2,1	0,9	0,7	1,0	0,8	2,5	1,6
Tunisia	10,0	7,1	8,9	16,5	14,3	13,3	25,5	16,2	17,2	11,0	13,5
Uganda	2,4	0,0	0,0	3,0	5,5	1,4	1,8	0,3	0,4	0,3	0,2
Zambia	0,8	2,2	1,1	2,0	2,1	4,1	3,0	1.45	4,3	2,9	5,6
Zimbabwe	21,1	13,1	3,9	15,3	6,2	5,1	NA	10,8	15,0	16,3	14,2
Africa (Average)	**7,5**	**7,7**	**7,3**	**9,6**	**11,8**	**13,5**	**15,4**	**13,6**	**10,9**	**10,4**	**9,7**
Other Developing Regions											
East Asia & Pacific	**58,6**	**73,0**	**90,1**	**68,4**	**87,9**	**162,1**	**112,2**	**208,2**	**145,6**	**154,4**	**127,7**
China	67,5	83,3	113,3	82,5	102,0	180,1	121,3	229,6	164,4	188,2	164,4
Malaysia	22,7	34,3	33,4	26,9	32,1	53,5	33,2	32,9	27,1	32,0	28,6
Indonesia	49,2	34,9	43,1	54,2	44,3	64,4	71,3	83,3	48,1	37,2	23,3
Thailand	115,4	115,4	91,7	73,9	75,8	64,2	78,2	112,1	104,8	85,1	70,4
Europe & Central Asia	**148,3**	**156,6**	**138,8**	**114,9**	**89,5**	**78,2**	**66,8**	**87,6**	**104,9**	**109,2**	**100,7**
Hungary	50,6	55,6	57,3	78,0	83,7	106,0	93,0	110,7	94,5	83,9	54,6
Russia	36,1	45,6	52,5	39,0	64,1	58,9	59,2	108,5	85,7	127,3	87,6
Turkey	174,3	194,7	176,9	154,9	140,5	134,7	118,5	141,7	158,4	162,7	136,5
Latin America & Caribbean	**25,3**	**25,4**	**28,6**	**30,9**	**34,6**	**45,0**	**57,0**	**54,4**	**50,9**	**51,5**	**47,9**
Argentina	0,9	6,9	17,9	30,4	6,4	9,9	19,3	5,4	4,6	4,8	3,8
Brazil	31,1	33,7	33,1	38,3	42,9	56,2	74,3	73,9	66,4	69,3	67,9
Mexico	24,2	20,8	29,1	25,7	27,3	31,0	34,3	26,9	27,3	26,0	25,3
South Asia	**170,6**	**158,4**	**125,3**	**111,6**	**103,2**	**87,1**	**86,0**	**117,6**	**74,3**	**55,5**	**53,2**
Bangladesh	56,9	23,2	36,1	31,5	28,4	92,3	137,3	212,6	129,2	92,6	61,2
India	163,3	138,9	113,7	92,2	93,1	84,0	85,2	119,3	75,6	56,3	54,6
Pakistan	343,8	497,4	324,1	376,3	276,8	173,5	116,0	82,9	36,2	28,6	31,3
World	**146,9**	**107,5**	**112,5**	**116,5**	**139,8**	**167,8**	**217,6**	**197,8**	**128,1**	**131,9**	**99,8**

Source: World Development Indicators, ASEA website and author's calculations.

Considering the various stock markets in Africa, there are significant variations in market microstructure across different markets. Trading in the majority of stock markets in Africa occurs daily (from Monday to Friday) with a few exceptions like Algeria, Cameroon and Mozambique. The operational features of African stock exchanges highlighted in Table 2.8 show that trading systems on these stock exchanges vary from open-outcry to call-over to electronic trading systems. However, most of the stock exchanges operate an automated trading system with an electronic clearing and settlement system. This has allowed clearing, settlement and delivery of transactions to be aligned with the global standard of T+3 in most exchanges. It is encouraging that most African stock exchanges have changed to electronic systems. This is particularly important as African stock exchanges hope to attract global investors and to improve their operational efficiency, which would be difficult without automation.

Also, African stock markets differ in terms of their trading mechanisms. Table 2.8 shows that margin trading is only allowed in seven markets. Furthermore, most stock exchanges in Africa offer intraday trading facilities which give investors the opportunity to open and close a position in a security on the same trading day. Online trading of securities on the other hand, is only operational in 11 stock exchanges.

In addition to these features, Table 2.9 shows that African stock exchanges mainly consist of equity and bond markets. However, bond markets in most African countries are not well developed. For instance, none of the markets in North Africa has a secondary bond markets (Allen et al., 2011). On the other hand, exchange traded funds (ETF) is available in few markets, while derivative securities are traded only in South Africa. However, Ghana and Kenya are making strong efforts to start trading in derivative securities (Allen et al., 2011). As a result, trading is limited to few securities – mainly shares, government bonds and corporate bonds. With a limited number of tradable securities in these markets, the implication is that investors are offered a very limited range of investment opportunities which can potentially affect their portfolio diversification strategy.

Studies have highlighted the importance of building institutional capacity for the successful operation and development of stock markets (Irving, 2005). However, prohibitive institutional barriers, such as poor trade policies and foreign exchange restrictions, can act as disincentives to investment. African markets still suffer from some imperfections, despite considerable effort in terms of financial market reforms to ease these institutional barriers.

Table 2.10 shows that most markets still operate within a regulatory environment with some restrictive controls on foreign investments, capital gains, interest payments and dividends. For instance, in countries like Kenya and Zimbabwe, there is a restriction on foreign investment. In Kenya, foreigners are not allowed to own more than 75% of share capital in any listed company, while Zimbabwe allows a limit of 10% ownership for individual and 40% for group investors.

Furthermore, most markets in Table 2.10 have a central depository system as well as a legal framework that guides and regulates stock trading. However, some of these markets were established on the back of poor regulatory framework that lacks the capacity to deal with market dynamics (Mlambo & Biekpe, 2007). In this context, the legal framework that is required to improve the standard of transparency and controls as well as efficiency in these markets is either inadequate or non-existent – and where it does exist, enforcement is often poor. Moreover, in order for African stock markets to develop successfully and to attract global investors, good regulatory frameworks that conform to international standards, are required. An appropriate legal and regulatory framework as well as sufficient supervision and enforcement are necessary to protect investors and the integrity of the market. This helps to ensure confidence, transparency and discipline in the stock markets.

The preceding discussion regarding the trends and characteristics of African stock exchanges presented in Tables 2.2 to 2.10, suggests that the majority of African stock markets are small, illiquid and underdeveloped by global standards. This poses many challenges to stock market development in the region. Deutsche Bank (2013) for instance, argues that portfolio investment in Africa is small due to low depth and liquidity. Other challenges facing stock market development in Africa emanate from the market microstructure of the various national stock exchanges in the region. Most of the stock exchanges in the region are operationally inefficient because trading is impeded by out-dated trading, clearing and settlement systems. Some stock exchanges still operate manual systems which are not equipped to handle sizeable capital flows. This lack of efficiency severely impairs the attractiveness of African stocks to global investors.

To some extent, the volatile political and economic conditions across some countries in the region affect investors' sentiment. The political instability and civil strife in some countries in the region not only make investing in those markets extremely risky, but also affect the growth and development of stock markets in the region. Although African stock markets remain a challenging investment environment, the next section presents an overview of different national stock exchanges in Africa.

Table 2. 8: Operational features of African stock markets

Country	Trading System	Clearing and Settlement System	Settlement Cycle	Trading Mechanism		
				Margin Trading	Intraday Trading	Online Trading
Algeria	Automated	Electronic	T+3	-	-	-
Botswana	Automated	Electronic	T+3	-	Yes	Yes
BRVM	Automated	Electronic	T+3	-	Yes	-
Cameroon	Automated	Electronic	T+3	-	Yes	-
Cape Verde	Automated	Electronic	T+0	-	Yes	-
Egypt	Automated	Electronic	T+2	Yes	Yes	Yes
Ghana	Automated	Electronic	T+3	-	-	Yes
Kenya	Automated	Electronic	T+3	-	Yes	-
Libya	Automated	Electronic	-	-	-	-
Malawi	Manual	-	T+5	-	-	-
Mauritius	Automated	Electronic	T+3	-	Yes	Yes
Morocco	Automated	Electronic	T+3	-	Yes	Yes
Mozambique	Automated	Electronic	T+3	-	Yes	Yes
Namibia	Automated	Electronic	T+5	Yes	Yes	No
Nigeria	Automated	Electronic	T+3	Yes	Yes	Yes
Rwanda	Open outcry	Electronic	T+2	-	Yes	-
Seychelles	-	-	-	Yes	Yes	Yes
Sierra Leone	Call-over	-	T+5	Yes	Yes	No
South Africa	Automated	Electronic	T+3	Yes	Yes	Yes
Sudan	Automated	Electronic	-	-	Yes	-
Swaziland	-	-	-	-	-	-
Tanzania	Automated	Electronic	T+3	Yes	Yes	Yes
Tunisia	Automated	Electronic	T+3	No	No	Yes
Uganda	Openoutcry	-	NA	No	No	No
Zambia	Automated	Electronic	T+3	-	Yes	-
Zimbabwe	Manual	-	-	-	Yes	-

Source: ASEA (2013 & 2012), UNDP (2003) and various stock exchange websites.

Table 2. 9: Types of market and product traded in the exchange

Country	Type of Product Traded in the Exchange			Type of Market in the Exchange			
	Share	Bond	Others	Equity	Bond	Derivative	Others
Algeria	Yes	Yes	No	Yes	Yes	No	No
Botswana	Yes	Yes	Yes	Yes	Yes	No	No
BRVM	Yes	Yes	No	Yes	Yes	No	No
Cameroon	Yes	Yes	No	Yes	Yes	No	No
Cape Verde	Yes	Yes	Yes	Yes	Yes	No	No
Egypt	Yes	Yes	Yes	Yes	Yes	-	Yes
Ghana	Yes	Yes	Yes	Yes	Yes	No	No
Kenya	Yes	Yes	No	Yes	Yes	No	No
Libya	-	-	-	-	-	-	-
Malawi	Yes	-	-	Yes	-	No	No
Mauritius	Yes	Yes	No	Yes	Yes	No	No
Morocco	Yes	Yes	No	Yes	Yes	No	Yes
Mozambique	Yes	Yes	Yes	Yes	Yes	No	Yes
Namibia	Yes	Yes	No	Yes	Yes	No	No
Nigeria	Yes	Yes	Yes	Yes	Yes	No	No
Rwanda	Yes	Yes	No	Yes	Yes	No	No
Seychelles	-	-	-	-	-	-	-
Sierra Leone	Yes	Yes	No	Yes	Yes	No	No
South Africa	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sudan	Yes	No	No	Yes	No	No	No
Swaziland	Yes	Yes	-	Yes	Yes	-	-
Tanzania	Yes	Yes	No	Yes	Yes	No	No
Tunisia	Yes	Yes	No	Yes	Yes	No	Yes
Uganda	Yes	Yes	No	Yes	Yes	No	No
Zambia	Yes	Yes	Yes	Yes	Yes	No	No
Zimbabwe	Yes	-	No	Yes	-	No	No

Source: ASEA (2013 & 2012), UNDP (2003) and various stock exchange websites.

Table 2. 10: Institutional features and tax regimes

Country	**Withholding Taxes**			**Central Depository System (CDS)**	**Governing Law**	**Foreign Investment Ceilings**
	Interest (%)	**Dividend** (%)	**Capital Gain** (%)			
Algeria	-	-	20	Yes	Yes	No
Botswana	10	7.5	-	Yes	Yes	No
BRVM	-	10	-	Yes	Yes	-
Cameroon	-	-	-	Yes	Yes	-
Cape Verde	5	0	15	Yes	Yes	-
Egypt	-	-	0	Yes	Yes	No
Ghana	-	8	0	Yes	Yes	No
Kenya	15	5 – 10	0	Yes	Yes	75% cap on ownership
Libya	-	-	-	Yes	Yes	-
Malawi	-	10	30	-	Yes	-
Mauritius	15	0	0	Yes	Yes	No
Morocco	-	10	15 – 30	Yes	Yes	No
Mozambique	-	10	-	No	Yes	-
Namibia	0	10	0	-	Yes	No
Nigeria	10	10	0	Yes	Yes	No
Rwanda	-	5 – 15	0	Yes	-	-
Seychelles	-	-	-	-	Yes	-
Sierra Leone	10	5	-	-	-	-
South Africa	-	-	-	Yes	Yes	No
Sudan	-	-	-	-	Yes	-
Swaziland	-	-	-	-	Yes	-
Tanzania	10	5	0	Yes	Yes	No
Tunisia	20	0	10 – 30	Yes	Yes	-
Uganda	-	10	0	Yes	Yes	-
Zambia	15	0	-	-	Yes	No
Zimbabwe	15	10	1	-	Yes	10% cap on individual and 40% on cap for group

Source: ASEA (2013 & 2012), UNDP (2003) and various stock exchange websites.

2.4 A review of major stock exchanges in Africa

The preceding accounts about African stock markets appear disheartening. Based on the indicators of financial development, it appears that stock markets in most African countries are quite underdeveloped even by the standards of other developing countries. However, this does not really capture the important progress that has been made in various stock exchanges in Africa following financial sector reforms. In order to capture these developments, it is important to consider an overview of individual national stock exchanges.

The following sections therefore, provide a summary of some important developments and trends in fifteen major stock exchanges in Africa. The stock exchanges considered are: Botswana, BRVM, Egypt, Ghana, Kenya, Malawi, Mauritius, Morocco, Namibia, Nigeria, South Africa, Tanzania, Tunisia, Uganda and Zambia. The choice of these stock exchanges is mainly based on data availability and on the fact that the majority of these markets constitute the major emerging and frontier stock exchanges on the continent (MSCI, 2015). Besides, they jointly accounted for 96.3% of the total stock market capitalisation in Africa in 2012[4]. Also, these stock exchanges represent approximately 55.6% of the total population of stock exchanges in Africa. Moreover, the significance of each of the selected stock exchanges within the sub-region of the continent is also taken into consideration. The Zimbabwe stock exchange, although among the oldest stock exchanges in Africa, is excluded from the analysis due to hyperinflation over the period under review.

2.4.1 Botswana Stock Exchange (BSE)

The BSE was established in 1989 as part of the Botswana's government strategy to broaden the financial sector and to provide a secondary market for publicly held shares (Jefferis & Okeahalam, 1999). The establishment of BSE started out as the Botswana Share Market (BSM) when it was trading as an informal market. At the time, there were only five listed companies with one broking firm (the Stock Brokers Botswana Ltd), which was charged with the responsibility of facilitating trading on the exchange. In 1995, the BSE was formally inaugurated as a fully-fledged stock exchange, following the adoption of the BSE Act in 1994. The exchange is governed by BSE Act No 11 of 1994 and the market is regulated by the Non-Banking Financial Institutions Regulatory Authority (ASEA, 2013).

Until early 1999 there were some exchange controls on inward investments, although different controls applied to portfolio investors (Jefferis & Okeahalam, 1999). However, as part of the strategy to develop and diversify the market after the liberalisation of exchange controls, three distinct indices were introduced. The domestic company index (DCI) consists of companies whose shares are listed only on the BSE, the foreign company index (FCI) reflects companies which are dual listed on the BSE and another stock exchange and the all company index (ACI), which is a weighted average of the DCI and the FCI.

In order to achieve prompt, efficient clearing and settlement of trades and minimisation of risks inherent in the process, the Central Securities Depository (CSD) was implemented in 2008. With the implementation of the CSD, the settlement cycle was reduced from T+5 to T+4, and T+3 effectively from 2012. Also, following the implementation of the CSD, plans

[4] This calculation is based on 22 stock exchanges in Africa for which data on stock market capitalisation is available. The data is sourced from the African Securities Exchange Association (ASEA) site.

were made to implement an automatic trading system (ATS) in 2009. However, the system was only implemented in August 2012. These developments were meant to facilitate trading for both local and foreign investors on the BSE. The market in 2014 laid the foundation for its transition to a commercial entity through the process of demutualisation.

The BSE has made significant progress since its establishment. At the end of 2012 it had grown from just five listed companies to 39 listed companies. The relative size of the BSE has increased over the years. The market capitalisation in 1993 was $2.3 million and it grew to $5.9 billion by 2007. Between 1993 and 2007, the market capitalisation grew by 29.1% annually. However, this growth was interrupted by the 2007 global financial crisis. The performance of the market was overshadowed by the financial crisis. In 2008, market capitalisation recorded a negative growth of -39.6% compared with the 49.2% (or $3.6 billion) growth at the end of 2007. The BSE signalled a recovery from the effect of the financial crisis when it registered a positive growth for two consecutive years up to and including 2012.

Furthermore, the number of domestic listed companies relative to the size of the economy has also increased over the years. The ratio of market capitalisation to GDP rose from 5.5% in 1993 to 31.6% by the end of 2012. However, the market turnover is small by world standards. A total turnover of $113 million in 2012 represents an average monthly turnover of $9.4 million. This means a very low market liquidity of 2.6%.

In terms of market returns the BSE has performed relatively well, despite the challenges posed by small size and low liquidity. The annual stock returns on the DCI over the period 2002 – 2007 rose from 1.9% in 2002 to a record level of 74.1% in 2006, before rising by 35.9% in 2007. At the same time, the annual return on the FCI rose from -28.0% in 2001 to 23.8% by the end of 2007. The market performance over the period remained robust even when measured in US dollar terms. It rose from 31.2% in 2001 to 37.2% in 2007. The average annual return over this period was 25.2% and 26.4% for the DCI and FCI respectively – or 27.5% in dollar terms. Following the global financial crisis, both market segments recorded a negative return at the end of 2008. For instance, DCI and FCI recorded -16.5% and -45.8% respectively, or -38.4% in dollar terms. In 2009, there was a recovery as the market registered some positive returns. Since the recovery from the financial crisis, the returns over the period 2010 to 2014 have shown an annual growth of 6.1% and 2.5% for

DCI and FCI respectively. Figure 2.1 provides a clear picture of the BSE performance over the period.

Figure 2. 1: BSE stock market returns, 2002 – 2015

Data source: Datastream and World Development Indicators

2.4.2 The Bourse Regionale des Valeurs Mobilieres (BRVM)

The BRVM is a regional stock exchange comprising eight countries of the West African Economic and Monetary Union (WAEMU); namely: Benin, Burkina Faso, Cote d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo. It was created in 1998 following the closure of the Bourse de Valeurs d'Abidjan (BVA) at the end of December 1997. Headquartered in Abidjan (Cote d'Ivoire), BRVM has branch offices in each of the member countries except for Guinea Bissau. The exchange is a limited company with a Board of Directors and the regulation of the exchange is under the supervision of the Conseil Regional de I'Epargne Publique et de Marches Financiers (CREPMF), which is a regional financial markets regulator for WAEMU (ASEA, 2014).

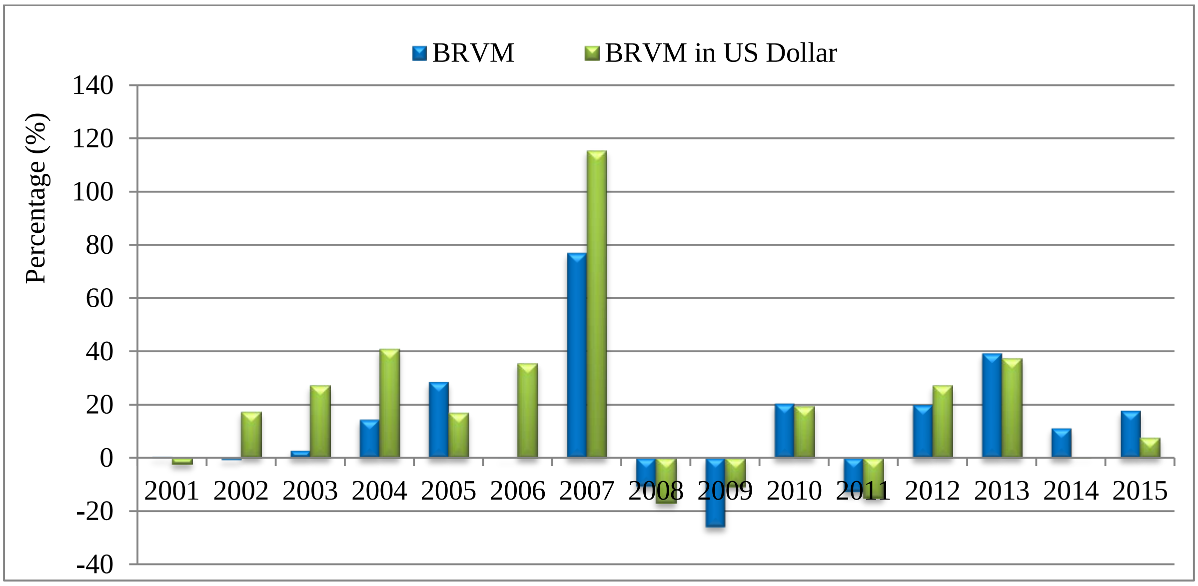
The clearing and settlement on BRVM is provided by the Central Securities Depository (Depositaire Central/Banque de Reglement – DC/BR). It operates an electronic trading platform which affords investors the opportunity to raise capital from the eight member countries. In other words, any company listed on the exchange enjoys visibility in the eight countries and its shares can be traded in all the member countries.

The market capitalisation of listed companies grew from $1.8 billion in 1998 to $8.3 billion by the end of 2007. During the period 2008 and 2009, market capitalisation declined by

14.5% and 26.5% respectively in comparison to the 2007 value. It recovered in 2010 before reaching an all-time high of $11.8 billion by the end of 2013. The value of shares traded increased from $33.2 million in 2000 to $ 315.0 million in 2008, before plunging to $163.0 million by the end of 2012. Between 2000 and 2012, the average turnover ratio was 2.2%, which suggests a very low liquidity.

In Figure 2.2 the stock market performance remains impressive, with annual stock returns growing from 0.4% in 2001 to 77.1% by the end of 2007. In US dollar terms, the market return grew from -2.4% to 115.6% over the same period. This reflects an annual average growth of 17.5% or 35.9% in dollar terms, over the period. This impressive performance was interrupted by the global financial crisis as stock market returns fell by 10.7% and 25.9% respectively in 2008 and 2009. The market made a brief recovery from the global financial crisis in 2010 but deteriorated rapidly in 2011 due to the Eurozone sovereign debt crisis. Despite the stock market returns having been on a positive trajectory since 2012, they are still below the peak witnessed in 2007.

Figure 2. 2: BRVM stock market returns, 2001 – 2015



Date source: Datastream and World Development Indicators

2.4.3 Egyptian Stock Exchange (EGX)

The Egyptian Stock Exchange is the second oldest exchange in Africa. Its humble origins date back to the 19th century with the establishment of the Alexandria Bourse in 1883 and the Cairo Stock Exchange in 1903. From the 1940s to the early 1950s, both the Alexandria and Cairo Stock exchanges were ranked fifth amongst the world stock exchanges. However, the socialist regime and the nationalisation policy adopted in the mid-1950s led to a significant reduction in the role of the private sector in activities of the exchanges (ASEA, 2014).

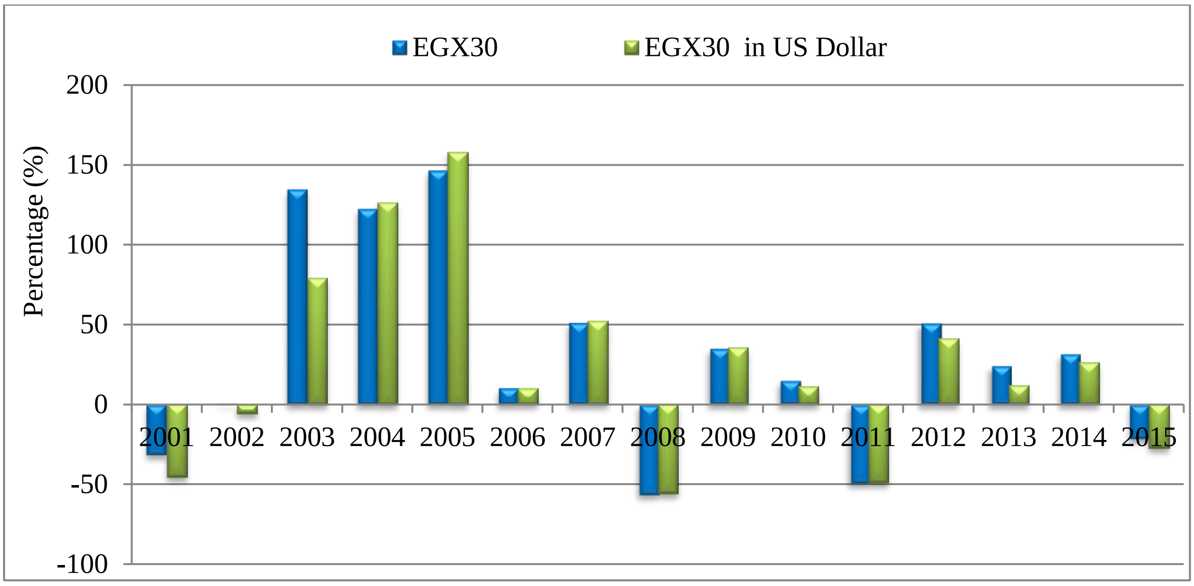
The exchange remained dormant for nearly three decades until 1992. Financial sector reforms and restructuring were undertaken in the early 1990s. In 1992, the Capital Markets Authority (CMA) issued the Capital Markets Law No. 95 – which helped to revive the exchange by providing the regulatory framework within which the exchange and financial intermediaries could operate. Consistent with this new policy shift, government privatised state owned enterprises through a number of initial public offerings on the EGX, which assisted in the revival of the exchange (ASEA, 2014).

The EGX has undergone a number of developments in terms of infrastructures, products and services. Trading on the EGX has gradually moved from an open outcry system, which existed prior to 1992, to an automated order-driven system. This was on account of increasing trade on the exchange. In 2001, the exchange adopted an automated clearing and settlement system. Also, a number of indices designed to capture the performance of the market have been developed over the years – these include, EGX20 Capped, EGX30, EGX70 and EGX100. In 2010, the Nile Stock Exchange (NILEX) was launched as a trading platform for medium and small-scale companies.

At the end of 2013, the EGX was the second largest stock exchange in Africa in terms of market capitalisation. Between 2000 and 2007 market capitalisation grew by 385.4% or an annual average of 25.3%. At the end of 2007, market capitalisation had reached an all-time high of $139.3 billion. In 2008, it dropped to $86.0 billion (or by 38.3%) due to the global financial crisis. Likewise, the relative size of the exchange to the economy also improved over the period from 28.8% in 2000 to 106.8% by the end of 2007, before declining significantly from 2008 to 2013, due to the global financial crisis and the Arab Spring. The market liquidity also increased from 36.1% in 2000 to 45.6% in 2007. At the end of 2013 however, the liquidity had dropped to 21.2%, owing to the combined effects of the Eurozone crisis and the Arab Spring.

The Egyptian stock market has maintained solid returns both in terms of the domestic currency and US dollar unit, after the Dot-com bubble crisis in 2002 (see Figure 2.3). Over the period 2001 to 2007, the average annual return was 61.9% or 53.6% when converted to US dollars. This performance was primarily driven by the strong momentum of the Egyptian economy over this period. In 2008, following the global financial crisis, the annual returns declined by 56.4% (or 55.8% in dollar terms) relative to 2007 values. Between 2009 and 2010, investors recorded some positive returns on their investments. However, by the end of 2011, the cumulative effect of political unrest across the Arab world and the Eurozone debt crisis led to a sharp decline of 49.3% in stock market returns.

Figure 2. 3: EGX stock market returns, 2001 – 2015



Data source: Datastream and World Development Indicators

2.4.4 Ghana Stock Exchange (GSE)

The GSE was established in July 1989 following the enactment of the Stock Exchange Act of 1971. The exchange was incorporated as a private company limited by guarantee under the Ghana Companies Code of 1963. In October 1990, the Executive Instrument No 20 was signed, which recognised the GSE as an authorised stock exchange. Trading on the floor of the exchange commenced in November 1990 while in January 1991, the exchange was officially launched (ASEA, 2012).

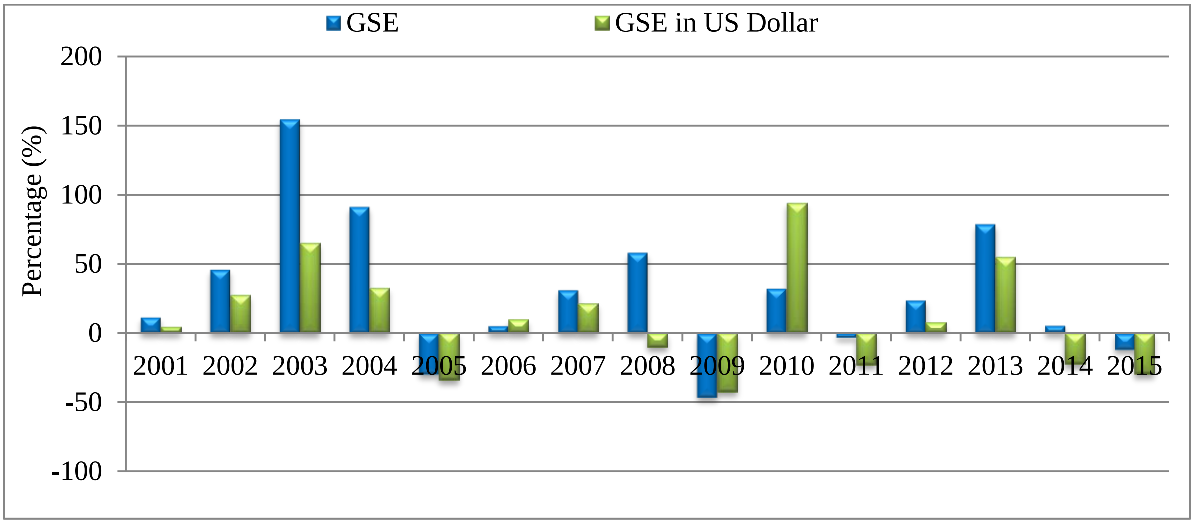
In 2006, Ghana introduced a new foreign exchange Act (Act 723) as a result of on-going financial sector reforms and the emphasis on financial liberalisation. The act allows foreign investors to participate in the GSE without limit or prior exchange control approval. It allows foreign investors a free and full foreign exchange remittance for the original capital plus all capital gains and related earnings. In 2007, the GSE embarked on a project to automate its trading processes as part of a series of measures geared towards repositioning the exchange. In 2008, the Securities Depository commenced operations while the GSE Automated Trading System (GATS) and electronic clearing and settlement systems were implemented in 2009.

Furthermore, in 2013, the GSE introduced a new market for small and medium scale enterprises known as Ghana Alternative Markets (GAX) in order to accommodate businesses with potential for growth (ASEA, 2014).

At the end of 1993 the GSE had only 15 listed companies with a total market capitalisation of $122.1 million, but by the end of 2006 the number had increased to 29 listed companies with a total market capitalisation of $1.8 billion. Despite the global financial crisis between 2007 and 2008, the number of listed companies increased to 31 and market capitalisation also rose by 18.5% to $2.8 billion by the end of 2008. Although market capitalisation fell by 14.7% at the end of 2009, it recovered quickly and grew to $4.9 billion by end of 2013. For the period 2000 to 2012, the annual average turnover ratio was 3.2%. By the end of 2013, the relative size of the market, as measured by the market capitalisation to GDP, remained small at 10.3%.

The GSE performance in terms of stock market returns was very robust before the global financial crisis – as shown in Figure 2.4. The average annual returns over the period 2001 to 2007 grew by 44.3% (or 18.2% in US dollar terms). In 2008, while annual returns rose by 58.2% in terms of domestic currency, they actually fell by 10.4% in US dollar terms. In 2009, the market recorded a negative return of 46.6% in domestic currency terms or 42.7% in US dollar terms. By 2010, the market had recovered from the effect of the financial crisis. However, the growth rate remained lower than the pre-crisis growth rate. For instance, the average growth rate of 20.9% for the period 2010 to 2015 is low compared to that of 2001 to 2007.

Figure 2. 4: GSE stock market returns, 2001 – 2015



Data source: Annual Reports Ghana (ARG) and World Development Indicators

2.4.5 Kenya - Nairobi Stock Exchange (NSE)

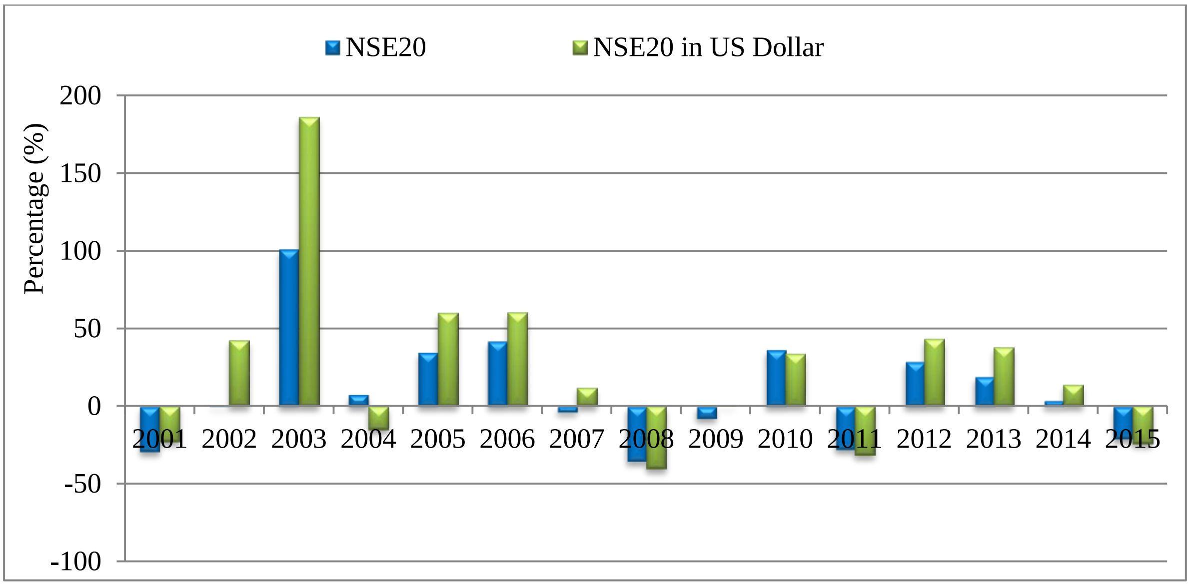
The NSE is the oldest stock exchange in the Eastern and Central African regions. It was established in 1922 at the Stanley Hotel in Nairobi and it operated as an informal exchange. The informal arrangement allowed trading to take place on a gentleman's agreement with standard commission. In 1954, the exchange was formally registered as a voluntary association of stockbrokers under the Societies Act. Between 1963 and 1970, the NSE operated as a regional stock exchange for the East African countries with a number of listed private and public companies from Kenya, Tanzania and Uganda. However, with the attainment of political independence and policy shifts in various members of the East African Community (EAC) companies domiciled in Tanzania and Uganda were delisted and the NSE became Kenya's national stock exchange (ASEA, 2014).

In 1991, the NSE was registered as a private company limited by share under the supervision of the Capital Market Authority (CMA) which was constituted following the CMA Act in 1990. The Central Depository and Settlement Corporation Limited (CDSC) was incorporated in 1999 under the Companies Act. However, it was only in 2004 that a fully automated clearing and settlement system was commissioned.

The NSE has become the largest stock exchange in Eastern and Central Africa in terms of market capitalisation. At the end of December 2007, market capitalisation was $13.3 billion - an increase of 1109.1% compared to its value of $1.1 billion in 1993. During the severe phase of the global financial crisis from 2008 to 2009, market capitalisation declined by 18.0% and 17.3% respectively, compared to 2007 value. As a percentage of GDP, market capitalisation grew from 18.5% in 1993 to 49.1% in 2007 before declining to less than 40% between 2008 and 2013. The turnover ratio had increased from 3.3% in 1993 to 10.6% in 2007, while the number of listed companies had increased from 38 to 55 over the same period.

By the end of 2001, the exchange had performed relatively well in terms of market returns. After registering a negative growth of 29.2% in 2001, the annual stock return had grown to 42.1% by the end of 2006. This represents an average annual growth of 26.1% or 46.1% in US dollar terms over the period. However, from 2007 to 2009, the combined effects of political unrest and the global financial crisis led to three consecutive years of negative returns in domestic currency terms (see Figure 2.5). The NSE, like other markets, recovered in 2010 before declining by 27.7% in 2011. Although the market return has been on an upward spiral since 2012, it is still well below that of the pre-crisis period.

Figure 2. 5: NSE20 stock market returns, 2001 – 2015



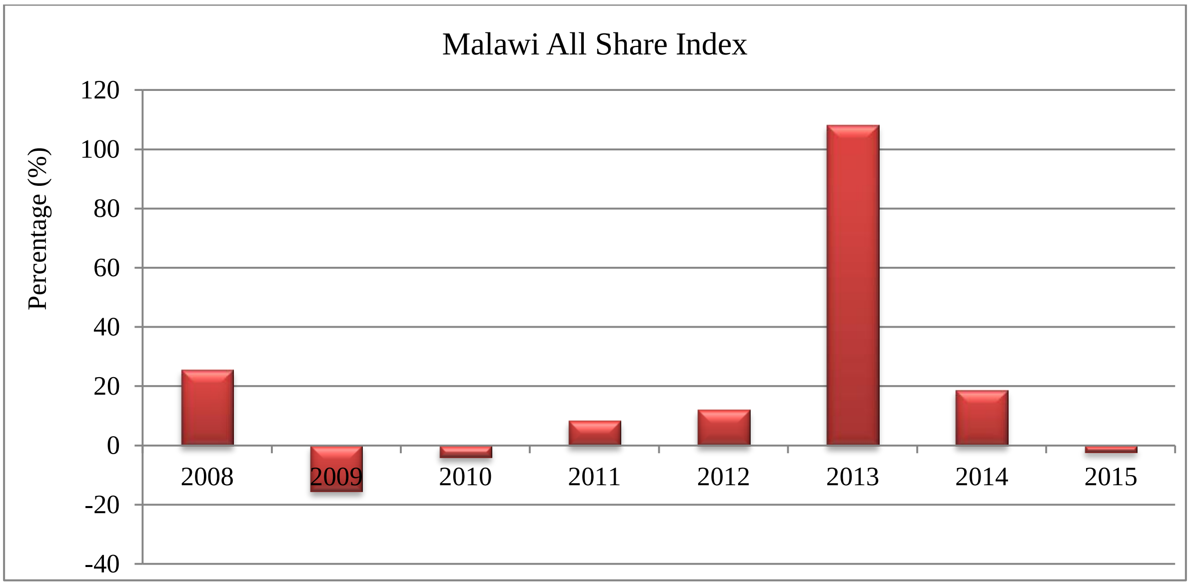
Data source: Datastream and World Development Indicators

2.4.6 Malawi Stock Exchange (MSE)

The MSE was formally inaugurated in March 1995. However, share trading on the exchange commenced in November 1996 following the listing of the National Insurance Company Limited (NICO), which was the first company to be listed on the exchange. The exchange operates under the Capital Market Development Act of 1990 and the Companies Act of 1984, with the Reserve Bank of Malawi as the market regulator.

Despite the economic challenges facing the country, the MSE has continued to develop, with market capitalisation growing from \$212.0 million in 2000 to \$1.3 billion by the end 2007. An increased market capitalisation of \$1.8 billion in 2008 seemed to suggest that the MSE had not been affected by the global financial crisis. However, since 2010 there has been a progressive decline. Relative to GDP, market capitalisation increased from 3.6% of GDP in 2003 to 41.4% in 2008, before declining to 17.8% by the end of 2012. Liquidity remains a challenge to investors as the market recorded a liquidity level of 1.5% at the end of 2012 – and that is well below the global standard. During the crisis period in 2008, the market maintained a positive annual return of 25.6%. However, following the strain in the global financial market, annual returns plummeted to -15.4% and -3.9% in 2009 and 2010 respectively. The market recovered from the negative returns in 2011 before posting a positive return of 108.3% at the end of 2013. From 2011 to 2014, the average annual returns grew by 36.9% (see Figure 2.6).

Figure 2. 6: MSE stock market returns, 2008 – 2015



Data source: Datastream

2.4.7 Mauritius - Stock Exchange of Mauritius (SEM)

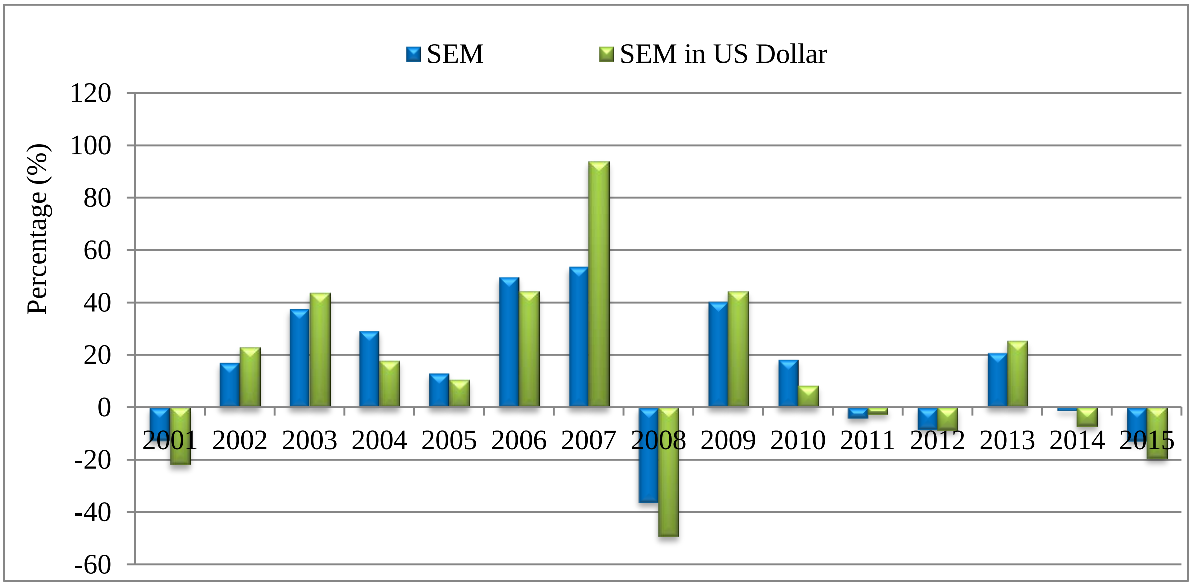
The Stock Exchange of Mauritius (SEM) was established in 1989 under the Stock Exchange Act of 1988. It was a private limited company, charged with the responsibility of operating, promoting and regulating the securities market in the country. The SEM became a public company in 2008. At the start of operations in 1989, trading on the exchange by means of the openoutcry system, only took place for about five minutes once a week. There were only five listed companies with a market capitalisation of about $92 million (ASEA, 2014).

Since its establishment, the SEM has made significant progress in its operations and regulatory environment and has undertaken a number of reforms toward the enhancement of the operational and regulatory efficiency of the market. In 1994, the market became liberalised following the removal of exchange controls, which meant that foreign investors could trade shares. At the beginning of 1997, the SEM successfully implemented the Central Depository System (CDS) which ensures efficient clearing and settlement of trade and at the same time reduces some of the risks inherent in the process. In June 2001, an automated trading system known as SEM's Automated Trading System (SEMATS) was launched. The SEM operates two markets: the official market, which was established in 1989, and the development and enterprise market (DEM), established in 2006. The DEM is a market designed for small and medium-scale enterprises and newly established companies with sound business and growth potential (ASEA, 2014).

The size of the market grew from a market capitalisation of approximately $92 million with five listed companies in 1989 to $7.9 billion with 67 listed companies by the end of 2007. Following the global financial crisis, the annual market capitalisation declined by 40.5% to $4.7 billion in 2008 before its recovery in 2009. By the end of 2013 the market capitalisation had grown to $8.9 billion. The relative share of the market capitalisation to GDP had grown to 72.7% by the end of 2007, before declining to 35.7% in 2008. The market recovered in 2009, and grew to 74.9% by end of 2013. The level of liquidity in the market remains very low when measured in terms of the ratio of stock traded to GDP and by the turnover ratio. For instance, the average liquidity in term of the ratio of stocks traded to GDP was 2.8% over the period 2000 to 2013, while the average turnover over the same period was 6.3%.

The SEM delivered robust growth performance, in terms of investment returns in the period before the global financial crisis. The stock market returns rose from -12.6% in 2001 to 53.8% in by the end of 2007. This reflects an average annual return of 26.9%. When converted to US dollars, the average return grew by 30.2% annually over the period. However, the market returns plunged by 36.1% (or 49.2% in dollar terms) by the end of 2008. The market proceeded to recover from the negative returns and rose by 40.4% in 2009 and 18.5% in 2010. However, since the end of 2010, the market return has been on a negative swing, except for 2013 (see Figure 2.7).

Figure 2. 7: SEM stock market returns, 2001 – 2015



Data source: Datastream and World Development Indicators

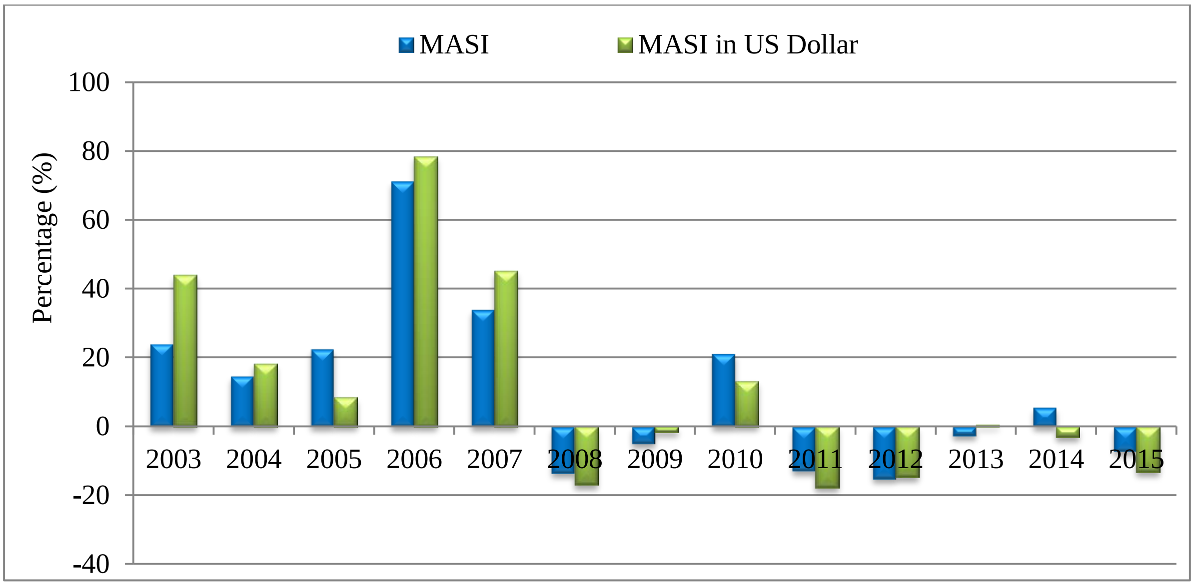
2.4.8 Morocco - Casablanca Stock Exchange (CSE)

The CSE is among the oldest securities exchanges in Africa. It was established in 1929 as the Office de Compensation des Valeurs Mobilieres under the management of Casablanca Chambers of Commerce. In 1967, reforms were undertaken in order to provide the market with a well-organised legal and technical framework. However, major reforms began in 1986 when the government embarked on a structural adjustment programme. In 1993, further reforms were undertaken to consolidate the market and these led to the creation of two market regulators- the Conseil Deontologique des Valeurs Mobilieres (CDVN), and the Societe de Bourse de Valeurs de Casablanca (SBVC) which is a private company, owned by brokers responsible for managing the CSE. In 1998, a central securities depository, known as the Maroclear, was established (ASEA, 2012).

The exchange has grown steadily over the years. By the end of 2000, 53 companies were listed on the exchange and this number had increased to 74 by end of 2007 with a market capitalisation of $75.5 billion. Similarly, market capitalisation as a percentage of GDP also increased from 29.4% to 100.4% over the same period. However, between 2008 and 2009, market capitalisation declined to $65.7 billion and $62.9 billion respectively. During the same period, market capitalisation as a percentage of GDP declined by 74.0% and 69.2% respectively. The liquidity of the market improved from an 8.9% turnover in 2000 to 42.1% by the end of 2007, making the CSE one of the most liquid markets in Africa over this period. However, the liquidity of the market declined steadily after 2009.

Furthermore, the annual stock returns for the period 2003 to 2007 were robust, growing at an average of 33.2% annually before declining by 13.5% and 4.9% in 2008 and 2009 respectively. The rate of growth in US dollar terms over this period was 38.9% annually before declining by 17.0% and 1.7% in 2008 and 2009 respectively. Although the market recovered in 2010, it has remained on a negative trend since 2011(except for 2014), as shown in Figure 2.8. This can be attributed to the combined effects of political unrest and the Eurozone debt crisis.

Figure 2. 8: CSE stock market returns, 2003 – 2015



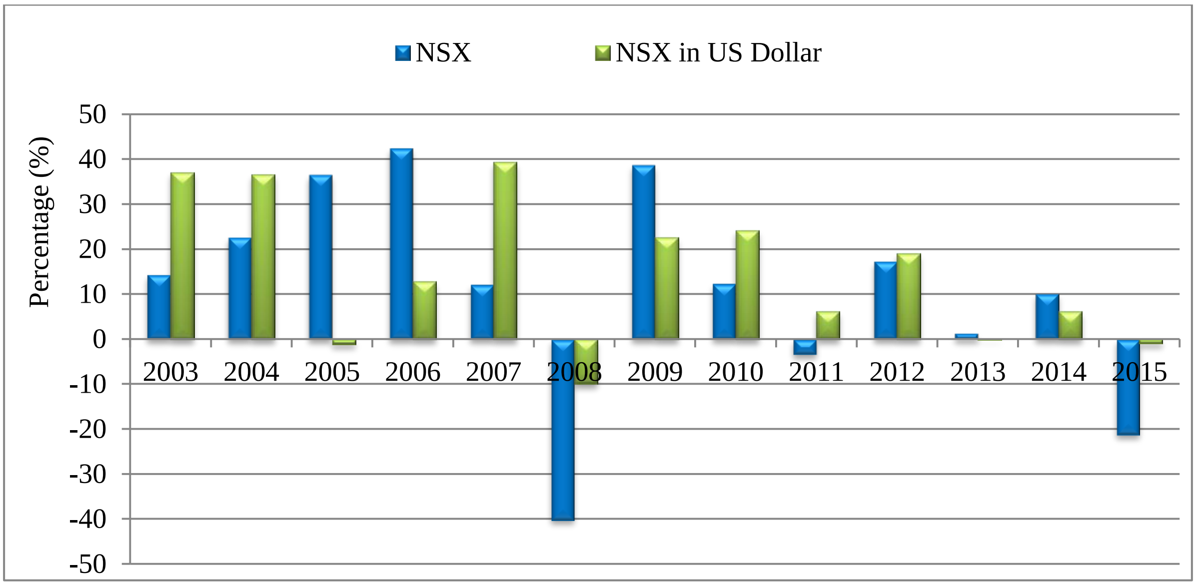
Data source: Datastream and World Development Indicators

2.4.9 Namibian Stock Exchange (NSX)

Although the NSX was formally launched in 1992, there was an earlier effort to establish a stock exchange during the diamond rush in 1904. The market operated for few years before closing down in 1910 following the end of the rush. The idea of establishing a new stock market began in 1990 following Namibian independence from South African occupation. At the launch of the NSX in 1992 under the Stock Exchange Control Act of 1985, it had only one dual-listed company and one stockbroker, with the Namibian Financial Institutions Supervisory Authority (NAMFISA) as the regulatory body (ASEA, 2013).

The market capitalisation of listed companies on the NSX has grown significantly since its launch in 1992. The total stock market capitalisation grew from $27.8 million in 1993 to $702 million by the end of 2007, before declining during the period 2008 to 2009. By the end of 2013, the total stock market capitalisation had reached $1.8 billion. As a percentage of GDP, market capitalisation increased from 0.9% in 1993 to 14.0% in 2013. Liquidity (measured by the turnover ratio) plunged from 15.8% in 1994 to 1.7 % by end of 2012. Market returns on the NSX Overall Index grew from 14.4% in 2003 to 42.4% in 2006 before declining to 12.2% by the end of 2007. Over the period 2003 to 2007, the market returns grew by approximately 25.6% annually, both in terms of domestic currency and dollar units. However, the market recorded a sharp drop in stock returns by 40.1% (or 9.9% in dollar terms) during the financial crisis period in 2008. The market recovered over the period 2009 to 2010 before declining in 2011 due to the debt crisis in the Eurozone.

Figure 2. 9: NSX stock market returns, 2003 – 2015



Data source: Datastream and World Development Indicators

2.4.10 Nigerian Stock Exchange (NSE)

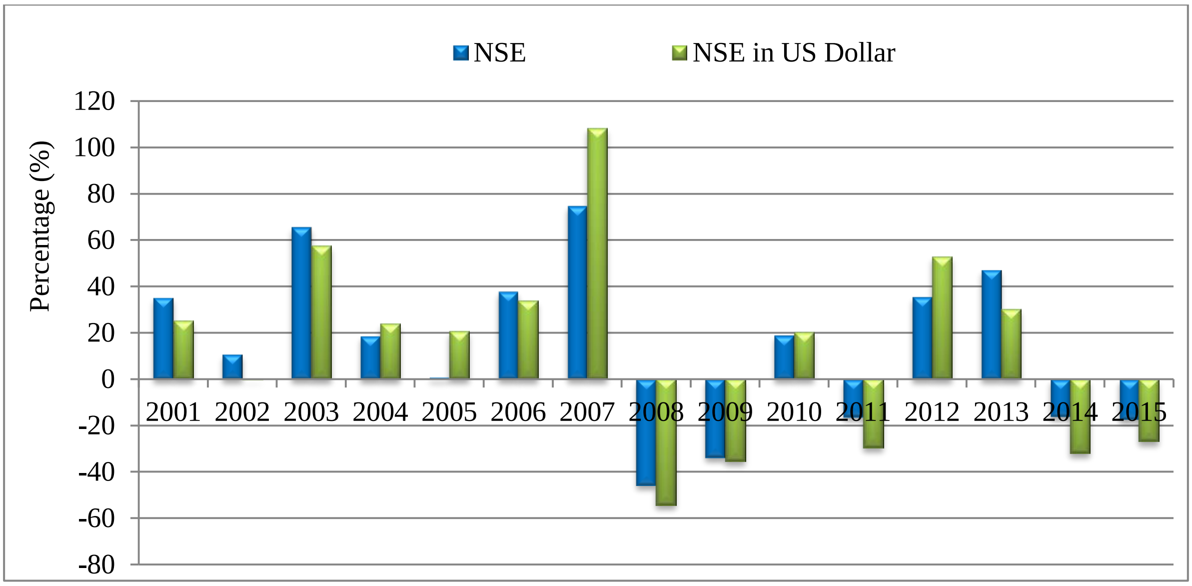
The NSE was established in 1960 as a company limited by guarantee under the Investment and Securities Act (ISA), and it is regulated by the Securities and Exchange Commission (SEC) of Nigeria. The exchange commenced trading in June 1961 with 19 listed securities comprised of three equities, six federal government bonds and 10 industrial loans. In 1984, it launched the All-Share Index, a value-weighted market capitalisation index with a base value of 100. In order to accommodate small and medium-sized firms, the market launched the Second-Tier Securities Market (SSM) in April 1985 (ASEA, 2014).

However, following reforms to improve the competitiveness of the market within the context of financial market liberalisation, the Nigerian capital market was deregulated in 1993. Also, in 1995, both the Exchange Control Act of 1962, and the Nigerian Enterprises Promotion Decree of 1989 were abolished. In order to further improve foreign participation in the market, the Nigerian Investment Promotion Commission Decree No 16 and the Foreign Exchange (Monitoring and Miscellaneous Provisions Decree No 17) were also introduced in the same year. Furthermore, the Central Securities Clearing System Limited (CSCS) was commissioned to provide automated clearing, settlement and delivery services. This was followed by the introduction of an automated trading system (ATS) in 1998.

The NSE has continued to experience substantial growth and development in equities trading. For instance, stock market capitalisation grew from \$2.1 billion in 1993 to \$86.3 billion by the end of 2007. This represents an average growth rate of 30.4% per annum. During the global financial crisis, stock market capitalisation declined by 42.3% and 61.4%, in 2008 and 2009 respectively relative to 2007 value. By the end of 2013, stock market capitalisation had recovered to $80.6 billion; however, this value was still lower than that witnessed before the crisis in 2007. The stock market capitalisation as a percentage of GDP increased from 13.6% to 51.0% over the period 1993 to 2007. It declined significantly following the financial crisis. At the end of 2013, it accounted for a mere 15.7%. Trading on the NSE increased to $42.0 billion in 2012 from $30.2 million in 1993 but the market is relatively illiquid, despite having improved from 1.8% in 1994 to 8.8% in 2012.

Despite the challenges concerning the liquidity and depth of the NSE, the stock market returns have improved, growing from 35.2% in 2001 to 74.7% in 2007. This represents an average annual growth of 34.8% (or 38.5% in US dollar terms). The performance of the NSE has been driven by rapid development in the oil and financial service sectors. The financial sector consolidation programme, which led to recapitalisation of banks, was initiated in 2002 and ended in 2006. However, stock market returns plummeted during the global financial crisis by 45.8% and 33.8% (or 54.2% and 35.4% in dollar terms) in 2008 and 2009 respectively. Like most stock exchanges, the market recovered in 2010 before declining sharply in 2011 due to the debt crisis in the Eurozone. The market has since recovered but the combined effect of political unrest and plummeting oil prices are putting strain on the market.

Figure 2. 10: NSE stock market returns, 2001 – 2015



Data source: Datastream and World Development Indicators

2.4.11 South Africa – Johannesburg Stock Exchange (JSE)

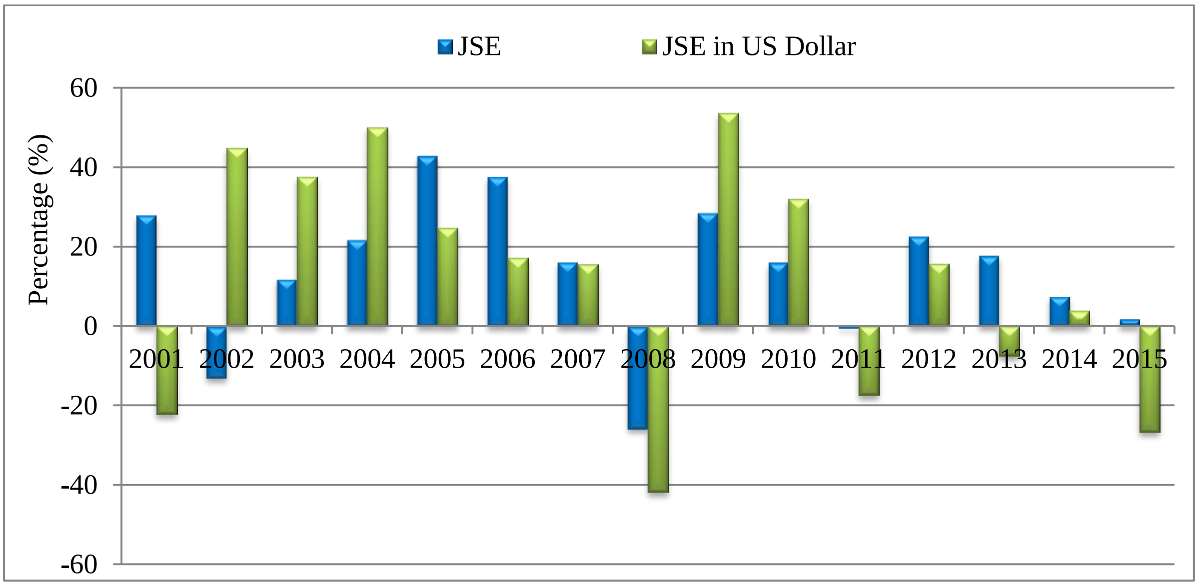
The JSE, the oldest stock exchange in Africa, was established in 1887 as a result of the gold rush. It is the most advanced stock exchange on the continent and offers trading opportunities across five distinct financial markets, namely: equities, bonds as well as financial, commodity and interest rate derivatives (ASEA, 2014). The exchange also has a variety of product offerings, including warrants, exchange traded funds (ETF) and other specialised products. In terms of size, the JSE is the largest on the continent and declared a market capitalisation of $942.8 billion, or 257.4% relative to GDP, at the end of 2013.

Despite having been affected by political changes the 1990s – particularly the re-entrance of South Africa into the global market following the lifting of the formal sanctions against the country – the JSE underwent a comprehensive set of reforms towards the end of 1995. These reforms were aimed at deregulating the exchange by improving the operational, institutional and regulatory frameworks. With these reforms, the JSE migrated from an open outcry trading system to an order-driven, centralised, automated electronic trading system. The implementation of these reforms allows greater foreign investor participation on the JSE.

The JSE has continued to dominate other stock exchanges on the continent in terms of size, depth and liquidity. Market capitalisation increased from $136.9 billion in 1990 to $833.5 billion before the financial crisis in 2007. This represents a growth of 508.8% over the period. Following the global financial crisis, market capitalisation declined significantly to $491.3 billion or (by 41.1%) at the end of 2008. Relative to GDP, market capitalisation grew from 122.2% in 1990 to 291.3% in 2007 and declined thereafter due to the financial crisis. The level of liquidity on the JSE has gradually improved steadily over the period. The total value of stock traded to GDP increased from 8.2% in 1990 to 148.8% in 2007, before declining to 86.9% by the end of 2013. Over the same period, the market’s turnover ratio rose from 6.5% in 1990 to 55.0% in 2007 and then declined to 34.4% in 2013. However, this ratio is relatively high when compared with other markets in the region and this indicates that the JSE is the most liquid exchange in Africa.

The JSE delivered a remarkable performance in terms of investment returns before the global financial crisis, with average annual market returns of 20.8% over the period 2001 to 2007. The market performance remains impressive even when converted to US dollar unit, with an average annual return of 24%. However, the global financial crisis saw a 25.7% (or 41.7% in dollar terms) drop in market returns in 2008 relative to 2007 values. The market recovered over the period 2009 to 2010 by registering a positive growth of 28.6% and 16.1% respectively, before declining sharply in 2011. The annual returns remained positive after 2012, but have declined over time. This may be attributed to the decrease in global commodity prices.

Figure 2. 11: JSE stock market returns, 2001 – 2015



Data source: Datastream and World Development Indicators

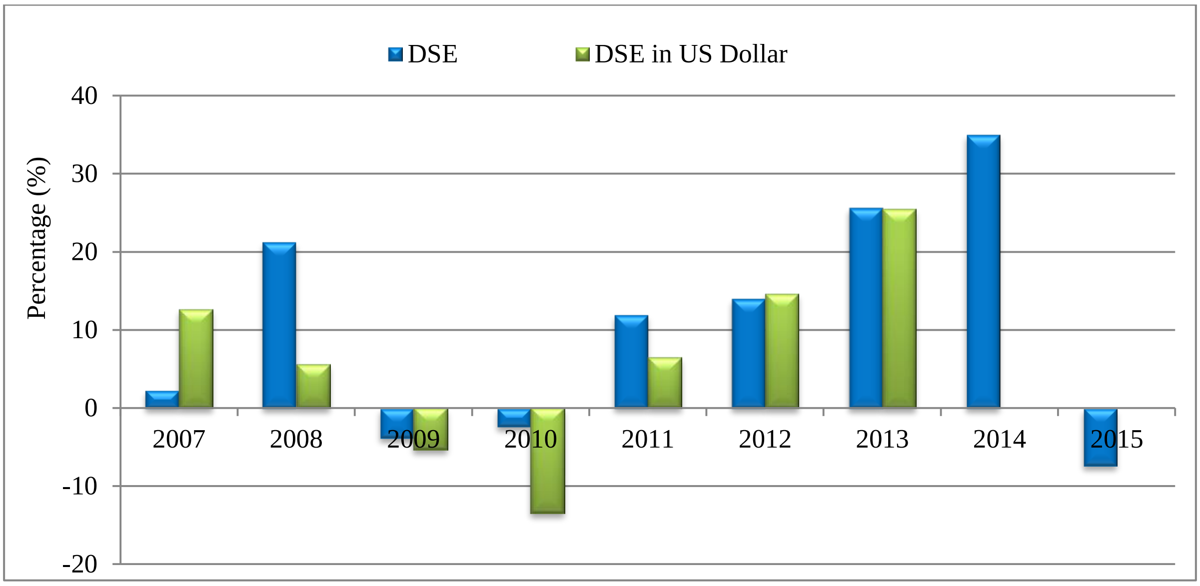
2.4.12 Tanzania – Dar es Salaam Stock Exchange (DSE)

The DSE was established in 1996 following the enactment of the Capital Market and Securities Act of 1994 and the establishment of the Capital Markets and Securities Authority (CMSA) as a regulator. The establishment was part of the government's economic reforms aimed at making the economy more market-oriented and encouraging a wider ownership of firms. As a result, the DSE was incorporated as a private company limited by guarantee. The exchange commenced operations in 1998 with a listing from one privatised company, Gases Limited (TOL). In 1999, the exchange launched a Central Depository System (CDS) and by 2006, the DSE had started trading using an Automated Trading System (ATS) which is linked with the CDS (ASEA, 2014).

The DSE has grown rapidly since its commencement of operations in 1998. The number of listings had grown from 1 in 1998 to 17 in 2012 and the market capitalisation over the period had increased from $232.9 million to $1.8 billion. However, this was lower than the $2.8 billion witnessed in the run-up to the global financial crisis in 2007. As a percentage of GDP, the market depth remains very small by world standards. It grew from 2.3% in 2000 to 6.4%

by the end of 2012. The level of liquidity declined from 19.4% in 2000 to 1.6% by the end of 2012. In terms of market returns, the market initially appeared to be resilient to the global financial crisis as market returns rose by 21.3% in 2008 from the 2.3% witnessed in 2007. However, stock market returns declined during the period 2009 to 2010, before recovering in 2011 (see Figure 2.12).

Figure 2. 12: DSE stock market returns, 2007 – 2015



Data source: Datastream

2.4.13 Tunisia – Tunis Stock Exchange (TSE)

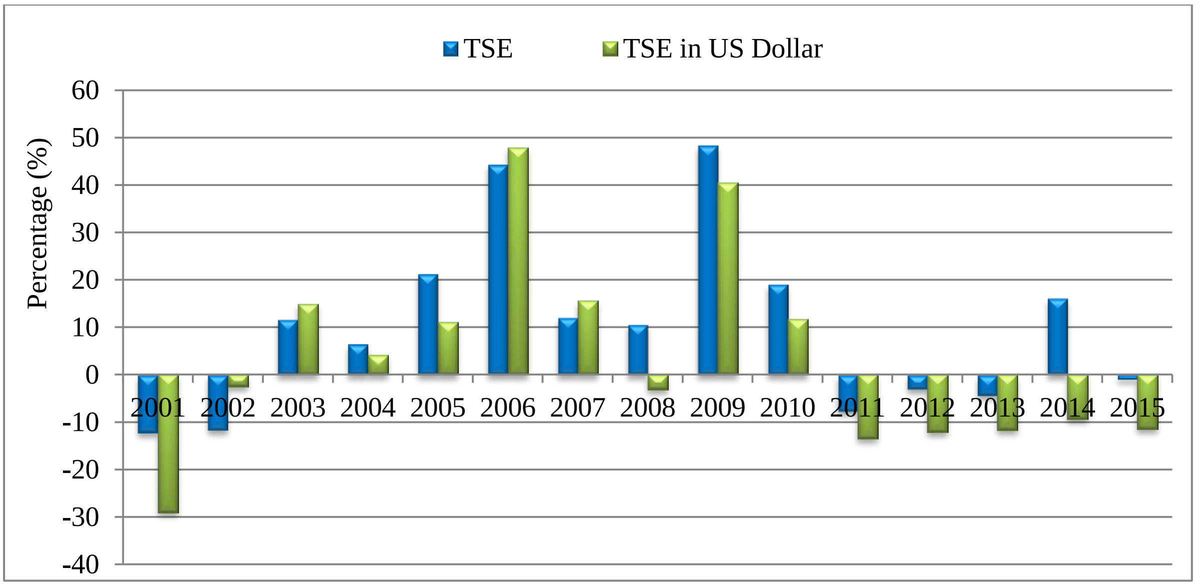
The TSE was established as a public institution in 1969. In 1994, a variety of financial reforms were introduced in order to promote stock trading on the exchange and to align it with international standards. As part of the reforms, the Law 14 of 1994 was adopted which created a separate regulatory body – Conseil du Marche Financier (CMF)/Financial Market Council. In 1995, the TSE became a private entity, exclusively owned by the brokerage firms. In order to achieve an efficient and transparent execution of order, the exchange implemented an electronic trading system in 1996 (ASEA 2012).

The TSE has developed steadily over the years and it is currently considered to be among the frontier stock exchanges in Africa. Market capitalisation increased from $2.8 billion in 2000 to $8.9 billion by the end of 2013. Despite the global financial crisis, the TSE still recorded a positive growth of 18.5% and 68.5% in 2008 and 2009 respectively compared to 2007 values. Similarly, market capitalisation as a percentage of GDP, improved from 13.2% in 2000 to 19.6% by the end of 2012. The value traded on the listed stocks grew by 99.8% to reach $1.3

billion in 2012, as opposed to the $626 million in 2000. Market turnover over the same period however, declined from 22.6% to 13.5%. The total value of stock traded to GDP remained relatively unchanged over the period, from 2.9% in 2000 to 2.8% by the end of 2012.

After the technology crisis in 2003, the performance of TSE index returns measured by the TUNINDEX was impressive (as shown in Figure 2.13). The average return grew at a rate of 19.2% annually over the period 2003 to 2007. In US dollar terms, the return over the period was 8.9%. Surprisingly, despite the decline in returns during the severe phase of the global financial crisis, the market still maintained a strong positive return in domestic currency terms. The average return between 2008 and 2009 was 29.5% annually (or 18.7% in dollar terms). This suggests that the market was relatively unaffected by the crisis. However, from the end of 2010, the market recorded three consecutive years of negative returns. The poor performance over the period 2011 -2013 can be attributed to the political uncertainty in the country during the period under review, given that Tunisia was the birth place of the Arab Spring that began 2010.

Figure 2. 13: TSE stock market returns, 2001 – 2015



Data source: Datastream and World Development Indicators

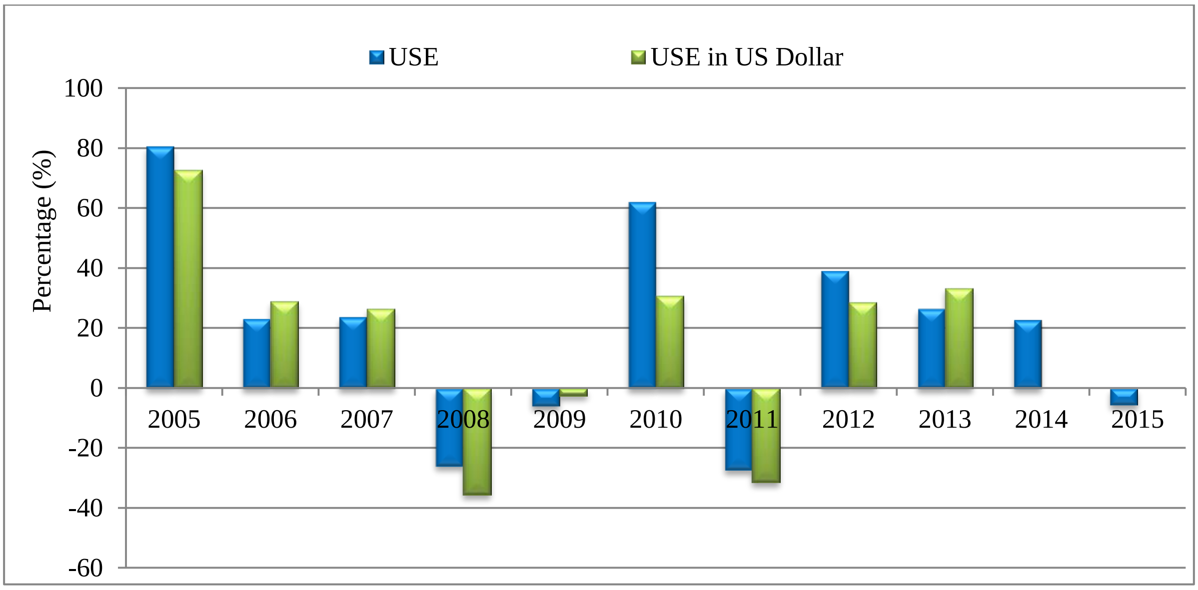
2.4.14 Uganda Securities Exchange (USE)

In 1997, the Capital Market Authority (CMA) of Uganda licensed the USE as a company limited by guarantee to operate as an approved securities exchange. The exchange officially commenced trading in 1998 with the listing of its first instrument, the 4-years East African

Development Bank (EADB) bond. In 2000, this was followed by the listing of its first equity, Uganda Clays Limited (ASEA, 2007)

While the exchange remains small in terms of listed companies, growing from just two companies in 2001 to 10 in 2012, the market capitalisation has improved over the period. For instance, the market capitalisation was $35.1 million in 2001 and it had grown to $7.3 billion by the end of 2012. Similarly, as a percentage of GDP, market capitalisation had increased from 0.6% to 36.4% over the same period. Conversely, the level of liquidity (turnover) was very small and has remained virtually unchanged from 0.6% in 2001 to 0.2 in 2012. Stock market returns improved over the period 2005 to 2007, growing at an annual average of 42.4%. However, due to the financial crisis, this was followed by negative growth during the period 2008 to 2009. Like other markets, the USE recovered in 2010 before declining again in 2011. While market returns have been positive since 2012, they have slowly begun to decline.

Figure 2. 14: USE stock market returns, 2005 – 2015



Data source: Datastream

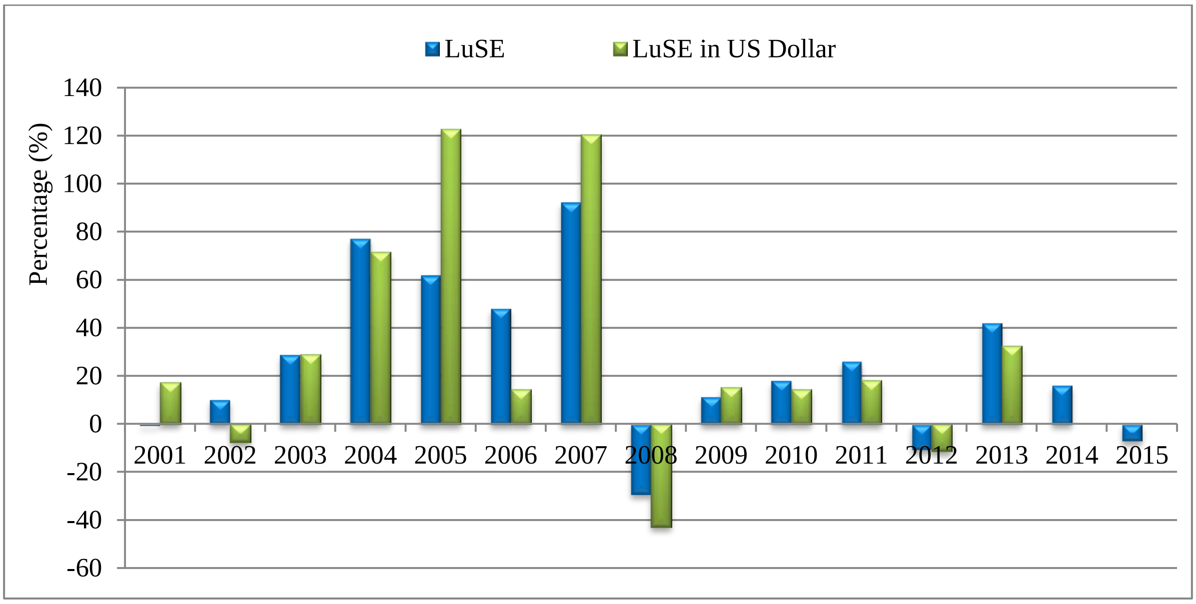
2.4.15 Zambia – Lusaka Stock Exchange (LuSE)

The LuSE was established in accordance with the Securities Act No 38 of 1993, with the Securities and Exchange Commission (SEC) as the regulatory body. The establishment of the exchange was part of the government's broader economic reforms aimed at encouraging more private sector participation in the economy through privatisation. This was anchored under the Privatisation Act No 21 of 1992, which recognised the role of private sector in the economic sphere. The exchange commenced operations in 1994 (ASEA, 2012).

The exchange has experienced rapid growth since its establishment. It started with only two listed companies with a market capitalisation of $428 million in 1995 and grew to 20 listed companies with a market capitalisation of $3.0 billion by the end of 2012. The ratio of market capitalisation to GDP in 1995 was 11.2%, but it gradually increased to 37.8% in 2008 before declining to 14.6% at the end of 2012. Despite these developments, the level of liquidity, as measured by the turnover ratio, remains low. The turnover in particular, was 0.9% in 1996 and 5.6% at the end of 2012. Similarly, the ratio of stock traded to GDP over the same period remained relatively unchanged 0.1% to 0.9%.

The market performance has been very robust in terms of stock market returns. The average stock market return grew from -0.5% in 2001 to 92.3% by the end of 2007 which represents an average annual growth of 45.5%. The performance remains even more impressive when converted to US dollars. The average annual return grew at 52.6% over the period. However, in 2008 the market recorded a negative growth of 29.1% (or 42.9% in dollar terms) before recovering in 2009 (see Figure 2.15). Since the drop in 2008, the market has continued to maintain a positive return growth except for 2012 and 2015.

Figure 2. 15: LuSE stock market returns, 2001 – 2015



Data source: Datastream

The preceding analyses have shown that the African stock markets have made great progress on many fronts, despite the challenges they have faced. These challenges have ranged from improving the size of the markets and their liquidity to making them more attractive to local and foreign investors. The markets have also performed surprisingly well in terms of investment returns – especially before the global financial crisis. However, it is important to consider how these markets are faring relative to other international stock markets, in terms of market returns before and during the global financial crisis. The following section will compare the performance of 15 stock exchanges in Africa against the major international stock exchanges, before and during the global financial crisis.

2.5 Performance of African stock markets relative to major international markets

The attractiveness of African stock markets as a viable investment opportunity depends on the extent to which they have the potential to improve risk-return trade-offs facing investors (Allen et al., 2011). To this end, this section compares performance of African stock markets to those of major international markets and four major emerging markets. Major international markets considered include: Australia (5), Canada (6), France (11), Germany (12), Hong Kong (1), Japan (7), Singapore (4), Switzerland (8), United Kingdom (3) and United States (2). In addition, the major emerging markets considered include: Brazil, China, India and Russia (or the BRIC countries). The choice of these markets is based on 2012 financial development index ranking (Word Economic Forum, 2012).[5]

While less noticeable, but nevertheless remarkable, is the fact that African stock markets recorded impressive performance in terms of market returns relative to other international markets before the global financial crisis. According to the pre-crisis data from 2001 to 2007 (provided in Table 2.11), the returns from African markets has been impressive both in terms of domestic currency and US dollar units. The average annual returns in African stock markets in dollar term were higher than those of major international markets over the period. For instance, the average annual return was 53.6% for Egypt, Zambia 52.5%, Kenya 46.1%, Nigeria 38.6%, BRVM 35.9% and Mauritius 30.2%. These figures compare favourably with returns from other international stock markets. Importantly, returns from African markets are much higher than those from the well-developed stock markets. They are also similar to those witnessed within the major emerging markets of Brazil, Russia, India and China.

[5] Financial Development Index ranks 62 of the world's leading financial systems and can be used by countries and policymakers as a benchmark (World Economic Forum, 2012). The numbers in parenthesis indicate the position of the country in the recent financial system development index ranking for the year 2012.

The global stock markets experienced a significant downward movement in stock market returns following the global financial crisis in 2008. The decline in stock market returns around the world was staggering (as shown in Table 2.11). The table shows that almost all stock markets experienced negative returns over the period. In Africa, Botswana, Egypt, Kenya, Mauritius, Nigeria, South Africa and Zambia were among the worst performing markets during this period. The decline in stock market returns in 2008 was also significant in other international markets. For instance, in the emerging markets, Russia recorded a 73.4% drop, India 64.1%, Brazil 57.2% and China 52.7%. In the developed markets, Australia recorded a 54.1% drop, Singapore 52.9%, United Kingdom 49.5%, Canada 49.0%, France 45.2%, Germany 42.8%, United States 38.5% and Japan 27.7%.

Fortunately, the decline in 2008 was followed by a recovery in 2009 as most markets registered a significant improvement in stock market performance. In Africa, Egypt, Mauritius, South Africa and Tunisia were the best performing markets. Likewise, other markets across the globe registered positive returns in 2009. Again, after the Eurozone debt crisis in 2011, most markets around the globe recorded negative returns for a period.

2.6 Conclusion

This chapter set out to provide a review of historical development and the characteristics of stock markets in Africa. It further considered the performance of major stock markets in Africa relative to other major international markets before and during the recent global financial crisis. In order to do this, the chapter focused on key stock market indicators to ascertain their behaviour before and during the crisis. The purpose of this was to acquire an understanding of the progress and state of stock markets in Africa before the 2007 global financial crisis as well as their behaviour in relation to developments in international stock markets during the crisis period.

The analyses in preceding sections have shown most stock markets in Africa to be nascent, with limited market breadth, depth and liquidity relative to other developing regions. The evidence from key financial market indicators points to low stock market capitalisation and liquidity of most African markets. The analysis also shows the dominance of the two oldest markets (the South African stock exchange and the Egyptian stock exchange) in terms of market capitalisation and liquidity. On the other hand, there is a significant variation in the level of stock market development in terms of market microstructure. Manual trading of securities as well as barrier to foreign trading, still exist in some stock exchanges. Also, trading is limited to a few securities, mainly equities and bonds. However, only a few countries have a secondary market for bond trading while the derivative market exists only in South Africa.

Nevertheless, African stock markets have witnessed a number of economic and financial reforms over the years. These reforms have not only focused on improving the trading environment, the size and liquidity of the markets, but also the positioning of the markets. As a result, there have been marked improvements in the trading environment, market capitalisation and liquidity, as well as an increase in the number of stock markets which have proliferated across Africa. Despite the challenges relating to low capitalisation and liquidity, the stock markets in Africa present attractive investment opportunities in terms of market returns. In particular, the performance of these markets has improved significantly, with the returns in some of the African markets exceeding those of the developed and emerging markets before the global financial crisis (when considered in local currency units). Although foreign investors may be concerned about currency fluctuation in Africa, even on this score, the performance of African stock markets remains impressive when converted into dollar terms.

The performance of stock markets in Africa before the global financial crisis was by no means a coincidence. This has been attributed to the extensive economic and financial sector reforms that had been carried out over the years – particularly those that supported the development of stock markets (Allen et al., 2011 and Senbet, 2009). These reform packages spanned a variety of measures, including interest rate liberalisations, removal of credit ceilings, restructuring and privatisation, along with supervisory and banking regulatory schemes as well as promotion and development of stock markets (Senbet, 2009). The financial sector reforms were also supported by the technological development that was spurred on by globalisation.

The emergence of the global financial crisis led to a significant drop in stock market returns across markets. The evidence from the crisis period shows that African markets were significantly affected by the crisis. Like other developed and emerging markets, most African stock markets experienced negative returns in 2008. The synchronous decline in the stock market returns in 2008 buttresses the impact of the crisis on stock markets' performance. Importantly, the synchronous decline in stock market returns suggests that African stock market performance appears to follow developments in the global market. However, whether the observed performance of African stock markets during the crisis period can be attributed to their integration into the global financial system, or contagion, remains largely an empirical issue. Consistent with this, the present study tends to empirically determine whether this is the result of integration of African markets or by contagion.

However, before proceeding to empirically investigate this issue, it is important to provide some perspectives on the level of global integration, on one hand and integration of Africa with rest of the world, on the other hand. This is important as it adds to the understanding of the background of this study and also in identifying the impacts as well as the transmission channels of the recent global financial crisis into different markets. Therefore, the next chapter will focus on the level of integration in the global economy.

Table 2. 11: Performance of stock markets before and during the financial crisis

Country	Average Returns (%) 2001 -2007		% Returns 2008		% Returns 2009		% Returns 2010		% Returns 2011	
	Local unit	**US$**	**Local unit**	**US$**	**Local unit**	**US$**	**Local unit**	**US$**	**Local unit**	**US$**
Botswana	25.2	27.5	-16.5	-38.4	2.9	24.3	-11.4	-6.8	8.7	7.5
BRVM	17.5	35.9	-10.7	-16.9	-25.9	-10.7	20.5	19.3	-12.7	-15.2
Egypt	61.9	53.6	-56.4	-55.8	35.1	35.6	15.0	11.5	-49.3	-49.1
Ghana	44.3	18.2	58.2	-10.4	-46.6	-42.7	32.2	94.1	-3.1	-22.8
Kenya	21.9	46.1	-35.3	-40.3	-7.8	0.6	36.5	33.8	-27.7	-31.6
Malawi			25.6		-15.4		-3.9		8.4	
Mauritius	26.9	30.2	-36.1	-49.2	40.4	44.2	18.4	8.2	-4.0	-2.5
Morocco		24.1	-13.5	-17.0	-4.9	-1.7	21.2	13.1	-12.9	-17.7
Namibia		16.6	-40.1	-9.9	38.8	22.6	12.3	24.2	-3.3	6.2
Nigeria	34.8	38.6	-45.8	-54.2	-33.8	-35.4	18.9	20.3	-16.3	-29.5
South Africa	20.8	24.0	-25.7	-41.7	28.6	53.7	16.1	32.1	-0.4	-17.4
Tanzania			21.3	5.6	-3.8	-5.3	-2.4	-13.5	12.0	6.5
Tunisia	10.3	8.9	10.6	-3.1	48.4	40.6	19.1	11.7	-7.6	-13.4
Uganda			-25.9	-35.5	-6.0	-2.5	62.2	30.8	-27.3	-31.4
Zambia	45.5	52.6	-29.1	-42.9	11.5	15.2	18.2	14.3	26.2	18.2
Emerging Markets										
Brazil	27.3	35.6	-41.2	-57.2	82.7	125.1	1.0	6.5	-18.1	-24.4
China	25.0	28.9	-65.4	-52.7	79.8	66.3	-14.5	6.9	-21.6	-21.7
India	29.7	34.6	-52.4	-64.1	81.0	94.1	17.4	18.7	-24.6	-38.0
Russia	47.1	45.3	-67.2	-73.4	121.1	106.6	23.2	21.7	-16.9	-23.4
Developed Markets										
Australia	10.8	19.9	-41.3	-54.1	30.9	72.4	-2.6	12.5	-14.5	15.5
Canada	7.5	14.8	-35.0	-49.0	30.7	57.5	14.4	22.0	-11.1	-14.7
France	1.4	8.2	-42.7	-45.2	22.3	25.6	-3.3	-9.9	-17.0	-19.5
Germany	7.4	15.0	-40.4	-42.8	23.8	25.8	16.1	7.4	-14.7	-16.6
Hong Kong	11.9	13.3	-48.3	-53.9	52.0	67.1	5.3	21.3	-20.0	-20.2
Japan	3.7	4.1	-42.1	-27.7	19.0	16.4	-3.0	9.6	-17.3	-12.2
Singapore	10.2	13.0	-49.2	-52.9	64.5	76.7	10.1	18.4	-17.0	-21.2
Switzerland	2.7	8.5	-34.8	-30.6	18.3	24.5	-1.7	11.0	-7.8	-9.4
United Kingdom	1.7	6.1	-31.3	-49.5	22.1	35.2	9.0	5.2	-5.6	-6.1
United States	2.7	2.7	-38.5	-38.5	23.5	23.5	12.8	12.8	-0.0	-0.0

Datasource: Datastream and World Development Indicators

CHAPTER THREE

GLOBAL INTEGRATION AND THE RECENT FINANCIAL CRISIS

3.1 Introduction

Over the past few years, the global economy has been buffeted by a crisis in the financial market, which erupted in 2007 after the collapse of the U.S. subprime mortgage market. The financial crisis was a significant shock to the financial system and the global economy. At the early stage of the crisis, there was a debate on whether the crisis in the U.S. housing sector would have a broader impact on the global economy or whether the global economy would be able to decouple from the downturn in the U.S. market. On the one hand, some analysts argued that the development in the U.S. housing market would not have a major effect on the global economy (IMF, 2007). This view was rooted in the belief that the crisis was a U.S.-specific sectoral development (given that the housing market has a relatively low imported component) rather than common shocks which affect all markets. This view also argued that trade linkages with the U.S. had become progressively less important to many countries following the strengthened domestic demand in different economies and demand from other developed and emerging markets (Bekiros, 2013; Levy Yeyati & Williams, 2012 and IMF, 2007).

The alternative argument was based on evidence from past U.S. crisis episodes, which usually had a negative impact on the global economy. Past crisis episodes in the U.S. usually affected other economies through two primary channels: trade linkages and financial linkages (IMF, 2007). This view is more in line with evidence in literature suggesting that shock can be transmitted across countries through trade and financial channels (IMF, 2007 and Massa & Velde, 2008). Most especially, in an increasingly integrated system, global risk, which incorporates risk aversion in an uncertain economic outlook, is more likely to enhance the scope for the spread of the crisis.

Moreover, contagion, whether through trade or financial linkages, may play a significant role in spreading the crisis. Consequently, the diminishing trade linkages of other countries with the U.S. should be balanced against the increasing cross-border financial linkages as well as the fact that the U.S. economy remains the largest economy with the most developed financial market (IMF, 2007). In addition, the U.S. market held the most foreign assets and liabilities of any single country in 2007, reflecting its large domestic financial market and investor base as well as its integration with other financial markets (MGI, 2008).

Studies tend to suggest that markets are becoming increasingly integrated (Gupta & Guidi, 2012 and Kenourgios & Padhi, 2012). However, this view requires a careful consideration as an integration process cannot be generalised. Indeed, there are markets or economies that have experienced a significant development over the years, and as a result, their interaction and linkages with other markets may have increased over time. At the same time, there are markets that have advanced very slowly in this regard. These differences are important in order to identify the impact of the 2007 global financial crisis on different markets around the globe. Hence, in discussing the transmission channels of the crisis to different markets around the globe, especially economies in Africa, it should be bourne in mind that these impacts may be related to the evolution of market integration.

Against this background, the present chapter explores the level of global integration, on one hand and integration of Africa with rest of the world, on the other hand. It also explores the channels through which the recent global financial crisis was transmitted into the global economy and Africa in particular. To fully understand the impact of the crisis, the chapter explores the controversial link between global integration and the financial crisis. Fundamentally, the chapter focuses on the two main channels through which a crisis can be transmitted into different markets, namely trade and financial channels (Karolyi, 2004 and Kaminsky & Reinhart, 2000). These transmission channels are reflected in the global cross-border flows of goods, services and finance. Consequently, analyses in this chapter use global cross-border flows as a primary metric to quantify the causal linkage between market integration and the crisis, by analysing and tracing their evolution before and during the crisis. Further, it also analyses the level of integration and impact of the crisis on African markets.

The purpose of this chapter is to identify in a broader framework the propagation mechanisms of the crisis with different characteristics in developed and developing countries/regions and to elucidate how vulnerable developing regions (African region in particular) are to global shocks. However, as a prelude, the discussion in this chapter begins with a general look at the state of the global economy before, during and after the crisis.

3.2 The state of the global economy before, during and after the crisis

The sustained momentum and resilience of the global economy before the crisis, in particular between 2001 and 2007, exceeded expectation despite different crisis episodes and disasters around this period. The United Nations Conference on Trade and Development (UNCTAD) statistics show that in the run-up to the global financial crisis, the global economic growth (as measured by the world GDP) increased from 1.8% in 2001 to 4.0% in 2007. This corresponds to an average growth of 3.2% annually. Of particular importance is the fact that the global GDP growth equalled, or exceeded, 4% several times during these periods, including 2000, 2004, 2006 and 2007 (see Figure 3.1). The growth over these periods has been attributed to a broad-based growth in the emerging and developing economies, especially in countries like China and India. For instance, China and India recorded significant growth in real GDP from 7.6% to 12.7% and 3.8% to 9.3% respectively, between 2000 and 2006 (IMF, 2007 and 2014).

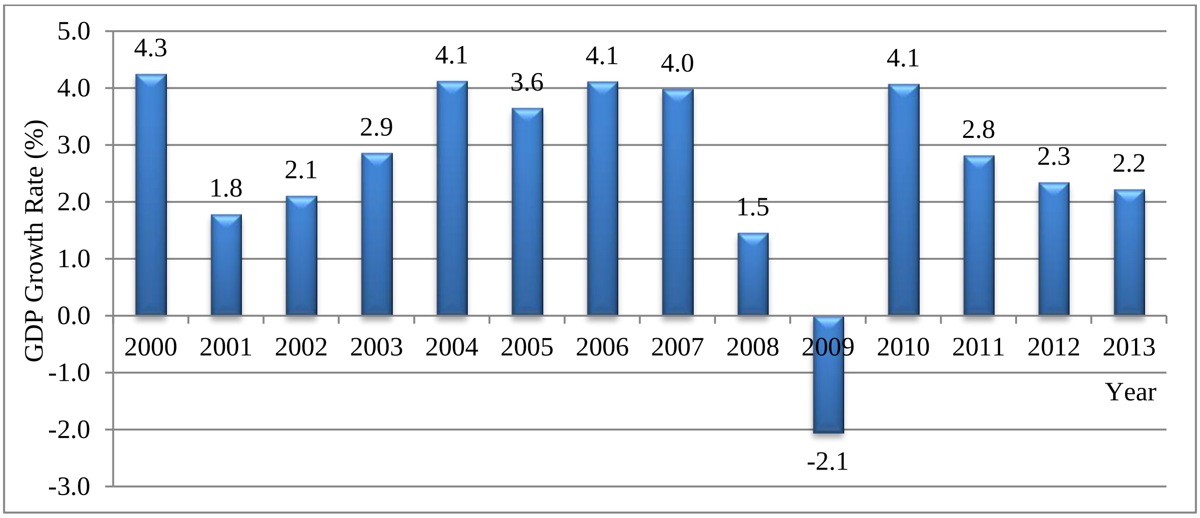
From the regional perspective, growth in the advanced economies declined from 3.8% to 2.5%, representing an average annual growth of 2.5% between 2000 and 2007, while growth in the developing economies increased from 5.7% to 8.0% over the same period. Continentally, there were significant variations in growth across regions over this period. Europe, for example, recorded a decline from 3.9% to 3.4%, while Asia grew from 6.9% to 9.0% and Sub-Saharan Africa grew from 3.5% to 6.1%. These trends, as illustrated in Figure 3.1 and Table 3.1 below, show that growth in the African region was comparable to growth elsewhere around the globe. In particular, the performance of the African economy over this seven-year period shows that the region outperformed advanced economies with an average annual growth of 5.4% relative to the 2.5% growth witnessed by the advanced economies.

However, the global economy was buffeted by a crisis in the financial market, which erupted in 2007 after the collapse of the U.S. subprime mortgage market. Notwithstanding the global economic growth of 4.0% in 2007, this was actually a deceleration of 0.1% from the 4.1% witnessed in 2006. Furthermore, an unprecedented contraction was witnessed between 2008 and 2009, as annual GDP growth fell to 1.5% and -2.1% respectively, due to the crisis. Advanced economies collectively recorded a negative growth of 3.7% in 2009. While developing economies as a group avoided a negative growth in 2009, many individual economies saw their GDP contracted, for example, China, India, Chile and South Africa.

The year 2010 saw a return to positive growth across different economies. The global GDP expanded by 4.1% in 2010 – one year after an unprecedented negative growth of 2.1% that accompanied the financial crisis in 2009. Growth recovery was faster in the developing Asian market (8.8%) than in other advanced and developing regions. Apart from Asia, growth in other developing and transitional economies was vigorous in 2010. Advanced economies grew more slowly than developing economies, weakened by concern about the sovereign debt defaults, especially in Europe. The concern about debt defaults during the second half of 2010, led to fiscal austerity in Greece, Ireland, Portugal and Spain, and contraction of growth to 2.0% in Europe.

Consequently, global growth contracted considerably between 2011 and 2013. The slowdown in global output growth may be due to persistent weakness, especially in a number of advanced economies as well as deep recession in some European countries in a sovereign debt crisis. Developing economies, which had rebounded strongly from the global financial crisis, were also affected by the recession in the Eurozone through trade and financial channels. As a result, there was a notable decline in economic growth in developing and transitional economies, reflecting a combination of external and internal vulnerabilities.

Figure 3. 1: Global GDP growth rate from 2000 – 2013



Data source: UNCTAD Statistical Database

In addition, crises stalking the global economy over this period were multiple and interconnected. High unemployment, weak demand due to fiscal austerity, high debt burdens, and financial sector fragility, even the political tussle in the U.S. regarding the debt ceiling, all played a significant role in weakening global growth after the recovery in 2010 (United Nations, 2013). In particular, the austerity measures taken by governments around the

Eurozone helped to aggravate and further weaken growth and employment prospects by weakening demand and making fiscal adjustment more challenging. Considering the fact that the U.S. and the European Union (EU) form the two largest economies in the world, their problems are more likely to spillover into other countries through trade and financial linkages.

Overall, the analyses of global economic performance before and during the crisis revealed some interesting facts regarding the impact of the crisis on the global economy as well as different regions. However, looking at the aggregate economic performance alone to analyse the impact of the crisis hides significant information about the transmission channels of the crisis and the level of cross-border economic linkages (integration) that could help in the propagation of the crisis. Moreover, the transmission channels and cross-border linkages are reflected in global cross-border flow of goods, services and finance. Hence, these flows taken together provide an aggregate measure of the size and intensity of cross-border linkages and more generally, of integration between different economies. As a result, the next section presents an overview of global cross-border flows.

Table 3. 1: Annual real GDP growth rate by economic grouping, 2001 – 2012

Economy / Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
World	1.8	2.1	2.9	4.1	3.6	4.1	4.0	1.5	-2.1	4.1	2.8	2.3
Advanced Countries	1.4	1.4	2.1	3.1	2.6	2.9	2.5	0.0	-3.7	2.6	1.5	1.3
America	1.0	1.9	2.7	3.7	3.3	2.6	1.8	-0.2	-2.8	2.6	1.9	2.7
Asia	0.3	0.3	1.7	2.4	1.4	1.8	2.3	-0.9	-5.3	4.7	-0.4	2.0
Europe	2.0	1.3	1.4	2.6	2.2	3.4	3.2	0.4	-4.4	2.0	1.6	-0.3
Oceania	3.9	3.4	4.1	3.2	3.1	3.5	3.7	1.2	2.0	2.2	3.3	2.9
Economies in Transition	5.8	5.0	7.4	7.8	6.6	8.5	8.7	5.3	-6.5	4.7	4.6	3.2
CIS	5.9	5.1	7.6	7.9	6.7	8.7	8.8	5.4	-6.8	4.9	4.7	3.4
Emerging Economies	0.9	2.9	2.8	5.5	4.2	5.2	5.4	3.1	-1.3	7.3	3.9	2.6
Developing Countries	2.8	4.3	5.3	7.4	6.9	7.7	8.0	5.2	2.8	7.8	5.8	4.6
Africa	4.3	5.2	5.1	5.7	6.0	5.8	6.1	5.5	2.6	4.9	0.9	5.4
Northern	4.4	3.5	6.5	4.6	5.7	5.4	4.9	5.7	3.4	4.4	-6.3	5.0
Sub-Saharan	4.5	6.3	4.5	6.3	6.4	6.1	6.8	5.2	2.4	5.2	4.6	3.9
America	0.5	0.4	1.8	5.9	4.5	5.6	5.5	4.0	-1.6	5.8	4.3	3.0
Caribbean	2.1	3.0	3.1	3.5	7.5	9.2	5.9	3.1	-0.3	2.6	2.4	2.5
Central	-0.4	0.4	1.7	4.3	3.2	5.1	3.5	1.7	-4.2	5.0	4.1	4.1
South	1.0	0.1	1.8	7.1	5.0	5.6	6.7	5.4	-0.2	6.4	4.6	2.5
Asia	3.6	6.0	6.7	8.3	8.0	8.7	9.1	5.6	4.4	8.8	6.9	5.1
Eastern	5.5	7.7	7.1	8.3	8.7	9.9	11.0	6.9	6.0	9.6	7.7	6.0
Southern	4.3	4.6	7.7	7.4	8.2	8.3	8.9	3.5	7.1	8.7	5.6	2.8
Western	-1.2	3.2	5.5	10.3	7.2	7.5	5.5	4.7	-1.0	6.9	7.2	3.9
Oceania	0.8	2.0	4.0	2.2	3.4	2.8	3.4	2.7	2.4	3.7	4.9	4.2

Note: CIS is Commonwealth of Independent States

Data source: UNCTAD Statistical Database

3.3 Global cross-border flow of goods, services and finance

The global cross-border flows encompass goods, services and finance and are a key indicator that measures the degree of cross-border linkage across markets. In other words, it defines the degree of global integration and cross-border exposure of different economies to global systemic risk, as well as a medium through which a contagious crisis could spread to different markets across the globe. Over the past few decades, an increasing share of economic activities is taking place across borders, linking together different national economies and allowing firms, lenders and borrowers, investors, traders and other institutions to operate outside the limited scope of their domestic markets. As different economies are participating in cross-border trading activities, the cross-border flow of economic activities is growing more dispersed, embracing an increasing number of countries and participants, and creating a more tightly interconnected world.

Also, well-established trading routes have emerged and the networks are expanding, as many developing countries are becoming more integrated into the global value chains. The expanding global flow not only represents an essential underpinning of global economic integration but also a potentially destabilising force with important policy implications, if not properly managed. As a result, thinking about how these flows have evolved over time is a valuable exercise.

Figure 3.2 documents the evolution of aggregate global cross-border flows over the period 1994 to 2013. One notable feature of the global cross-border flow over these periods is the striking long-term expansion from 1994 to a peak in 2007. In 1994, the combined value of trade in goods and services and finance was just $6.2 trillion, or 18.8% of global GDP. Their combined value increased by more than four times, reaching $27.2 trillion or 48.6% of global GDP by the end of 2013. Over this period, these flows expanded to an average annual growth of 8.1%. At the same time, individual components of the global flow expanded also. For instance, the flow of goods expanded at an annual average of 8.1%; in line with the 7.9% expansion in services trade and 8.2% expansion in financial flows.

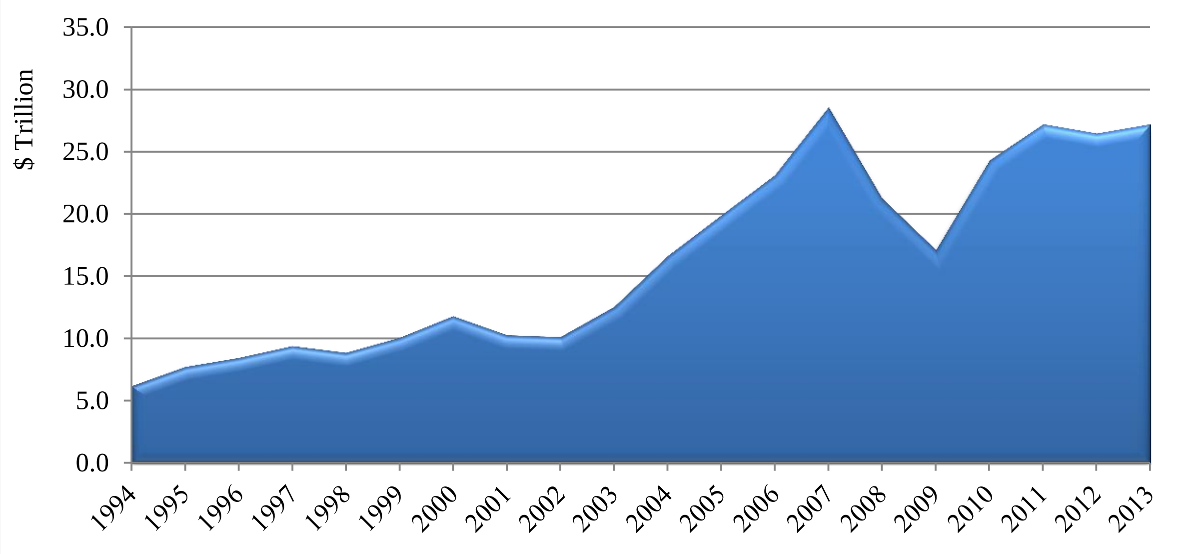
Importantly, in the run up to the crisis (2000 – 2007), there was a significant surge in global flow. Over this period, the total global flows expanded to more than double their size in 2002, from $11.8 trillion to a peak $28.6 trillion in 2007, corresponding to an annualised growth of 13.5%. In comparison with the global GDP, the share of global cross-border flows increased from 29.3% of global GDP in 2000 to 56.8% by the end of 2007. This suggests that more than half of global economic activities take place across borders or more than one out of every two business dealings occurs across borders. It also underlines the deeper integration that exists across the global markets.

However, the expansion in global flows was not without interruption. The long-term expansion was interrupted in 2008 – 2009 following the global financial crisis. The crisis and resultant economic recession underlines the web of linkages in the global economic system, which allowed the crisis to spread rapidly to other economies. The resultant recession brought about a sharp decline in the global cross-border flows, due to a large slump in individual components of the flow. The collapse suggests evidence of the impact of the crisis on all components of the global flow, hence, a decline of $7.3 trillion and $11.5 trillion respectively for 2008 and 2009 relative to before the crisis peak in 2007. This brought the total global cross-border flows to $21.3 trillion (or 34.2% of global GDP) in 2008 and $17.1 trillion (or 25.1%.of global GDP) in 2009.

Global flows recovered in 2010, after increasing by $7.2 trillion from the previous year value which brought the total flow at end of the year to $24.3 trillion or 46.7% of global GDP. However, the recovery is still below pre-crisis levels, indicating that the global economy has not fully recovered from the crisis.

The collapse of global flows during the crisis, and recovery after the crisis, not only reflects a web of cross-border linkages but also indicates the impact of the crisis on global economic activities. However, to capture the linkages and impacts of the crisis as comprehensively as possible, it is important to disentangle different components of the global flows so as to understand their evolution and decline during the crisis. Therefore, the sections that follow take a more nuanced look at the evolution of individual components of the global flow before 2007 and their decline during the crisis. In doing that, these components are broadly classified into two channels, namely trade or real channels and financial channels. In what follows, this study considers a number of trade channels through which the crisis affected other markets.

Figure 3. 2: Global flow of goods, services[6] and finance[7], 1994 – 2013



Sources: Author's calculations based on the UNCTAD and IMF BOP Statistical Database

3.3.1 Trade/real channels

The trade channel is one of the fundamental channels through which a crisis in one market spreads to other markets. However, trade, specifically international trade in goods and services, is among the key drivers of economic growth as well as the integration of markets. As noted above, the increasing volume of cross-border flows over the period has been associated with trade in goods and services. Moreover, the combined trade in goods and services is the largest component of global cross-border flows, accounting on average for approximately 77.7% of total cross-border flow from 1994 to 2013. This primarily reflects growing trade integration or linkage across the globe. Therefore, in the section below, the study considers two important trade channels, namely the global flow of goods and the flow of services.

[6] The global flow of goods and services is defined here as exports of goods and services. This is consistent with the fact that in principle, world exports and imports are expected to be equal; any discrepancy between the two could be due to differences in data recording or missing data.

[7] Finance is used to describe cross-border financial transactions recorded in the external financial account, as described in the sixth edition of the IMF Balance of Payment and International Investment Position Manual (BPM6). Consistent with this manual, financial outflows (inflows) are recorded as assets (liabilities). Following this, outflows are purchases of foreign financial assets by domestic investors (outflows with a negative sign) less sales (disinvestment) in the same assets (outflows with a positive sign). Inflows are purchases of domestic assets by foreign investors (inflows with a positive sign) less sales (disinvestment) in the same assets (inflows with a negative sign). Globally, outflows should equal total inflows. In practice, however, there may be some discrepancies due to missing data. Hence, financial outflows are used as a proxy for global financial flows. Financial flows as used here focus mainly on private capital flows. Thus, reserve assets accumulation is excluded. Also, financial derivatives are excluded from the calculation of financial flow.

a. Global flow of goods – merchandise import and export

The global cross-border flow of goods constitutes the largest component of the global flows, accounting on average for approximately 62.3% of total global flows or 21.8% of global GDP annually, from 1994 to 2013. This underscores the importance of trade in goods as one of the main channels through which a crisis can have a ripple effect on other economies. Importantly, the global flow of goods had been growing rapidly both in volume and dollar terms before the global financial crisis. For example, the value of global merchandise exports rose from just $4.3 trillion in 1994 to $14.0 trillion in 2007. On average, this value reflects an annual growth of 6.4%, or an accumulative growth of 225.6%, over the period. At the same time, the share of global merchandise exports relative to global GDP increased from 13.1% in 1994 to 27.8% in 2007.The period 2000 – 2007 saw a remarkable increase in global merchandise exports, rising from $6.5 trillion, or 16.0% of world GDP in 2000, to $14.0 trillion or 27.8% of GDP in 2007.

The global merchandise trade, when measured in terms of volume of world imports and exports, averaged 5.7% on a year-on-year basis between 2000 and 2007, representing a cumulative growth of 40.3%, while growth in dollar value terms averaged approximately 12.0% per annum over this period (see Figure 3.3). The rapidly increasing global merchandise trade reflects the globalisation of consumption, most importantly production, supported by the introduction of new technologies that allow the production process to be unbundled. At the same time, it mirrors the growth in international production and supply chain networks, with both manufacturing and service activities being offshored to lower-cost locations in an increasingly globalised market. In addition, the international production networks are supported by the increasing international mobility of capital, within a more open and liberalised trading environment.

The global merchandise exports reached their peak in 2008 with a value of $16.1 trillion. or 31.6% of the global GDP. However, this was actually a deceleration, as world trade lost momentum following the slowdown in the global economy. Between 2008 and 2009, the volume of world merchandise trade declined significantly. On the export side, the volume of world merchandise trade fell to 1.7% and -13.2%, while imports fell to 2.2% and -13.6% in 2008 and 2009 respectively, compared with the average growth attained between 2000 and 2007 (see Figure 3.3). The decline corresponds to a cumulative loss of 11.7% over this period as a result of the global financial crisis. In dollar value terms, the decline over this period is more pronounced. As illustrated in Figure 3.3, the dollar value of world trade is increased and/or decreased much faster than the volume of trade. This is partly explained by the rising commodity and energy prices and the depreciation of the U.S. dollar (United Nations, 2011).

Similarly, trade across regions exhibited the same pattern of behaviour as illustrated in Figure 4.4. During the pre-crisis period (2001 – 2007), each of the regions recorded positive growth in merchandise exports, with trade volumes averaging 3.7% annually in advanced economies, 7.2% in economies in transition, 8.3% in emerging economies and 9.7% in developing countries. While growth across the regions increased over this period, the growth had been dominated by developing, emerging and transition economies, particularly developing countries in Asia, Africa and America, with an average annual growth of 11.5%, 5.0% and 4.7% respectively.

However, the marked weakness in external demand, as measured by the volume of world imports, especially for advanced economies following the financial crisis, led to a fall in merchandise trade. In 2009, the volume of imports by the advanced economies dropped to -14.7%, compared to -10.1% in developing countries. On the export side, while some regions recorded positive trade growth for the most part of 2008, this was actually a deceleration across all regions (except developed Oceania) when compared with 2007 growth. As a consequence of the economic slowdown that started in the U.S. and the deep financial crisis, negative export growth was recorded across all regions in 2009 (see Figure 3.4). The dramatic downward adjustment in exports across the globe severely affected developing countries as their export revenue declined. Specifically, the decline in public sector revenue in developing countries following the dramatic downward adjustment in exports caused fiscal deficits and pressures to borrow, thus increasing their potential for debt-servicing defaults.

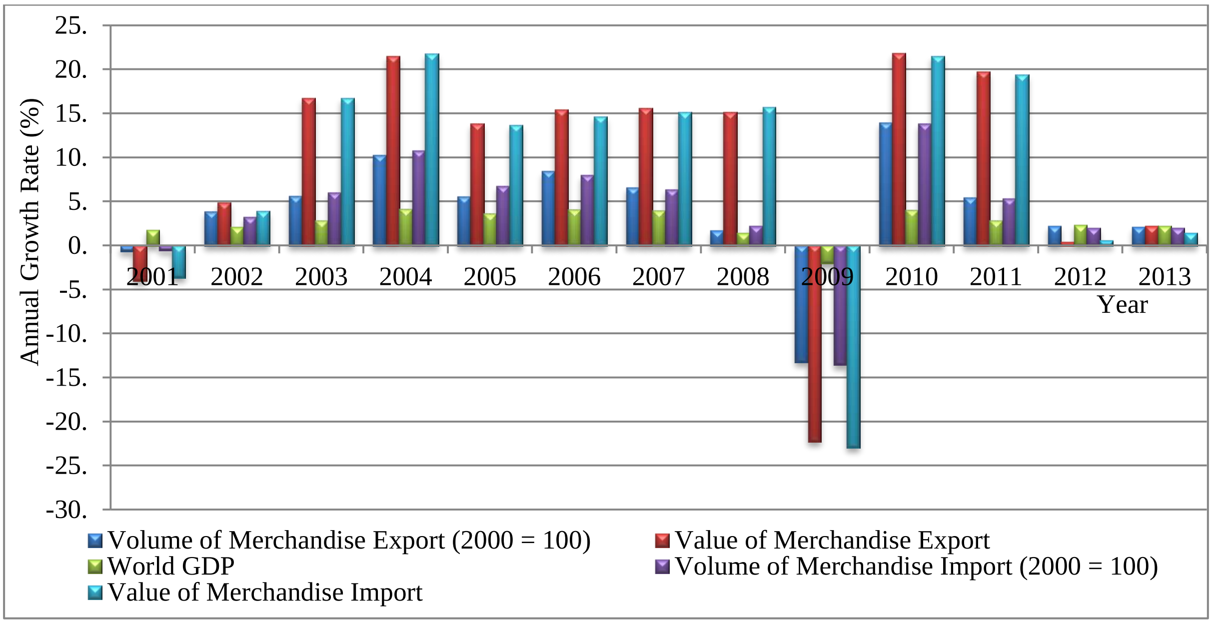
The slump in trade during the crisis period was attributed to weak global economic growth, especially the weak demand for imports in advanced economies (United Nations, 2013). For instance, in 2008, demand for imports in advanced economies declined to -1.1% from an annual average of 3.8% between 2001 and 2007. Moreover, in 2009 there was a marked fall in global aggregate demand to -13.6%, compounded by strain in the global financial market that led to an increase in the cost of capital and a shortage of credit, which affected trading activities during the crisis period.

Notably, the decline in import demand from advanced economies following the crisis marked an end to their dominance in international trade. Over the period 1995 to 2010, their share in world merchandise trade gradually declined from 69% to 55%, while that of developing countries increased from 29% to 41%. Moreover, the developing countries' import growth contributes to approximately half of world import demand growth relative to 43% before the crisis (United Nations, 2012). Also, the direction of goods flow has changed. In 1990, 54% of all good traded was between advanced economies but by 2012 this trade had declined to just 28% (MGI, 2014). This suggests the increasing participation of developing economies in the global economic activities as well as their integration into the global value chain.

Nevertheless, global trade flows rebounded strongly in 2010 as the volume of imports and exports expanded by approximately 14% following their collapse during the crisis. Across regions, the speed of the recovery was not even. The developing and emerging economies led the recovery, in line with the strong expansion of their economies. The volume of exports for these groups surpassed their pre-crisis peak of 2004, as they recorded an export growth of approximately 16.0%. At the same time, the volume of exports rose to 12.9% in advanced economies and 11.4% for economies in transition over the same period. The differences in trade volume between the developing, emerging and advanced economies was even greater on the import side, where the advanced economies' imports rose by 10.8%, compared with 18.8% and 23.9% in developing countries and economies in transition respectively.

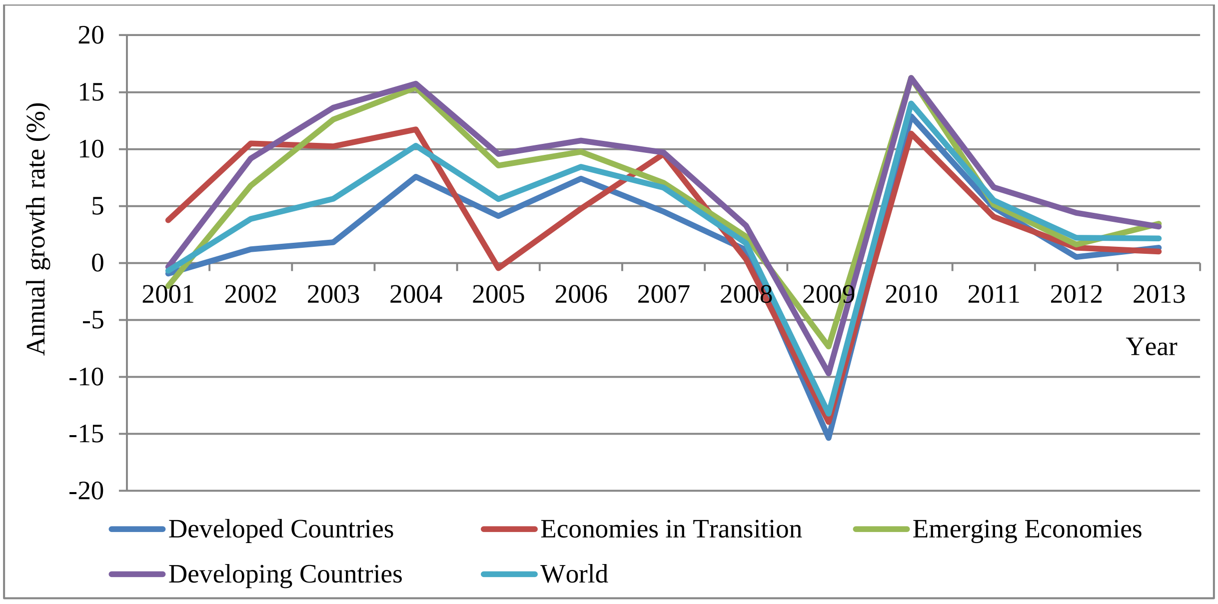
However, the robust recovery of world trade in the aftermath of the global financial crisis quickly lost momentum. The volume of world merchandise trade moderated sharply from 14% in 2010 to 5.5% in 2011 and, to a further 2.2% in 2012. At the same time, growth across all regions diminished by more than half of that of 2010. There was also a further decline in import demand across all regions in 2012, except Africa where it increased from 4.1% in 2011 to 8.9% by the end of 2012. Although trade flows remained positive in most regions after 2010, the contagious effect of downward demand spreading from Europe and other advanced economies significantly impacted on trade flows. In particular, the declining import demand in the euro-area as a result of fiscal austerity measures combined with the debt crisis caused aggregate demand to drop (United Nations, 2013).

Figure 3. 3: Growth in volume of world merchandise trade and GDP, 2001 – 2013



Data source: UNCTAD Statistical Database

Figure 3. 4: The volume of merchandise exports by region (2000 = 100)



Data source: UNCTAD Statistical Database

b. Global flow of services – import and export of services

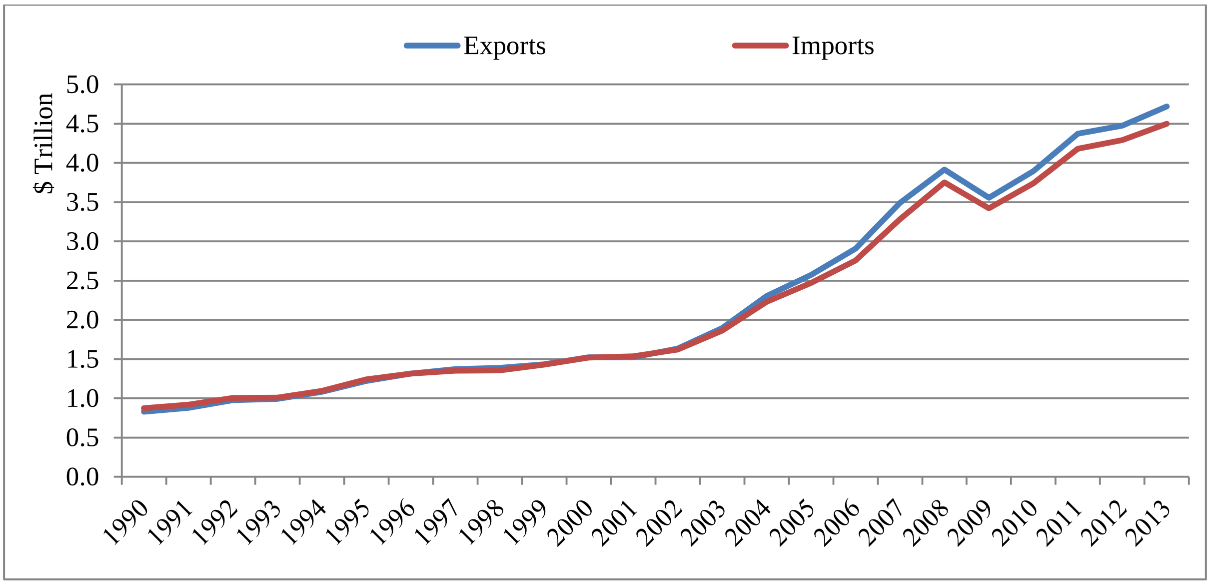
The share of services in the global flows is still low relative to cross-border flow of goods and finance, despite the shift of global trade towards more services. Annual trade in services accounted for approximately 15.5% of the total flows or just 5.4% of world GDP, from 1994 to 2013. As a result, services are the smallest component of the global flow.

Nevertheless, there has been a growing demand for cross-border services since 2000 compared to decades before. From the export side, global flow of services increased from $1.5 trillion in 2000 to $4.7 trillion in 2013, reflecting an average annual growth of 9.1%. Similarly, imports of services increased from $1.5 trillion in 2000 to $4.5 trillion by the end of 2013, reflecting an average annual growth of 8.7%. From 2005 to 2007, global exports of services increased from 11.8% to 20.0%. However, global export of services decelerated during the crisis period. In 2008, exports of services rose by just 12.2% compared with 20.0% growth between 2006 and 2007. By 2009, trade in services stood at $3.6 trillion, or $360 billion below their 2008 value. This corresponds to a growth of -9.6% over this period (see Figure 3.5). Global trade in services rebounded quickly in 2010 to $3.9 trillion or a growth of 9.6% from its 2009 value.

Across regions, global trade in services was vigorous in the period leading up to the crisis. However, the financial crisis triggered a sharp retreat in cross-border flow of services across all regions. By 2009, global export of services recorded a negative growth in all regions, for instance, advanced economies -8.5%, developing economies -10.5%, economies in transition -15.6% and emerging economies -16.2%. Another obvious effect of the crisis was the declining share of advanced economies in the global service exports. Their share as a percentage of global service export fell from 75.5% in 2000 to approximately 71.0% between 2008 and 2009. It further declined to 69.2% in 2010. For developing economies, their share rose from 23.1% in 2000 to approximately 26.5 % between 2008 and 2009. Similarly, on the import side, the share of advanced economies decreased, while that of the developing countries increased over the period. However, all regions returned to positive growth by the end of 2010 after a year of steep fall, as illustrated in Figure 3.6.

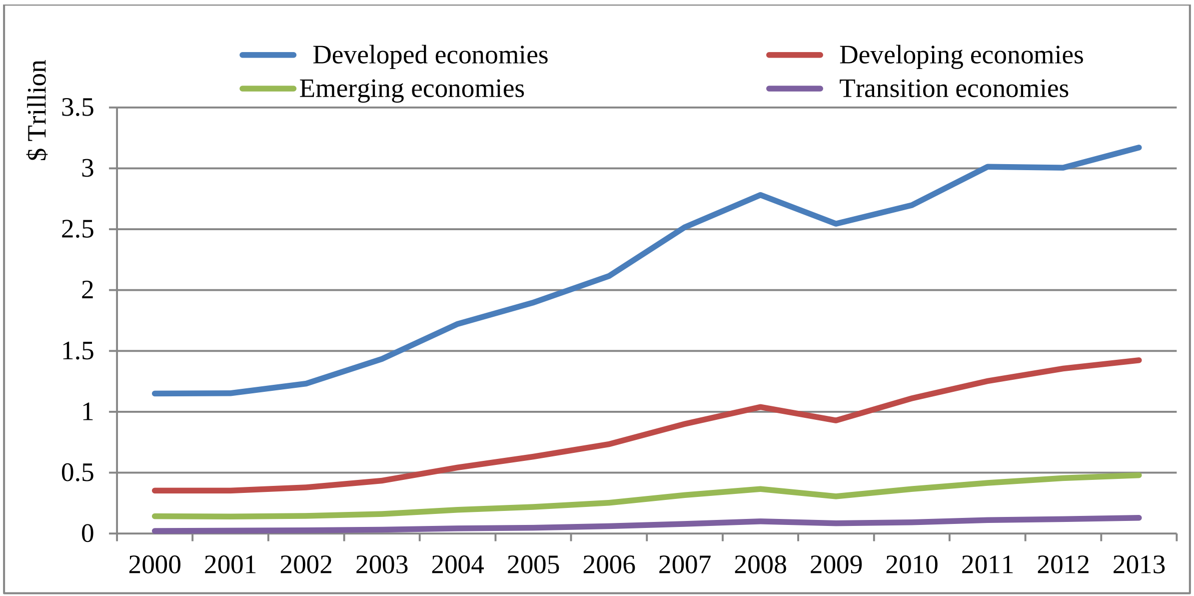
Overall, trade in goods and services have been part and parcel of global economic activities for centuries, linking together different countries and their economies. In addition, the traditional trade routes are expanding and many regions are forging new trade routes. Although the combined trade in goods and services is still the dominant component of global flows, the financial flows are rapidly closing the gap, particularly in the run-up to the financial crisis. In the next section, this study discusses different financial channels with a view to understanding the extent of global financial integration, as well as the impact of the crisis on the global financial system.

Figure 3. 5: Global import and export of services, 1980 – 2013



Data source: UNCTAD Statistical Database

Figure 3. 6: Global export of service by region, 2000 – 2013



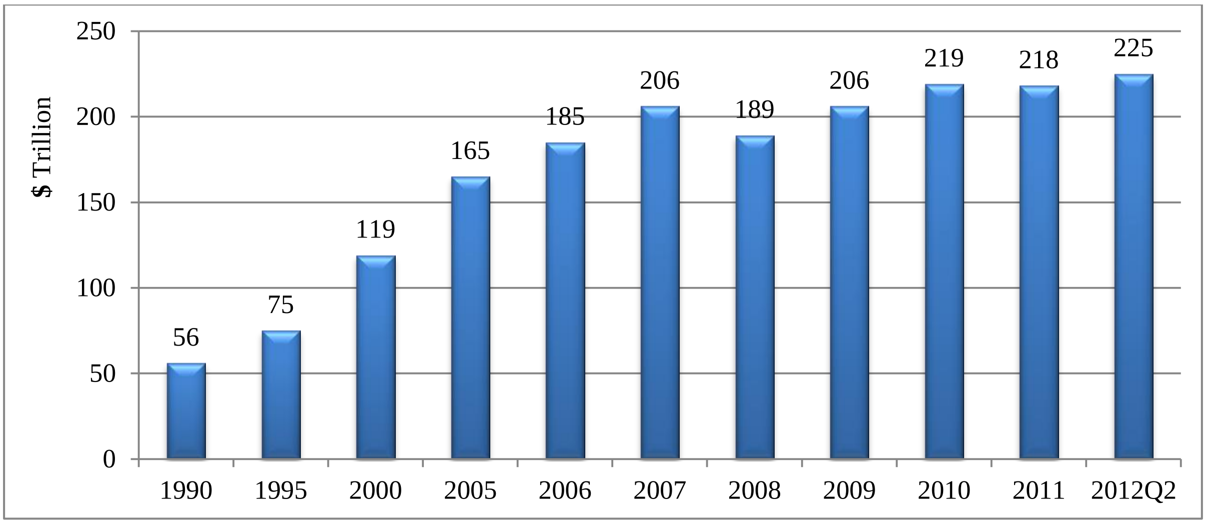
Data source: UNCTAD Statistical Database

3.3.2 Financial channels - global cross-border capital flows

The process of global financial integration has manifested in the form of steadily rising cross-border financial flows and the growing accumulation of large financial assets and liabilities. Taken together, these are an aggregate measure of activities in the global financial sector and also a measure of activities of the global investors, banking and nonbanking financial institutions, and firms setting up new operations abroad. At the same time, they reflect the size of transaction in financial assets as well as the degree of financial linkage across different markets.

The expansion in the global financial environment has been one of the main driving forces behind economic growth since 1990 (MGI, 2013). For instance, from 1990 to 2007, the value of global financial assets[8] – including the value of equity market capitalisation, corporate and government bonds, and loans – rose to approximately $206 trillion in 2007, from around $56 trillion in 1990 (see Figure 3.7). This indicates an annualised growth of 8.0% over this period. Globally, equities and private debts account for most of the increase in financial assets, since 1990 (MGI, 2013).

Figure 3. 7: The value of global financial assets at constant 2011 exchange rates



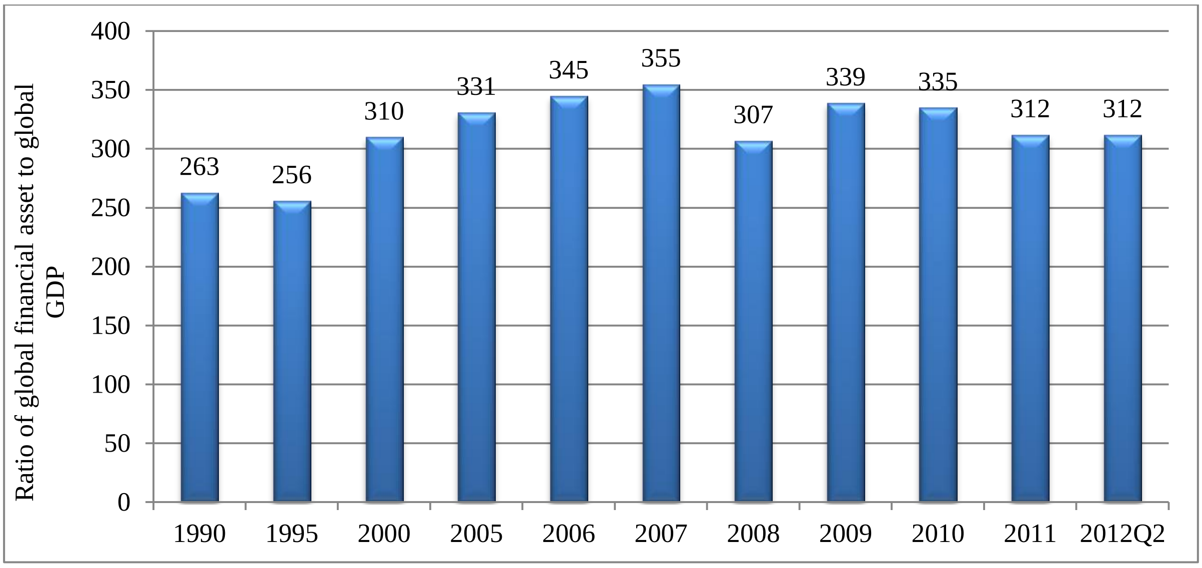
Data source: MGI 2013

One notable feature of the global financial system over this period was the rapid growth of the global financial assets relative to the underlying economy, a process known as financial deepening. Over this period, the depth of the global financial market increased significantly more than the global GDP (see Figure 3.8). The depth of the global financial market as measured by the ratio of global financial assets to world's GDP rose to 355 % in 2007 from 263 % in 1990 (MGI, 2013). These developments in the financial market indicate the extent to which corporations, households and governments can fund their activities through financial markets and other financial intermediaries. This development is attributed to numerous interrelated trends, including advancement in information technology, financial market

[8] Global financial assets is defined by McKinsey Global Institute as the market capitalisation of equities, outstanding values of government and corporate bonds and other debt securities, securitised assets, and loans.

liberalisation, and innovation in financial products and services, as a result of financial globalisation (OECD, 2011).

Figure 3. 8: The depth of the global financial market



Data source: MGI, 2013

Accompanying the growth in global financial assets are the growing cross-border capital flows, including foreign direct investment, portfolio investment (purchases and sales of equities and debt securities), and other investment (cross-border lending and deposits). Investment in these assets had grown considerably before the financial crisis. These flows are important in that they reflect the degree of integration in the global financial system. In addition, capital flows are important indicators that closely reflect the behaviour of global investors as investors at home and abroad seek to diversify their risks and take advantage of high returns across different markets.

However, one of the key elements to have spurred growing cross-border capital flow over the last three decades has been the reduction in restrictions (financial liberalisation) that impede cross-border capital flows. As a result, cross-border flow of capital is expected to grow. Moreover, economic theory suggests that financial liberalisation should lead to greater capital flows, and consequently to diversification of risks and improved access to finance for investments. At the same time, capital flow represents one of the fundamental channels through which shocks are transmitted across borders.

As a result, some studies suggest that greater capital flows can complicate macroeconomic management, because of faster international transmission of shocks and the increased risks of overheating (OECD, 2011). In line with this view, Alberola, Erce and Serana (2012) argue that large financial flows can lead to exchange rate misalignments and contribute to higher risk of credit and asset price booms and busts, which could potentially lead to financial crises and sudden stops. The authors further argue that the rapidly growing global capital flows not only signify investment but a potentially destabilising force. Therefore, reflecting on how these flows evolved during the recent financial crisis is very important, since they signal a vital transmission channel of crisis.

Before the crisis, the global cross-border capital flows increased faster than other components of the global flows. On the outflows (assets) side, cross-border capital grew from approximately $815 billion in 1994 to a peak of $11 trillion in 2007 (or an average of 22.2% annually). Relative to other components of global flow, the share of global cross-border capital flows rose from 13.1% to 38.7% (or an average of 22.3% annually) over this period. On the inflow (liabilities) side, capital flow rose from approximately $1.0 trillion to $12.1 trillion over the period, reflecting an average annual growth of 21.0%. Figures 3.9 and 3.10 document long-term expansion in global cross-border capital outflows and inflows respectively, disaggregated by destination into advanced and developing economies.

There are a number of stylised facts which are notable in these figures. First is the rapid expansion in the global capital flows from 1994 to their peak in 2007. Over this period, capital inflows and outflows of advanced economies expanded far more rapidly than capital flows in and out of developing economies. The second pattern that is clearly visible is the dramatic collapse in cross-border capital inflows and outflows following the global financial crisis 2008 – 2009. At the peak in 2007, the relative share of total capital inflows and outflows to global GDP amounted to 24.1% and 22.0% respectively. However, total capital inflows dropped to approximately $2.3 trillion in 2008 and $1.8 trillion in 2009, corresponding to 4.1% of the global GDP. Outflows dropped to $1.2 trillion and $1.0 trillion or 2.2% of global GDP. This decline was due to a steep and simultaneous fall in all the three main components of cross-border private financial flows (namely FDI, portfolio investment, and other investment) during the crisis. However, the sharp correction in cross-border portfolio investment and other investment flows was the largest contributor to the contraction in capital flows.

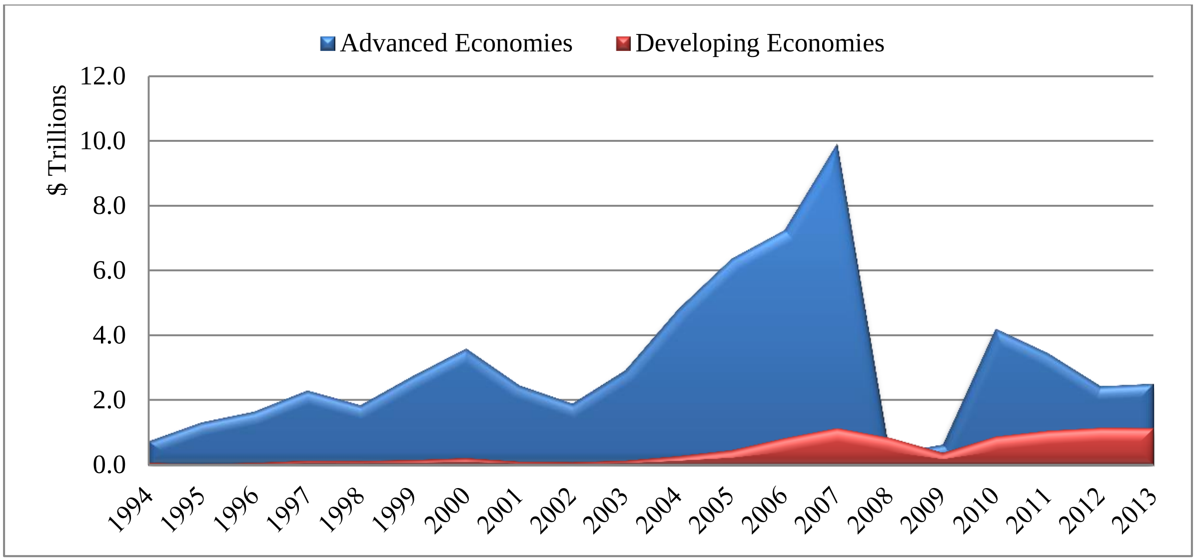
Also, the steep drop in the global capital flows over this period has been attributed to several factors. The demand for foreign investment by banks, companies, and investors fell due to an increase in global risk aversion triggered by the impact of the U.S. sub-prime mortgage crisis on the balance sheets of banks across the globe, especially in the U.S. and Europe. Also, the bankruptcy of Lehman Brothers in September 2008 exacerbated the crisis and necessitated a broader decline in global capital flows (OECD, 2011). With the collapse of major financial institutions in the advanced countries, global interbank markets deteriorated significantly and resulted in tightened credit conditions and severe funding pressures on developing countries. This increased the complexity and rapidity of international transmission of financial shocks and vulnerabilities associated with increased international financial flows.

Another important trend is that, historically, capital flows have been driven mainly by flows between advanced economies. However, developing economies have begun to emerge as both the origin and destination of capital flows. In particular, the combined share of developing economies' capital flows is significantly greater than it was a decade ago. For instance, the combined share in total global capital inflows of developing economies increased from an annual average of 8.4% between 2000 and 2007 to an annual average of 44.0% between 2008 and 2009. On the outflow side, their share increased from 6.7% to 53.8% annually over the period (see Figure 3.11). This suggests that capital flows to and from developing economies was much less affected by the crisis than flows in and out of advanced economies, especially during the severe phase of the crisis. In addition, the growing capital inflows and outflows of developing economies reflect a reduction in capital flow restrictions and their improved attractiveness to foreign investors. This is essentially due to broad improvement in macroeconomic policy framework, good governance and transparency.

The global capital flows regained their upward momentum in 2010 following a recovery in portfolio investment and other investments. However, the recovery was short-lived in 2011 as as result of the crisis in the Eurozone. The decline in capital flows was much sharper for portfolio investments compared to other components. Although capital flows are now above the level witnessed during the crisis, they are still well below their pre-crisis level.

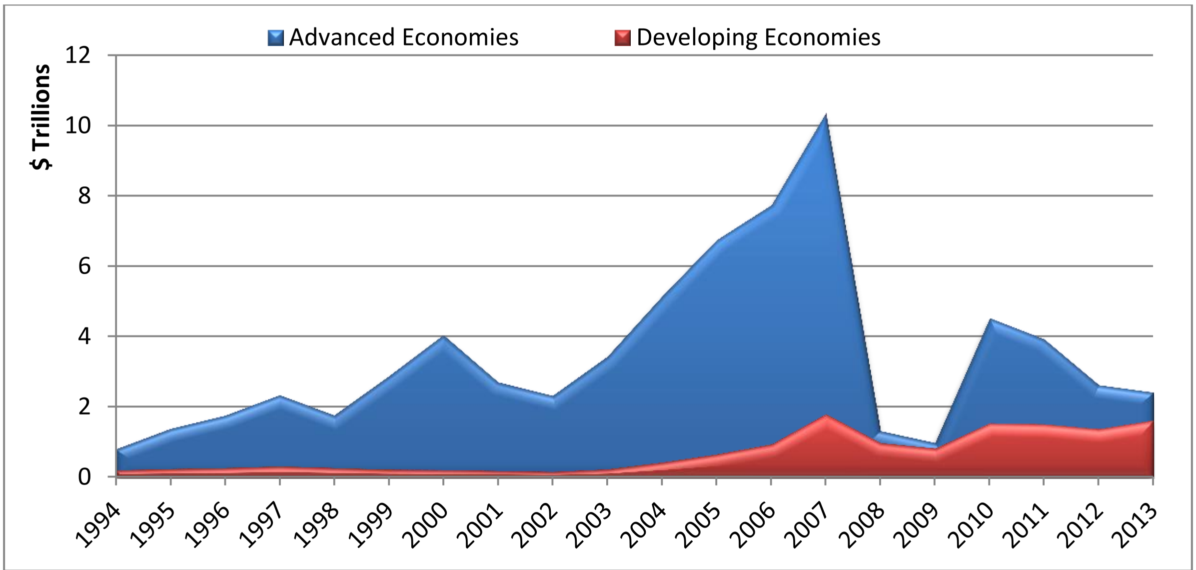
In sum, the global economy has experienced growing financial integration, with a large increase in the volume of cross-border capital flows in both advanced and developing economies. This process of integration has been far from smooth. As noted above, one of the important stylised facts of the global financial crisis was a steep fall in the cross-border capital flows. The decline following the crisis was far from homogeneous across individual components of capital flows. Consequently, the analyses of the effects of the crisis based on aggregate (gross) capital flows mask some vital impacts of the crisis on the individual components of capital flows and risks of contagion across regions. To this end, the consideration of individual components of capital flows, their evolution and direction over the period are important to understand cross-border financial linkages as well as the impact of the financial crisis and the transmission channels. Also, the analyses of individual components are designed to elicit different economic motivations and patterns of behaviour during the recent financial crisis. Therefore, the section below will seek to analyse the behaviour of individual components before and during the crisis.

Figure 3. 9: Global capital outflows in advanced and developing economies, 1994 – 2013



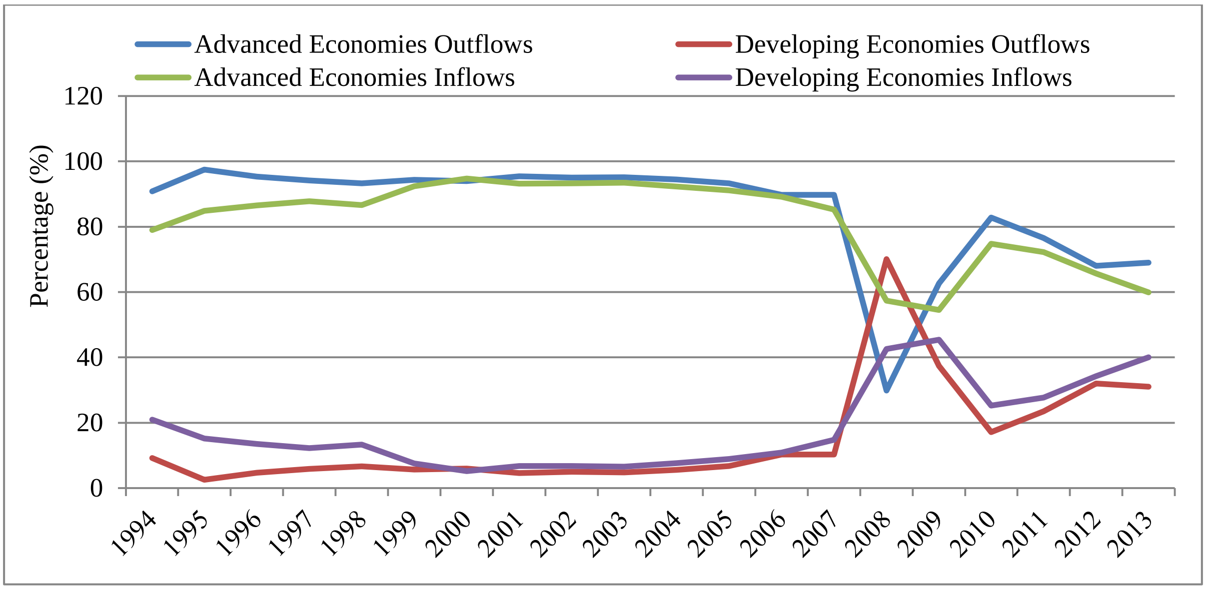
Source: Author’s calculations based on the IMF BOP Statistical Database

Figure 3. 10: Global capital inflows in advanced and developing economies, 1994 – 2013



Source: Author’s calculations based on the IMF BOP Statistical Database

Figure 3. 11: Advanced and developing economies' share in capital flows, 1994 – 2013



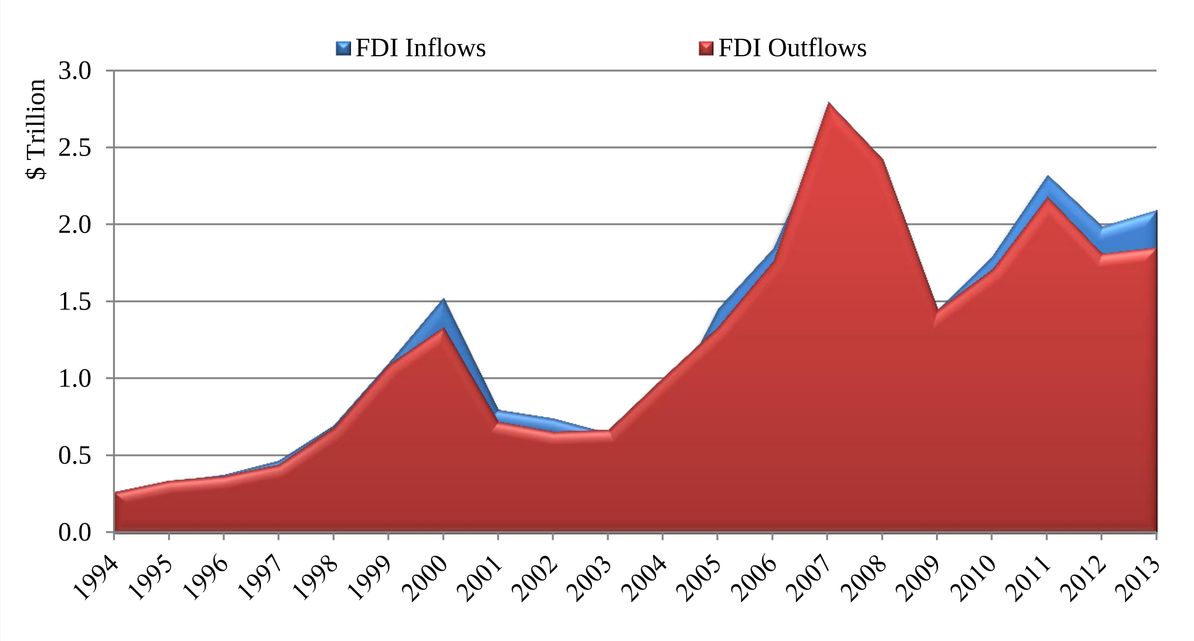
Source: Author's calculations based on the IMF BOP Statistical Database

a. Foreign direct investment (FDI)

Direct investment, commonly known as foreign direct investment (FDI) is a category of cross-border investment associated with a resident in one country having control or a significant amount of influence on the management of an enterprise in another country, as well as the equity that gives rise to control or influence in a foreign enterprise (IMF, 2009). After declining for three consecutive years from 2000 to 2003, the level of FDI has been particularly high since 2004 – buoyed by strong economic growth and improvement in the investment environment in a number of countries (see Figure 3.12). Global FDI inflow and outflow over this period reached a record level of approximately $2.6 trillion and $2.8 trillion respectively in 2007, reflecting an average annual growth of 42.0% between 2003 and 2007.

However, in 2008 and 2009, global FDI inflows and outflows declined significantly following a period of uninterrupted growth from 2003 to 2007, indicating the dampening effect of the global financial crisis. After a 14.3% decline in 2008, global FDI inflows fell by a further 45.3% to $1.4 trillion in 2009 relative to their peak in 2007, while, outflows fell by 48.2% to $1.5 trillion in 2009. This global decline was a reflection of the weak economic performance in many parts of the globe.

Figure 3. 12: Global FDI inflows and outflows, 1994 – 2013

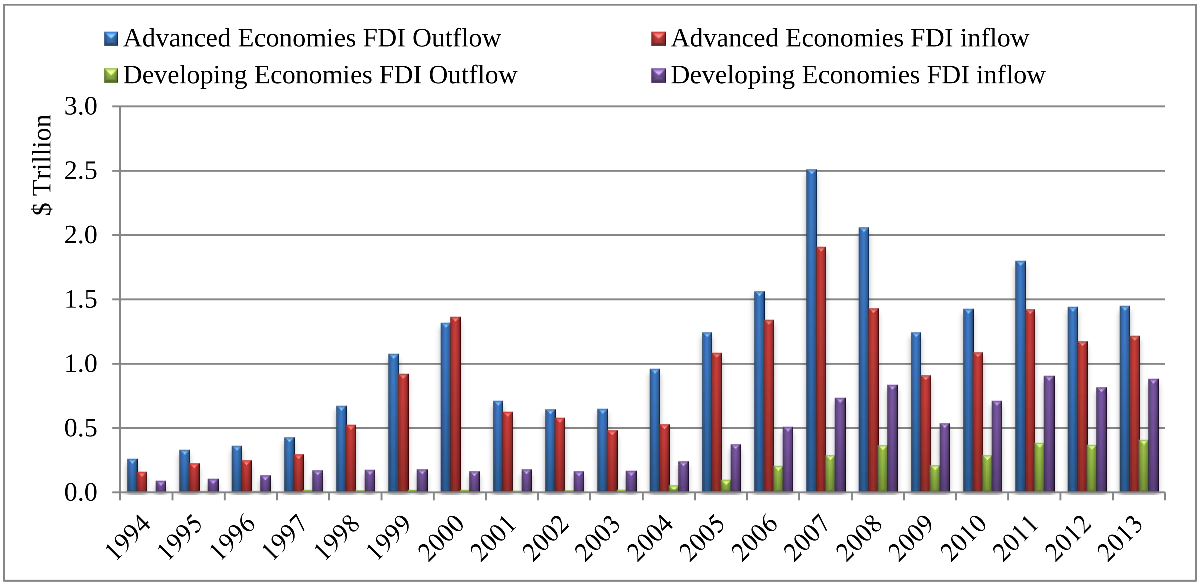


Source: Author's calculations based on the IMF BOP Statistical Database

The global economic slowdown and intensifying financial crisis had different impacts on FDI flows across different regions. Figure 3.13 shows the historical trend in FDI inflows and outflows, disaggregated by origin and destination for advanced and developing economies. FDI inflow started declining first in the advanced economies. For instance, FDI inflow to advanced economies plunged in 2008 with inflows declining by $477 billion (or 25.0%) relative to the peak of $1.9 trillion in 2007. There was a further decline in 2009 with total FDI inflow of $910 billion (or 52.3% decrease relative to 2007 value), as the crisis entered a tumultuous phase after the collapse of Lehman Brothers in September 2008. On the outflow side, it declined by $454 billion (18.1%) and $1.3 trillion (50.5%) respectively for 2008 and 2009 relative to its 2007 value.

However, developing economies were on a different growth path, as these countries continued to experience increasing FDI inflows in 2008, despite the financial crisis. FDI inflows into these economies increased from $737 billion in 2007 to $835 billion in 2008, while FDI outflow increased from $289 billion to $366 billion over the same period. The geographical difference ended in 2009, as data points to a general slump across all regions. FDI flows into developing economies declined. However, the decline in FDI inflows to these economies began almost one year after the start of the crisis. This reflects a time lag associated with the initial economic downturn and the consequent slump in import demand in advanced economies (UNCTAD, 2009). The crisis also affected FDI flows through reduced access to finance, following tightened credit conditions as well as heightened risk aversion on the part of global investors.

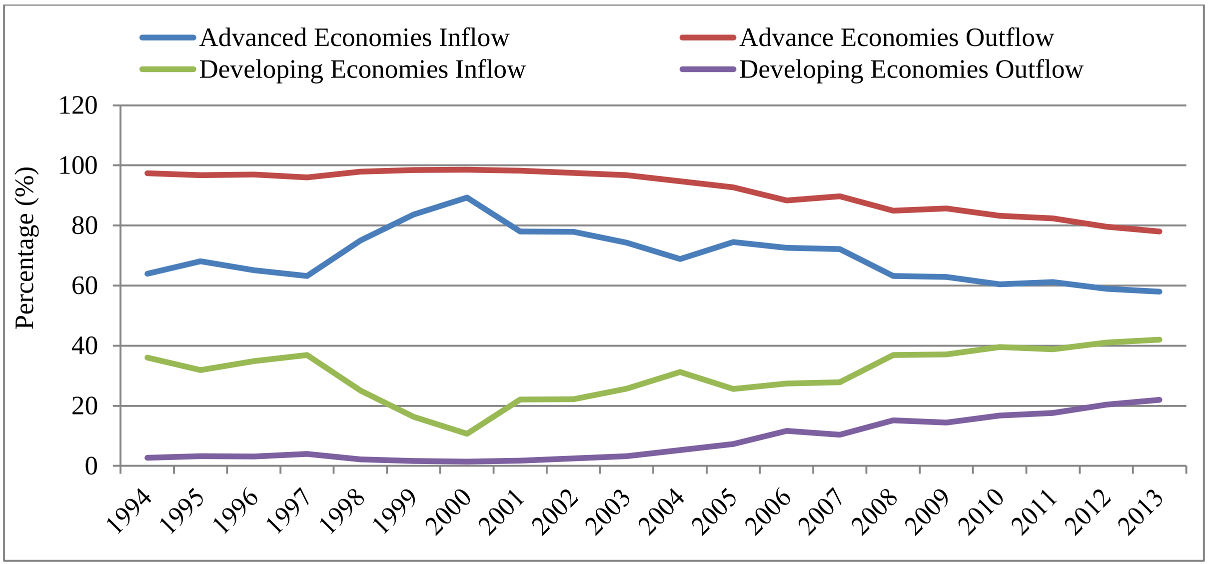
Figure 3. 13: FDI inflows and outflows in advanced and developing economies, 1994 – 2013



Source: Author's calculations based on the IMF BOP Statistical Database

One noticeable trend in global FDI flows since 2004 is the gradual change in the pattern of overall FDI flows. While advanced economies still account for a large proportion of FDI inflows and outflows, developing economies are gradually closing the gap. Figure 3.14 illustrates the relative share of advanced and developing economies in the total global FDI inflows and outflows. For instance, the share of advanced economies in the global FDI inflows accounted for an average of 73.8%, from 1994 to 2003, while their outflows accounted for an average of 97.4% over the same period. Developing economies' inflows and outflows on the other hand, accounted for just 26.2% and 2.7% respectively over this period. However, since 2004, this trend has changed significantly. Developing economies now account for 33.9% of FDI inflows and 13.2% of FDI outflows. This illustrates the increasing importance of these economies in the global economic sphere as well as their growing financial integration with the developed economies.

Figure 3. 14: Relative share in total global FDI inflows, 1994 – 2013



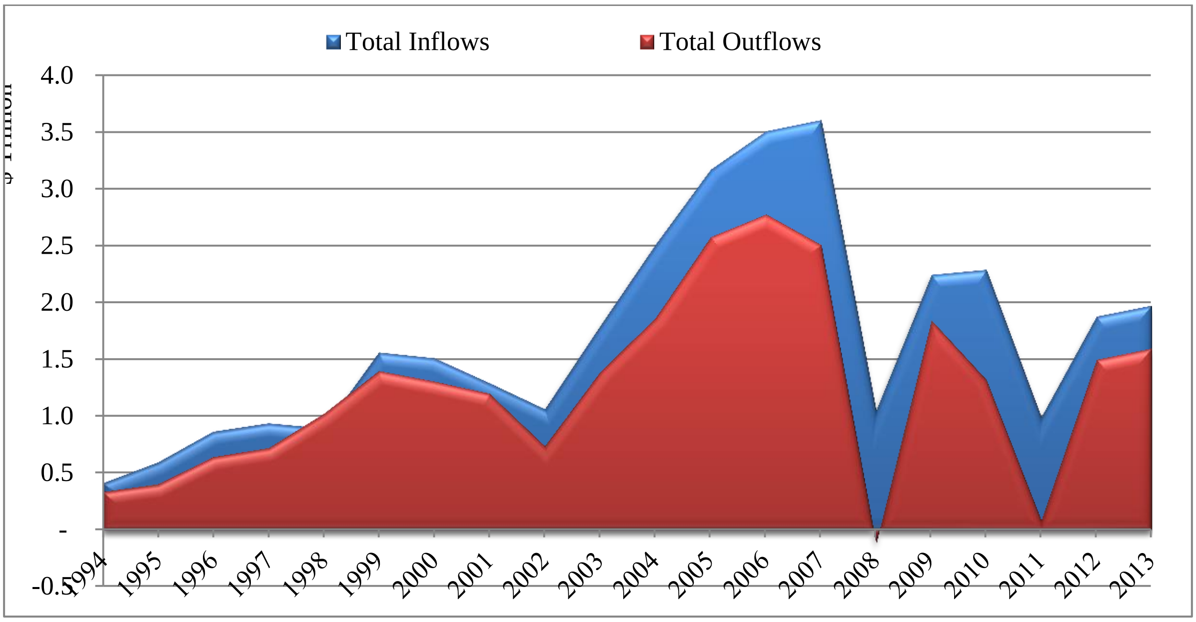
Source: Author's calculations based on the IMF BOP Statistical Database

b. Portfolio investment flows

Portfolio investment comprises cross-border transactions and positions in debt or equity securities. Its coverage is not restricted to securities traded on organised financial markets but also includes those that occur in less public and lightly regulated markets. Unlike FDI, which is associated with a lasting relationship through acquisition of ownership or controlling stakes in a foreign enterprise, portfolio investment typically plays a lesser role in the decision making of the enterprise (IMF, 2009). Hence, portfolio investment is distinctive because of the arms-length relationship that exists between the issuers and the holders, and the high level of trading liquidity in the instruments. Another important element of portfolio investment is that it offers a direct way to access financial markets by providing liquidity and flexibility to investors and other participants, as well as opportunity for sharing of risks across markets. It involves financial markets and their specialised services through which financial assets and risk are traded. Consequently, it reflects the degree of integration in the global equity and debt markets. Therefore, the behaviour of portfolio investment is an important indicator of market sentiment with implications for future flows and stock price volatility.

Cross-border portfolio investment was one of the fastest growing components of global capital flow before the financial crisis. It contributed to an annual average of 37.8% of the total global cross-border capital flows over the period of 1994 – 2007. This must be seen against the backdrop of increasing financial market liberalisation which permits global investors to pursue higher returns as well as diversify their risks across markets and asset classes. Accordingly, portfolio investment inflows rose to $3.61 trillion in 2007 from approximately $415 billion in 1994, corresponding to an average annual growth rate of 18.1%, on the one hand. On the other hand, outflows rose to $2.51 trillion from just $336 billion (an annual growth of 16.7%) over the same period. From 2002 to the peak in 2007, there was a steep rise in portfolio flows as both inflows and outflows grew at an average annual rate of approximately 27.7% (see Figure 3.15).

Figure 3. 15: Global portfolio inflows and outflows, 1994 – 2013



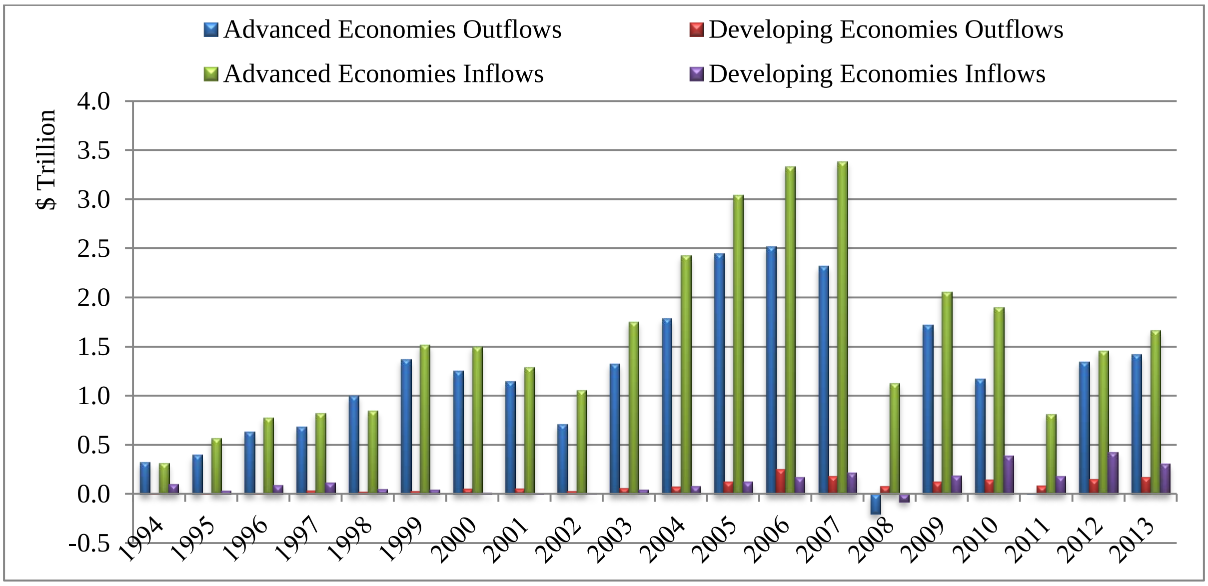
Source: Author's calculations based on the IMF BOP Statistical Database

However, the global financial crisis left a huge dent in the global cross-border portfolio flows. As illustrated in Figure 3.15, especially in 2008 the cross-border portfolio outflows fell to approximately -$122 billion, while inflow fell to $1.1 trillion. Notably, the retrenchment (negative value) in portfolio outflows suggests evidence of disinvestment. In other words, on a net basis, global investors liquidated their foreign positions and repatriated their funds. This trend, which is popularly known as financial sector deleveraging, was induced by low risk appetite during the crisis and was one of the main reasons for the slump in cross-border portfolio flows.

In addition, the decline in portfolio flows during the financial crisis was mainly on account of the widespread collapse in cross-border investment in equities. For instance, cross-border portfolio investments in equities plunged to negative, with inflows of -$195 billion and outflows of -$225 billion in 2008. The decline in portfolio equities appears to be consistent with the global equity market performance. The total value of equities outstanding (the world's stock market capitalisation) declined by $28 trillion (or 43.8%) to $36 trillion in 2008 relative to $64 trillion witnessed in 2007. Similarly, portfolio investments in debt securities declined sharply to $1.3 trillion in 2008 from $2.7 trillion in 2007 for inflows, while outflows declined from $1.6 trillion to $137 billion over the same period. The trend in portfolio flows during the crisis was in line with general expected behaviour. Generally, debt securities, unlike equities, are historically considered to be safer investments, in particular government bonds. Hence, in a period of higher uncertainty, investors sought safer investments like government bonds. This may partly explain why portfolio flows into debt securities managed to remain positive during the severe phase of the crisis.

Furthermore, there are a number of differences in the geographical pattern of portfolio investment flows. Figure 3.16 highlights some geographical differences by depicting portfolio inflows and outflows across advanced and developing economies. Basically, portfolio investment flows were dominated by inflows and outflows between advanced economies. For instance, advanced economies contributed an annual average of approximately 92.2% and 93.4% to total global portfolio inflows and outflows respectively, over the period 1990 – 2013, while developing economies accounted for an annual average of approximately 7.2% of total portfolio flows.

Figure 3. 16: Geographical pattern of portfolio inflows and outflows, 1994 – 2013



Source: Author's calculations based on the IMF BOP Statistical Database

After the collapse in 2008, the cross-border portfolio flow steadily recovered and the annual inflows and outflows reached $2.2 trillion and $1.8 trillion, respectively in 2009. However, these values are still 37.7% and 26.5% (respectively for inflows and outflows) below the peak reached in 2007 before the crisis. By the end of 2011, portfolio flows declined again following the crisis in the Eurozone. Consequently, portfolio flows remained relatively subdued up to the end of 2013.

c. Other investments (bank flows)

The term 'other investments' encompass a number of cross-border financial transactions, including loans, deposits and other accounts receivable/payable (trade credit). The cross-border loans and deposits are the dominant components of this category of capital flows[9]. However, they are major channels through which banks and other financial institutions invest in other countries. They also provide a means through which firms can fund their liquidity needs through global markets rather than just the national ones. Taken together, the total cross-border investment in this category of capital flows represents an aggregate measure of integration in global banking financial intermediaries, as well as a channel through which a crisis can be transmitted across markets.

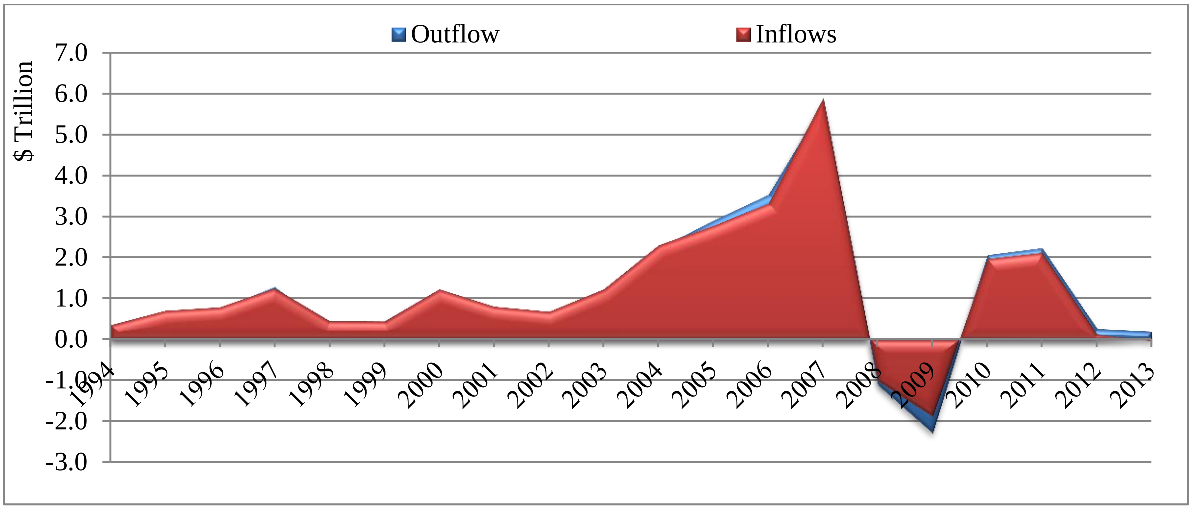
Between 1994 and 2007, before the outbreak of the global financial crisis, global cross-border bank inflows and outflows grew significantly. Specifically, from 2003 to the peak in 2007, cross-border bank inflows grew fivefold, from approximately $1.2 trillion to $5.9 trillion – corresponding to an average annual growth of 47.9%. On the outflow side, cross-border bank flows grew from $1.0 trillion to $5.8 trillion and this corresponds to an average annual growth of 54.1%. The share of bank flows relative to other components of cross-border capital flows rose from 33.5% to 48.5% on the inflow side or 33.1% to 52.0% on the outflow side over the same period. Figure 3.17 illustrates the behaviour of bank flows between 1994 and 2013. As the figure shows, the total volume of bank flows rose sharply in the run-up to the crisis (between 2003 and 2007).

However, the financial crisis triggered a sharp retreat in cross-border bank flows. Bank flows experienced an extended period of deleveraging and retrenchment, as inflows and outflows plummeted in 2008 and 2009. Bank inflows fell markedly from $5.9 trillion to -$1.0 and -$1.9 trillion while outflows fell from $5.8 trillion to -$1.1 and -$2.3 trillion respectively for

[9] Due to the dominance of bank loans and deposits in this category of capital flows, the term "bank flows" is used to describe this component.

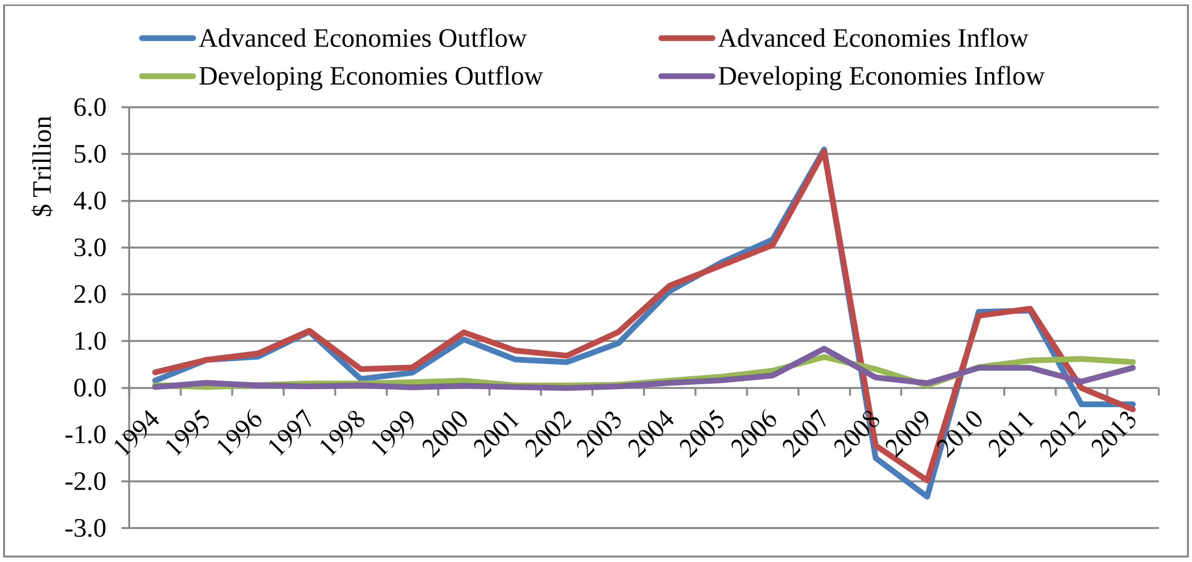
2008 and 2009. Most of the decline in cross-border banking flow was between advanced economies, especially within Europe. As shown in Figure 3.18, bank flows in and out of advanced economies fell from around \$5.1 trillion to -\$1.5 trillion in 2008 and by a further -\$2.3 trillion in 2009. Cross-border banking flows to and from developing economies held up better, but still fell by more than \$613 billion in 2008 and \$738 billion in 2009 – from their 2007 value (i.e. on the inflow side). This decline corresponds to 73.3% and 88.3% respectively. Outflow fell by more than \$265 billion (or 40.0%) in 2008 and \$614 billion (or 92.6%) in 2009 relative to the 2007 value.

Figure 3. 17: Bank inflows and outflows, 1994 – 2013



Source: Author's calculations based on the IMF BOP Statistical Database

Figure 3. 18: Geographical pattern of bank inflows and outflows, 1994 – 2013



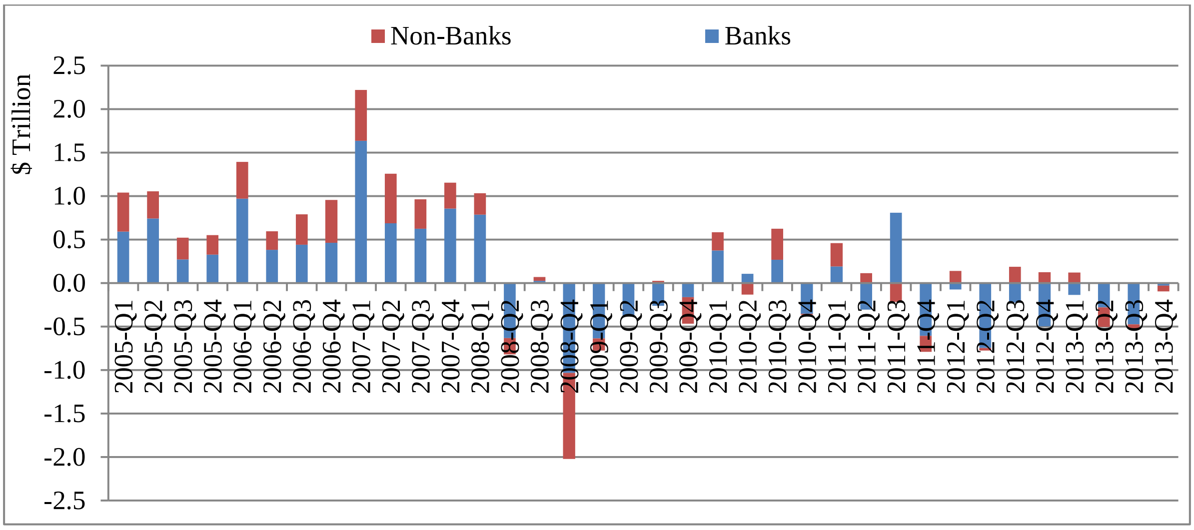
Source: Author's calculations based on the IMF BOP Statistical Database

Moreover, aggregate data on outstanding cross-border claims of the banks, as reported by the Bank for International Settlement (BIS)[10] revealed severe market strains following the crisis in 2008 – 2009. As presented in Figure 3.19[11] below, cross-border claims recorded six consecutive quarters of negative growth from the second quarter of 2008 to the last quarter of 2009. For instance, cross-border bank lending fell from $1.1 trillion at the end of 2007 to minus $2.0 trillion at the end of 2008. The overall decline during this period was driven by a collapse in the interbank credit market. About 51.2% of this decline, or $1.0 trillion, was due to the drying up of interbank lending after the collapse of Lehman Brothers in September 2008. On the other hand, loans to non-banks accounted for 48.8% or $986 billion over this period.

The negative inflow and outflow during the crisis suggests that on a net basis, banks pulled their capital back to their home markets – a clear case of deleveraging. The deleveraging process involved a significant restructuring of bank balance sheets, which led to a reduction in cross-border lending as banks withdrew more cross-border loans – cancelling or not renewing some lines of credit, not rolling over loans, and so on. This was mainly on account of liquidity shortages relating to the breakdown of the interbank markets, triggered by heightened uncertainty and asymmetric information between the lenders and borrowers which led to an increase in risk aversion (Milesi-Ferretti, & Cedric, 2010 and ECB, 2012). As a result of the liquidity shortage in the global banking sector, banks sold more than $722 billion in assets and operations from the start of the financial crisis in 2007, of which foreign operations accounted for almost half of this total. In addition, European banks accounted for more than half of these asset sales (MGI, 2013). Deleveraging in the banking sector and the cutback in global lending activities gave rise to a less competitive credit market and increased the cost of borrowing. This indicates a high degree of risk aversion – one that chokes off the financing needed for investment in business expansion. In particular, the crisis highlighted a banking system that had failed in its primary function of providing a healthy flow of credit to the real economy.

[10] Bank for International settlement (BIS) compiles detailed data on international banking activities. The locational data cover the assets and liabilities of banks in different countries using a residency concept of balance of payments.
[11] All reported outstanding cross-border claims have been adjusted for exchange fluctuation and breaks in the series. These data are not same as the actual flow data because of fluctuations in the exchange rate of non-dollar claims, but they provide a better approximation for actual flow data.

Figure 3. 19: Cross-border claims by counterparty sector, 2005Q1-2013Q4



Data source: BIS locational banking statistics by residence

By 2010, global credit markets had recovered somewhat but were still not unimpaired. The recovery in 2010 was in part explained by unprecedented policy actions undertaken by central banks and governments worldwide. The stabilising effects of fiscal and monetary policy stimulus measures helped improve banks' financial condition and reduced funding pressures. Bank lending and interbank market activities resumed, albeit with massive support from the public sector. However, overall bank lending conditions remain tight, as deleveraging pressures persist due to the banking crisis in the Eurozone. Expansion in bank credits to both banks and other sectors still remains below levels witnessed before the crisis given the mounting number of non-performing loans.

Overall, the analysis of global cross-border capital flows shows a steadily growing share in the global trading of financial assets and liabilities. Specifically, capital flows surged from late 2002 up to 2007 across all components and the surge was mainly driven by bank flows, followed by portfolio investment. Subsequently, in 2008 – 2009, this trend reversed significantly following a broad collapse in capital flows due to the global financial crisis. Individual components of capital flow declined, but were more pronounced for bank flows and portfolio flows, during the financial crisis. FDI held up better than other types of capital flows and this reflects the fact that FDI is the least volatile type of capital and is therefore less subject to sudden change.

Nevertheless, the reversal in capital flows was synchronised across countries at different stages of development. This suggests a synchronised downturn in the business cycle across markets. For many developing economies, particularly Africa, the synchronised contraction in global capital flows during the crisis may suggest evidence of financial integration with advanced economies. Consequently, the next section of this study considers the behaviour of cross-border flows into and out of Africa with a view to understanding the level of integration of African markets. It also attempts to fathom the various channels through which the crisis spread into African markets.

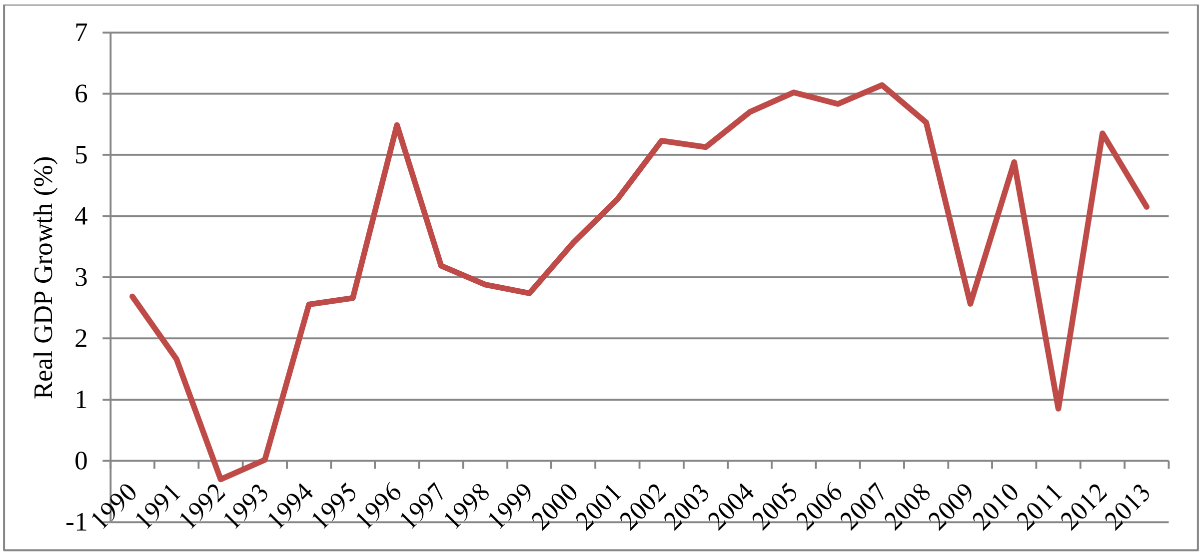
3.4 Integration of African markets

The integration of the African region into global economic activities is reflected in the economic transactions between African countries and the rest of the world as accounted for in their balance of payments. Evidence shows that African markets have become remarkably integrated based on the growing volume of cross-border flows in the period before the financial crisis. This increase is more in line with the broad robust economic performance in the region over the last two decades, particularly between 2000 and 2007. In fact, the African region experienced what amounted to growth renaissance before the global financial crisis. The GDP growth in the region increased from 3.6% in 2000 and peaked at 6.1% in 2007. This corresponds to an average annual growth of 5.2% (see Figure 3.20). The GDP growth also outpaced population growth and as a result, the region experienced a significant increase in GDP per capita (Senbet, 2009).

This development was supported by strong growth prospects, improved macroeconomic management and reforms, increased political stability, as well as robust global commodity demand, which drew the attention of global investors to the region (Macias & Massa, 2009 and Deutsche Bank, 2013). The rate of inflation in the region was brought under control and there was an improvement in fiscal discipline. Moreover, there was a significant decrease in the debt burden and increase in debt servicing capacity (Senbet, 2009). Also, the record low interest rates in developed markets led to sizeable cross-border inflows to the region, accompanied by increasing foreign investment and remittance flows. Table 3.2 below shows some key macroeconomic indicators in Africa over the period 2003 to 2007.

Following the robust economic performance in the region, the total value of cross-border inflow of goods, services and finance rose from $156 billion in 1994 to $698 billion in 2008, while total outflows rose from $128 billion in 1994 to $677 billion in 2008 as shown in Figure 3.21. The cross-border flows of goods and services dominated the total cross-border flows in the region over this period, contributing to an average of approximately 90.8% of total inflows and outflows annually, while financial inflows in and out of the region accounted for just 9.2%.

Figure 3. 20: Real GDP growth in Africa, 1990 – 2013



Source: UNCTAD Statistical Database

Table 3. 2: Selected macroeconomic indicators in Africa, 2003 – 2007.

Selected Indicator	2003	2004	2005	2006	2007
Per capita income ($)	783	909	1,042	1,161	1,291
Domestic investment ratio (%)	20.4	21.4	21.1	21.8	23.1
Fiscal balance (% of GDP)	-2.0	-0.1	2.8	4.2	2.8
Export Growth, volume (%)	8.2	7.8	5.9	2.8	7.5
Terms of trade (%)	2.8	6.1	14.8	8.6	-1.7
Trade balance ($ billion)	2.7	4.0	7.0	7.8	6.3
Net total ODA flows ($ billion)	25.1	27.5	33.7	41.3	N/A
Total external debt (% of GDP)	50.9	45.1	34.9	26.2	22.7
Debt service (% of exports)	13.0	11.2	10.3	9.9	6.3

Note: ODA means official development assistance

Source: Senbet, (2009)

Before the outbreak of the financial crisis, between 2002 and 2008, both inflows and outflows more than tripled – corresponding to an average annual growth rate of 23.0% over this period (see Figure 3.21). However, the African share relative to the total global flow of goods, service and finance was still very low by comparison, accounting for an annual average of 2.0%, between 1994 and 2008. This therefore, not only signifies the relatively small size of African markets but also, their degree of participation and low level of integration in global economic activities.

Nevertheless, during the financial crisis (2008 – 2009) the cross-border flows of African markets declined. In 2009 for instance, inflows declined by 10.2% and outflows by 27.0% relative to their 2008 values. This decline reflects some time lag in the impact of the financial crisis, which started with a downturn in advanced economies. It also suggests that African markets were initially resilient to the crisis. However, the contagious effect of the crisis following tightened credit conditions, as well as heightened global risk aversion, may have played a role in the decline of cross-border flows into and out of Africa. The direct effects of volatile and falling commodity prices on export revenues (particularly in resource rich countries) and capital inflows in the region may also have contributed to the decline.

For individual components of the flows, the crisis had diverse sets of pressures which created increased volatility and impacted individual components of the flows in different ways. Between 1994 and 2007, before the outbreak of the global financial crisis, cross-border trade flows (that is, inflows and outflows of goods and services) grew significantly. Specifically, from 2000 to 2007, these flows nearly tripled their values. Inflows grew from approximately $172 billion in 2000 to $494 billion in 2007 (or an average annual growth of 16.3%) before reaching the peak of $635 billion in the wake of the crisis in 2008. At the same time, outflows grew from $181 billion in 2000 to $515 billion in 2007 – corresponding to an average annual growth of 16.1% over this period (see Figure 3.22).

However, cross-border trade flows into and out of the region declined by 13.9% and 27.3% for inflows and outflows respectively in 2009 – after reaching their peak in 2008. This decline was due to a sharp drop in global trade in the fourth quarter of 2008 and into 2009, with a devastating impact on commodity exports in Africa, particularly in resource rich countries. Examples of resource rich countries in the region include Angola, Botswana, Congo Brazzaville, Nigeria, South Africa and Zambia. Almost all the resource rich countries in the region rely on very few commodities for their exports. This lack of export diversification is endemic to Africa, making it quite vulnerable to sudden domestic and international shocks.

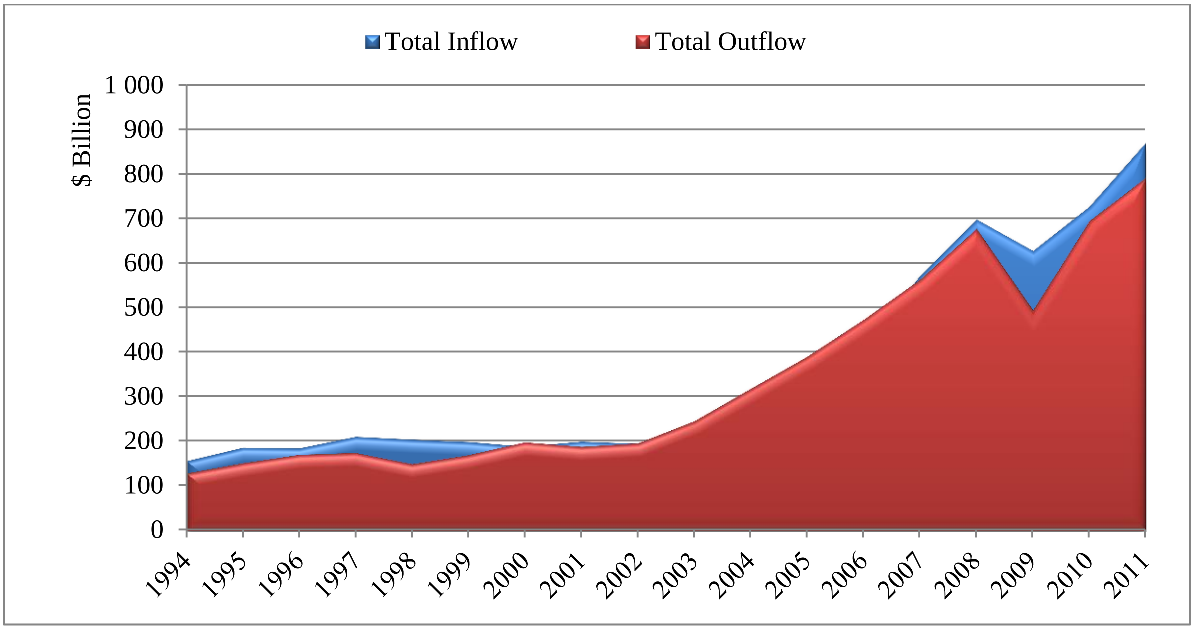
The other channels of crisis transmission into the African region are through financial flows. Financial flows into and out of the African region also grew significantly in the run-up to the crisis. Both inflows and outflows peaked in 2007 to the value of $77 billion and $47 billion respectively (see Figure 3.23). The positive financial inflows were driven by a search for higher yields resulting from low interest rates in advanced economies (Macias & Massa, 2009 and Deutsche Bank, 2013). However, the effects of the global financial crisis led to a fall in cross-border financial flows into and out of the region in 2008. Financial inflows declined by 19.5% in 2008 and rose in 2009. Outflows declined by 48.9% in 2008 and a further declined by 57.4% in 2009 relative to the peak in 2007. This indicates the dampening effect of the global financial crisis.

The impact of the crisis on African markets has been particularly significant following the decline in the commodity exports due to a sharp drop in global demand and prices. Also, the decline in trade flows, capital flows, remittances, aid flows, as well as the drop in access to international real and financial markets following the global crisis, had adverse consequences on African markets, particularly, in their aggregate economic performance. Therefore, there was a sharp decline in GDP growth from 6.1% in 2007 to 5.5% in 2008 and a further decline to a growth of 2.6% in 2009.

Like other regions, total cross-border flows into and out of the African region recovered in 2010. Importantly, these flows have exceeded their pre-crisis level, reaching $869 billion for inflows and $792 billion for outflows in 2011. These increasing flows into and out of the region reflect in part the continued positive macroeconomic performance, coupled with accommodative monetary policies in advanced economies, and renewed foreign investors' interest in the region (IMF, 2013). It also reflects the weaknesses in advanced economies which led some investors to diversify out of troubled advanced economies into Africa and other developing economies. Furthermore, the recovery suggests that the crisis had a limited impact on African markets and this may be related to the extent of their participation in the global economic activities. Consequently, it suggests that the crisis had only temporarily halted the integration process of African markets and that this process has continued in the aftermath of the crisis.

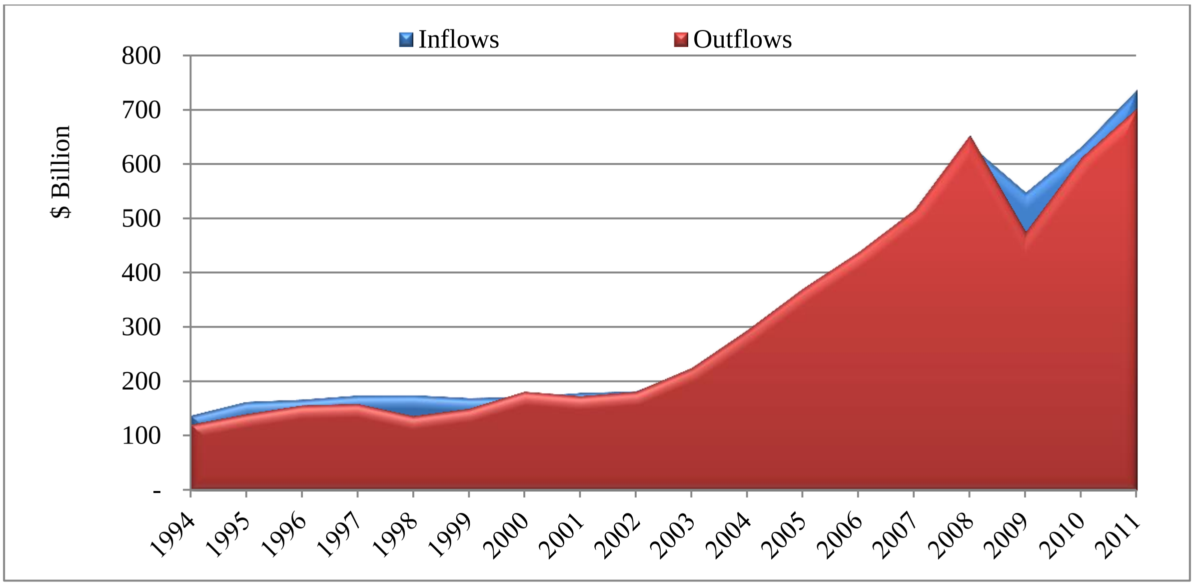
Overall, the African region enjoyed an increasing volume of cross-border flows in the run-up to the crisis. These cross-border flows into and out of the region might have presented important opportunities. For instance, they would have allowed recipient countries in the region to finance more investment than could be supported by their domestic markets. They might also have increased market efficiency by facilitating technological transfers and managerial expertise, improved resource allocation as well as increased domestic competition. However, the spread of the crisis put all these potential benefits at risk. The impact of the crisis on the region was less severe compared to advanced economies, given that the African region appears to be less integrated. Nevertheless, the region was not immune to the crisis and was exposed to the downturn in the global economy.

Figure 3. 21: Flow of goods, services and finance in and out of Africa, 1994 – 2011



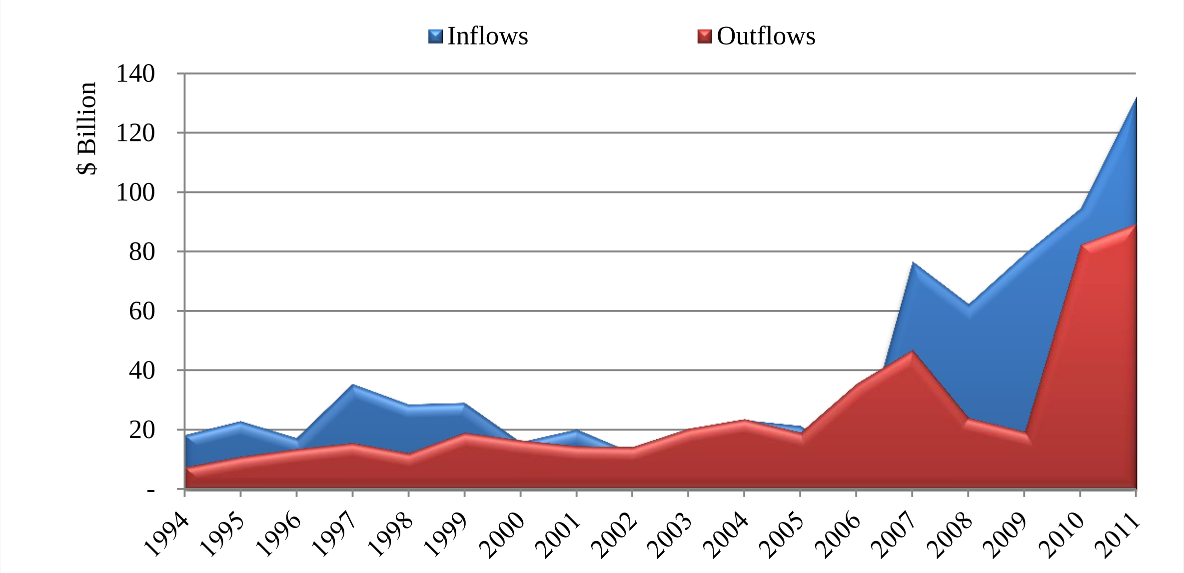
Source: Author’s calculations based on the UNCTAD and IMF BOP Statistical Database

Figure 3. 22: Cross-border of goods and Services in and out of Africa, 1994 – 2011



Source: Author’s calculations based on the UNCTAD Statistical Database

Figure 3. 23: Cross-border financial flows into and out of Africa, 1994 – 2011



Source: Author's calculations based on the IMF BOP Statistical Database

3.5 Conclusion

This chapter set out to provide some general perspectives on the level of integration in the global economy, on one hand and the integration of African markets with the rest of the world, on the other hand. To do so, the chapter focuses on the global cross-border flow of goods, services and finance as a crude measure of integration in the global economy and as a metric for quantifying the transmission channels of crisis.

Although global cross-border flows have been part and parcel of global economic activities for centuries, they are currently expanding and creating a new era for an interconnected world. The rapid increase in the global cross-border flows across advanced and developing economies in the last decade, often described as the process of 'global integration', has been associated with a substantial increase in the volume of international trade in goods, services and finance. A closer examination of the global cross-border flows reveals a web of linkages and integration. However, the degree to which countries are integrated through cross-border flows differs by the type of flows.

Generally, the analysis shows the dominance of real/trade linkages in the global cross-border flow. In particular, it suggests that more markets are integrated into the global economy through trade in goods. This also points to trade channels as the major transmission mechanism given their share in total cross-border flow. Further, the analysis indicates that financial flow grew more rapidly relative to other components of the global cross-border flow over the period under review. Also, there is a significant divergence in financial flow between advanced and developing economies. While advanced economies dominated financial flow before the global financial crisis, their dominance continues to decline after the crisis.

Developing economies make substantial strides in their participation to become more relevant in the global economy. The growing share of developing economies in the total global cross-border flows has steadily increased over time; however, they still lag behind advanced economies. In particular, evidence from cross-border flows indicates a relatively low level of integration of African markets in the global economic activities as implied by its share in the total global cross-border flows. Notwithstanding their relatively low level of integration in global economic activities, African markets were not immune to the forces emanating from the global financial crisis.

The spread of the global financial crisis, which originated in the advanced world, led to a sharp fall in cross-border flows, thus putting the growing process of integration at risk. Events during the crisis have shown that in an increasingly integrated system, cross-border flows can react quickly to adverse shocks. Specifically, periods of high uncertainty can generate rapid changes, which may manifest in the form of sudden swings. Nevertheless, the synchronised downturn witnessed across markets at different levels of economic development during the crisis period suggests the increased likelihood that an adverse shock in one major market can be transmitted across countries. In this respect, the decline in the cross-border flows during the crisis period serves to highlight an important aspect that needs to be taken into account when analysing the integration of African markets (that is, the financial integration of Africa).

To this end, the general objective of this study is to examine the level of financial integration, contagion and volatility transmission between Africa and developed financial markets with a specific focus on stock market integration. It is vital, before proceeding further, to consider some basic concepts as well as the theories and previous studies relating to this objective in order to facilitate a better understanding of this study. Against this backdrop, the next chapter will focus on a review of both theoretical and empirical studies relating to the issue of integration, contagion and volatility transmission.

CHAPTER FOUR

LITERATURE REVIEW

4.1 Introduction

This chapter provides a review of literature pertaining to the study. Studies considered here are those that have examined financial integration, contagion, volatility transmission, and business cycle synchronisation. The main objective of this chapter is to position the study within the current stance of existing literature by highlighting the key areas in which research on this topic has been undertaken, as well as prevailing weaknesses, in order to help identify the strength and the contributions of this study to existing literature. However, this chapter proceeds first with the analysis of some conceptual issues relating to the study, followed by the theoretical literature, the empirical literature and lastly, the conclusion.

4.2 Conceptual issues

The objective of this section is to facilitate a good understanding of the basic concepts which are fundamental to this study. The basic concepts considered here are; financial globalisation, financial market integration and contagion. A closer look at these concepts, which to some extent have been ignored in many studies and which this study believes should be at the core of any study on the international transmission of crises, is very important for an understanding of this study.

4.2.1 Financial globalisation and financial market integration

Financial globalisation and financial market integration are literally different concepts and their meanings are derived from the term globalisation. Globalisation is a contested term; however, from an economics perspective it refers to economic integration of countries into one global economic system (Dominelli, 2010). Also, Stalling (2007) defines globalisation as increasing integration of the world through transnational flows of goods, capital, ideas and norms. Following the above definitions, Prasad, Rogoff, Wei and Kose (2007), describe financial globalisation as an aggregate concept that refers to rising global linkages through cross-border financial flows.

On the other hand, financial market integration can be viewed from two perspectives. First is complete or perfect integration (strict definition), which refers to a market condition whereby the market participants face a single set of rules, have equal access and are treated equally

(Baele, Ferrando, Hördahl, Krylova and Monnet, 2004). In such a world, markets are considered integrated when assets with identical risks and returns command the same price irrespective of the market where there are traded (Bekaert & Harvey, 2003). The above definition is closely linked to the law of one price. This assumes that in the absence of trade restrictions, the possibility of arbitrage would cause the price of identical assets to be equal, after adjusting for exchange rates and transaction costs (Levy Yeyati, Schmujler & van Horen, 2009). Further, it assumes that international investors face both common and country-specific risks. However, in a fully integrated world, only the common risk factors are priced because country-specific risks are completely diversified internationally. It follows that, in a fully integrated market, the cross-market premium should be the same. Hence, the same asset pricing relationships apply in all countries and expected returns should solely depend on common risk factors (Arouri, Nguyen and Pukthuanthong, 2012). In other words, purchasing power parity exists between markets and asset prices are at least weak-form efficient (Fama, 1991).

Although the above view seems theoretically attractive, in reality no one market closely resembles it due to some impediments on market forces that prevent asset prices from being the same across markets (Piesse & Hearn, 2012; Levy Yeyati, et al., 2009; and Park & Gaidai, 2005). Moreover, it is argued that financial market integration is a gradual process involving different types of implicit and explicit barriers (Arouri & Foulquier, 2012). As a result, the focus of this study is based on the second view. The second view is associated with partial financial integration (broad definition), referring to an individual financial market's linkage to international financial markets (Herrero and Wooldridge, 2007 and Prasad et al., 2007).

Notwithstanding the apparent difference, financial market integration can be understood in the context of financial globalisation. Both include the integration of a country's financial system with international financial markets and institutions. The process includes opening up a country's financial markets and institutions to foreign investors as well as permitting domestic investors to invest abroad. This typically requires a reduction or removal of barriers to cross-border flow of capital and financial services by the government. It might further require harmonisation and standardisation of policies among participating countries through mutually agreed minimum standards.

In addition, financial market integration takes the form of increased financial interactions between different financial markets like; stock, bond, currency and commodity markets on the one hand. On the other hand, it also includes interaction of those financial markets that exist inside each of the singular markets at national and international level (Nicolau, 2012). At the international level, financial integration can either proceed globally or regionally. Therefore, in this study, financial globalisation is understood as the financial integration of a country's local financial market with international markets and institutions. Accordingly, the two terms are used interchangeably in this study for the purpose of simplicity.

4.2.2 Financial contagion

The prevalence of financial crises and the simultaneous crash of financial markets has led many to believe in the susceptibility of the financial system to shocks. Accordingly, theory suggests that shocks, which initially affect a particular country or region, can potentially spread to other areas by contagion. Most studies on international transmission of shocks have attempted to explain the evolution and transmission of shock by analysing the intermediaries of financial shock as well as isolating the channels through which shocks are transmitted from one country to another (Levy Yeyati & Williams, 2012 and Kenourgios & Padhi, 2012).

Financial contagion is a widely discussed concept in financial market literature. Conceptually, it is used as a framework for analysing cross-border financial relationships and how volatility, or shock, is transmitted across countries in the international financial system. The existing studies provide many definitions of contagion in financial market (for an overview, see Pericoli & Sbracia, 2003; Forbes & Rigobon, 2001 and Claessens, Dornbusch & Park, 2001). However, there is no consensus among economists regarding the appropriate definition of contagion and what constitutes contagion (Morales & Andresso-O'Callaghan, 2014; Asongu, 2012; Bae, Karolyi & Stulz, 2003; and Forbes & Rigobon, 2002). The divergent views in the literature about contagion can be reconciled as they are related to one critical question: is shock propagated through existing channels or along a new pathway created by the shock? This question suggests three distinct possible reasons for such disagreement among economists.

The first is the belief in the relative stability of the transmission mechanism, while the reality is that the features of shocks are time varying. In this sense, World Bank provided a broad definition of contagion as the cross-country transmission of shock or the general cross-country spillover of volatility. Obviously, this definition implies that any transmission of shock constitutes contagion, whether or not the correlation increases during the crisis period relative to pre-crisis/stable period. In addition, it suggests that transmission of shocks is proportional to the factor exposures (Bekaert, Ehrmann, Fratzscher & Mehl, 2011). The fundamental focus of this definition is to identify the linkages (that is, real and financial linkages) through which shocks are propagated. Another implication is that it assumes that the particular factor that triggers the initial shock is irrelevant and that spillover is due to links between the countries which exist during the pre-crisis or stable period but manifest during crisis.

The fact that different countries and markets are related through trade and investment suggests that any shock to macroeconomic fundamentals in one country is likely to be propagated to another. Therefore, the realisation that a financial crisis in one market might induce a crisis in another market as well. This, however, generates co-movement between returns of different investors in different countries. Under the broad definition of contagion, it is difficult to account for the large co-movement around the globe in extreme circumstances often without apparent linkages of economic fundamentals, especially of those economies that are weakly linked to the crisis country. Consequently, this form of co-movement emphasised by the broad definition reflects normal interdependence of different economies and cannot be related to contagion despite the fact that it appears after the shock occurred (Calvo & Reinhart, 1996 and Cheung, Tam & Szeto, 2009).

The second possibility rests on the view that every simultaneous crash of different markets is associated with contagion. Such a view underscores the need to distinguish between contagious shock and common shock. To distinguish between the competing explanations of contagion, one must separate the influence of common shocks from specific shocks. For instance, Gropp and Hartmann (2004) argue that if several markets crash simultaneously due to the occurrence of common adverse economic shock, this is not contagion. Rather, it reflects instability as a result of aggregate shock affecting many markets at the same time. Similarly, Kaminsky and Reinhart (2000) argue that a crisis could be synchronous across markets due to common shocks that affect the entire global financial system.

A stylised fact about the financial market is that asset price volatility usually increases during episodes of financial crisis. Asset price volatility is generally regarded as a good proxy for market uncertainty and magnitude of shocks (Pericoli & Sbracia, 2003). In effect, financial contagion refers to spreading of uncertainty across different markets. In some periods all markets globally are affected by the same shocks (common shocks) and therefore they tend to move together. However, a simultaneous rise in volatility in different markets may not be due to contagion between these markets but rather, can be attributed to common shocks that affect the structure of the financial system simultaneously. Accordingly, such systemic shocks should not be regarded as contagion (Kaminsky & Reinhart, 2000). In other periods when common shocks do not occur, equity market co-movements could be driven by country-specific (idiosyncratic) shocks originating from one market due to contagious shocks.

To account for the possibility of common shocks, the World Bank provides a restrictive definition of contagion. That is, the transmission of shock to other economies or cross-country correlation, beyond fundamental links among the economies and beyond common shocks. Viewed from this perspective, contagion refers to excess co-movement.

The third possibility relies on the idea that periods of crisis are characterised by the occurrence of shocks of unusual proportion, which may lead to structural breaks in the transmission mechanism. The underlying argument rests on attempting to define contagion by making two broad distinctions between pre-crisis and crisis periods. Hence, the belief that the transmission mechanisms changed during the crisis and therefore, co-movements between different markets increased during the crisis. In other words, there is a regime shift in the factors driving the transmission of shocks after the initial shock has occurred.

In addition, this view assumes that correlation between different markets increases significantly during the crisis period relative to the pre-crisis period. In this way, if correlations do not increase during the crisis period, then any propagation of volatility is nothing more than a mere expression of the normal interdependence between markets rather than contagious shocks (Forbes & Rigobon, 2002).

In the context of the third possibility, contagion occurs when cross-country correlations increase during the crisis period compared to correlation during the pre-crisis period. This is a very restrictive definition of contagion, as noted by the World Bank. Therefore, the open issue is to draw distinction between a pre-crisis period and a crisis period. Also, this definition of contagion is related to multiple equilibria issues and in such a situation contagion during a crisis episode reflects a switch from one equilibrium position to another (Boschi, 2011 and Pericoli & Sbracia, 2003). In keeping with this view, some studies further argue that if financial contagion during a crisis episode reflects a switch between different equilibrium positions, co-movement in asset prices will increase by more than what can possibly be justified by market fundamentals during a crisis period and that constitutes evidence of contagion (Gropp & Hartmann, 2004 and Pericoli & Sbracia, 2003).

Following the various possible reasons and definitions of contagion in the literature, it becomes imperative to distinguish between three important concepts, namely interdependence, contagion and common shock. Empirical literature has attempted to formalise the distinction between these concepts on theoretical grounds. For instance, Forbes and Rigobon (2001) provide theoretical explanations of the distinction between interdependence and contagion using two theories – crisis contingent and non-crisis contingent theories.

According to Forbes and Rigobon (2001), crisis contingent theories assume that the transmission mechanisms changed during the crisis period and therefore market co-movements increased after a shock. Following the crisis contingent theory literature, contagion as opposed to interdependence is related to the idea that there is a structural break in the parameters of international transmission mechanisms owing to a financial crisis (Corsetti, Pericoli & Sbracia, 2005 and Bonfiglioli & Favero, 2005). This view is associated with the very restrictive definition of contagion above.

On the other hand, non-crisis contingent theories assume that any increase in cross-country co-movement after a shock is due to an existing linkage between the two markets before the crisis (Forbes and Rigobon, 2001). Based on this view, it follows then that interdependence exists if the observed co-movement between two markets during a crisis is in line with the historically measured co-movement (Bonfiglioli & Favero, 2005). This view implies that the observed co-movement should remain relatively the same before and during crisis periods. This view is associated with the broad definition of financial contagion.

On the empirical front, most studies on contagion attempt to differentiate interdependence from contagion by identifying pre-crisis and crisis periods, and comparing whether there is any significant change in the levels of correlation and volatility in both periods. However, Corsetti et al. (2005) argue that if a crisis is driven by an increase in the variance of a common factor (shock) and causes higher than usual volatility in several markets (even when there is break in the transmission mechanisms), such a shock naturally leads to cross-country co-movement. Hence, an increase in co-movement during the period of crisis does not necessarily suggest evidence of contagion. That is, to separate contagion from a common shock, it is important to identify common factors, which simultaneously affect all markets (Dungey, Fry, Hermosillo & Martin, 2005).

In summary, defining contagion is central to the understanding of this study. However, the debate on the nature of contagion tends to rest on differentiating contagion from interdependence and common shock. Despite the lack of consensus in the literature over what constitutes contagion and how contagion should be defined, several studies have proposed empirical tests to address the issue. On the empirical grounds, studies tend to compare cross-country correlations of asset returns in pre-crisis and crisis periods, by testing contagion as a structural break in the parameters of the underlying data-generating process (see Rejeb & Boughrara, 2015; Samarakoon, 2011; Cheung et al., 2009; Bonfiglioli & Favero, 2005; Forbes & Rigobon, 2002 and Forbes & Rigobon, 2001).

Consistent with the above studies, the present study defines contagion as a significant increase in correlations between (pair-wise observed) asset returns across markets during the crisis periods relative to the correlations during the pre-crisis period. The support for this definition rests on the fact that it provides a baseline to compare the incremental effect of shocks during the crisis period relative to pre-crisis period. However, some studies have argued that increased correlation and volatility during the crisis period may be due to interdependence of different markets rather than contagion (Pretorious, 2002 and Lin, Engle & Ito, 1994). In this regard, it is arguably even more important to account for integration of different markets prior to the crisis period as this will permit a better understanding of contagion. This is to accommodate the diverse views expressed in the literature, particularly the crisis and non-crisis contingent theories.

To this end, this study evaluates evidence of contagion and volatility transmission during crisis period against the financial integration of different markets to ascertain whether there is evidence of contagion, or otherwise interdependence between the markets. In keeping with this line of thought, this study provides two conditions under which contagion may be deemed to exist. First, if two markets are integrated before a crisis, any increase in correlation during the crisis period cannot be considered as contagion unless the correlation between the markets increased significantly. This condition requires a good understanding of the historical correlation as well as the correlation during the pre-crisis and crisis periods. Under this case, the analysis of the historical correlation provides a benchmark for determining change in correlations.

Second, contagion exists when the markets are not integrated before the crisis and there is evidence of a significant increase in correlation during the crisis period relative to the pre-crisis period. In this context, contagion does not require direct linkages of macroeconomic fundamentals for shocks to be transmitted across markets. That is, contagion can be transmitted indirectly through other markets. Therefore, these two conditions provide a basis for analysing contagion in this study.

4.3 Transmission channels of contagion

Contagion is an important theoretical framework for analysing the international transmission of shocks. Studies on the international co-movement of equity markets focus on understanding how a crisis is transmitted globally, because financial crises often lead to disruptions in the international linkages of equity markets. Evidence in the literature has identified different channels through which contagion effects can be transmitted between markets. Cheung et al. (2009), Karolyi (2004), and Kaminsky and Reinhart (2000) point out that there are fundamentally two possible channels through which shocks from one market could be transmitted to other markets; real (trade) linkages and financial linkages. Based on this, the sections below explain these two fundamental channels.

4.3.1 Trade linkages

A key emphasis in the studies of the transmission channels of contagion has been on the trade linkages, which is usually associated with international trade in goods and services. Most explanations of trade linkages in transmission of shock focus on Nurkse’s competitive devaluations (Rose & Spiegel, 2009; Karolyi, 2004; Kaminsky, Reinhart & Vegh, 2003 and Kaminsky & Reinhart, 2000). According to this view, when countries trade and compete in the third market, a devaluation of the exchange rate in one country would negatively affect the other country’s competitiveness. In this setting, authorities in both countries may attempt to safeguard their respective country’s competitiveness by devaluing their currencies, which may trigger a crisis in the end (Cheung et al. 2009). For example, Karolyi, (2004) and Peckham (2013) argue that the Asian financial crisis of 1997 was triggered by the forced devaluation of the Thai baht, which led to a chain of devaluation and a fall in stock prices in the neighbouring countries.

4.3.2 Financial linkages

Finance literature stresses the importance of trade in financial assets, such as foreign direct investment, portfolio investment in equity and debt instruments and other investment (cross-border loans and deposits), and how each of these can cause a crisis to be transmitted from one country to another. Here, studies emphasise the transmission of contagion through foreign financial asset exposure. Importantly, financial linkages manifest when different markets are connected through the international financial system. For example, Rose and Spiegel (2009) point out that cross-border financial asset holding could facilitate contagion, as a downturn in the financial centre of the issuer would result in balance-sheet losses as well as liquidity shortages for the international investor holding those assets. In this sense, financial linkages serve as the platforms through which shocks can be propagated to asset prices in different markets. Furthermore, Cheung et al. (2009)[12] highlight different ways that financial linkage might help propagate contagion, such as common creditors, interconnected lenders, interactions under a market-based financial system and portfolio rebalancing, which arise as a result of the need for cross-market hedging of risk.

Overall, economic integration usually involves both trade and financial linkages, such that shocks from one country can easily be propagated to other countries. Accordingly, the spread of a crisis depends somewhat on trade and financial linkages due to integration. In other words, the higher the degree of integration, the more intensive the expected contagious effect becomes. However, studies have argued that trade and financial linkages can facilitate the transmission of real and common shocks, but they do not necessarily trigger them (Morales & Andreosso-O'Callaghan, 2012 and Karolyi, 2004). Cheung et al. (2009) provide a summary of different hypotheses suggested in the literature that help to explain the causes of contagion (see Box 4.1 below).

Box 4.1: Hypotheses that explain contagion

The following are some commonly-cited hypotheses that explain contagion.

1. Asymmetric information and expectation formation (herding)

Contagion is commonly referred to as being the result of herding behaviour. When fundamentals and common shocks do not fully explain the relationship among countries, spillover effects are attributed to herding behaviour, either rational or irrational. Such a

[12] See Cheung et al. (2009) for a detailed discussion on different ways financial linkages can help propagate shocks from one market to another.

phenomenon is explained by models of expectation formations in the context of imperfect and asymmetric information. These models explain why herding behaviour among investors and fads can be rational. If each individual investor has some private information (and knows that others have it too), then observing the actions of others gives some clues as to what they know (assuming that they cannot credibly share their information), making it rational to imitate them.

Different mechanisms help explain herding behaviour, with some studies emphasising asymmetric information. Information is costly to obtain, so less informed investors may choose to follow the "leader", causing markets to move together. Or, investors may not be able to differentiate one foreign market from another, and when they see a crisis in a foreign economy they reassess the risks of investing abroad, so that a crisis in one economy may lead to wholesale withdrawal of investments in all foreign markets.

2. Macroeconomic feedback models

In macroeconomic feedback models, adverse expectations of a particular event (typically a devaluation) make that event more likely (typically, by raising borrowing costs or wages). For example, the decision to devalue is triggered when foreign exchange reserves fall below a certain threshold. A higher domestic interest rate, triggered by fears of devaluation or default, feeds back in an adverse way on the economy's prospects, by making a devaluation or default more likely because it increases the economy's foreign debt servicing or because higher interest rates trigger a run on the banking system, a contraction of domestic liquidity, and an outflow of reserves. In this case, shifts in expectations are to some extent self-fulfilling, and there are several rational expectation equilibria.

3. Models of liquidity and bank runs

In models of liquidity and bank runs, a large number of bank customers withdraw their deposits because they believe the bank is, or might become, insolvent. Lenders/depositors need to form expectations of what other depositors are doing: if others run, then it is optimal for an individual to run too, if the amount of liquid assets available to the bank is less than demand deposits outstanding. As a bank run progresses, it generates its own momentum, in a kind of self-fulfilling prophecy: as more people withdraw their deposits, the likelihood of default increases which encourages further withdrawals. The destabilising effect, if serious enough, can lead to bankruptcy of the bank.

In Diamond and Dybvig (1983), it is the realisation of a shock that determines whether each individual wants to consume now, rather than later. However, even those who have planned to defer consumption may want to withdraw their money if they think a bank run will occur, and if they do, the bank run will exhaust the bank's liquid assets. The outbreak of the crisis will depend on whether or not the depositors coordinate in the run or no-run equilibrium.

4. Wake-up call

The wake-up call hypothesis refers to the case where a crisis elsewhere provides new information about the seriousness of problems in the home economy. This could sometimes be explained by similarities in the fundamentals and economic structure between economies. As such, economies with weak macroeconomic fundamentals would be more prone to contagion in crisis conditions. For example, if a country with a weak banking system is discovered to be susceptible to a currency crisis, investors could re-evaluate the strength of the banking system in other economies and adjust their expected probabilities of a crisis accordingly. However, it is also possible that the change in beliefs is overdone, perhaps for reasons related to fads. It may involve shifts in sentiment, some of which are not related to knowledge of the true fundamentals of the economy.

Source: Cheung et al. (2009)

4.4 Theoretical literature on financial integration

The theoretical literature in this study is related to the benefits and costs that arise from international integration of financial markets. These benefits and costs need to be considered from the perspective of all the market participants, given that financial integration could lead to internationalisation of the investor base and possibly help explain co-movement in the returns of financial assets as well as financial crisis. Following this framework, Das (2003) points out that in a financially integrated world, where capital flows seamlessly, two outcomes are plausible: the first is that countries can benefit from an increased level of investment as well as the opportunity to diversify their risk; and the second is that these countries also face boom-bust cycles.

Theoretically, markets are considered perfectly integrated, when all market participants with the same relevant characteristics in the market are governed by a single set of rules, and have equal access and treatment (Baele, Ferrando, Hördahl, Krylova & Monnet, 2004). Operationally, this means that in such markets, assets of identical risk should command the same expected return irrespective of their country (Bekaert & Harvey, 2003). That is, perfect integration would result in risk-adjusted returns denominated in the same currency, to be equal in all trading countries.

In addition, the theory further postulates that investors bear both idiosyncratic and common risks. But, if markets are fully integrated, only the common (global) risk factors are priced, in that the idiosyncratic risk factors can be diversified internationally. Hence, the return on equivalent assets in different markets or countries should be driven by a common factor and be relatively immune to domestic economic shocks. In such an environment, the same asset pricing relationships exist in all markets and the expected return depends solely on the global risk factors (Higson, Holly & Petrella, 2013).

This theory is closely associated with the law of one price, which forms the basic foundation for explaining financial integration, in a more strict sense of the term. Following this framework, there are two possibilities. On the one hand, the absence of integration would suggest that the risk-return relationship differs across countries and markets. Hence, it is likely that different markets will demand different levels of risk premiums. Then, arbitrage opportunities (and possibility of diversification) exist in that investors could simply adjust their portfolios by investing in markets offering greater returns while maintaining the same level of risk (Morelli, 2009).

On the other hand, in a non-discriminatory environment (as in the case of integration) where investors are free to invest in different markets, any arbitrage opportunity will be fully exploited by investors, thereby restoring the validity of the law of one price. Similarly, Von Furstenberg and Jeon (1989) argue that when international stock markets are sharing a common trend, the returns will be perfectly correlated over long term, suggesting that there is no gain to be made from international portfolio diversification. The theory therefore suggests that integration of financial markets would diminish the diversification benefits.

Moreover, integrated financial markets usually exhibit co-movement in their asset returns, which is commonly known to be apparent especially in the equity markets during a crisis period. Accordingly, Ahlgren and Antell (2010) note that if financial markets are more closely linked during the period of crisis, then the opportunities for international diversification are severely reduced when they are needed most.

Notwithstanding this, standard economic theory predicts that financial integration allows for cross risk sharing and efficiency in capital allocation among countries (Demyanyk &

Volosovych, 2008; Coulibaly, 2009 and Kose, Prasad & Taylor, 2011). Furthermore, Bekaert and Harvey (2003) stress that integration would cause foreign investors to bid up prices of local financial assets with diversification benefits while turning down assets with no diversification benefits. In the process, the cost of capital should fall, which in turn may increase the level of investment and ultimately increase economic welfare.

However, Haldene, (2009) emphasises that risk is shared through diversification until a certain level is reached, at which point integration serves as a shock-amplifier, rather than a dampener. Risk-spreading, which leads to fragility, then prevails, highlighting the interlinkages which amplify local shocks across the financial system. In another view, Higson et al. (2013) note that integration among countries may emerge as an additional explanatory factor: a common stochastic trend in financial markets of those countries potentially mirrors their economic fundamentals that are significantly related to one another.

In a related argument, Hassler (1999) argues that financial market integration is likely to cause greater market interdependence, which may increase financial market volatility, by adding a new source of noise. The author further argues that an increase in domestic financial market volatility may be due to sensitivity of the market to a common stochastic process that affects the global financial markets caused by integration.

Consequently, the theoretical prediction that deeper integration of financial markets acrosscountries should bring their business cycles closer and make them more interdependent and vulnerable to common shocks as well as crisis, supports Das' (2003) argument of two possible outcomes. Moreover, evidence in the literature has shown the possibility of countries reaching either one of the two outcomes. ECB (2012) provides an elaborate discussion of the benefits and costs associated with financial market integration (see Box 4.2 below).

Therefore, economic theory is not unambiguous on the analysis of the effect of financial market integration. Such an analysis is ultimately an empirical matter that requires quantification of the potential benefits and costs associated with financial integration. Hence, equity markets provide a demanding setting for testing the predictions of financial integration theory. Moreover, equities are securities written on complex real assets and the fundamentals of the real economy – growth rates, labour costs, competitiveness and institutional setting including taxation – they may also display different degrees of secular convergence and will reflect different sectoral compositions.

Finally, it is important to note that the above analysis relates to some extent to an ideal state of perfect integration. But these conditions are rarely met in practice, due to home asset bias, asymmetric information and transaction costs (Bekaert & Harvey, 2003 and Schmukler, 2003). The theory nonetheless provides the basic conceptual benchmark for explaining financial market integration. Therefore, the section below examines the empirical studies relating to the financial market integration, contagion, volatility transmission and business cycle synchronisation.

Box 4.2: The benefits and challenges associated with financial market integration.

There is a broad consensus in the literature on international financial integration that integration is beneficial to all participating countries, and that, over a longer horizon in particular, the benefits can be sizeable.

First, financial integration allows economies to share the risk associated with their individual domestic business cycles. By enabling a country to borrow during economic downturns and to lend in economic upturns, cross-border financial flow enhances consumption and income risk-sharing, while reducing the volatility of consumption growth. This counter-cyclical effect of global capital markets on real variables is particularly important, given that shocks tend to be temporary or idiosyncratic. Besides, improved risk-sharing, in turn, enhances the ability of countries to specialise in their most productive sectors, leading to increased economic efficiency.

Second, integration is essential in order to direct global capital to the areas where it can be used most productively. This observation is based on the neoclassical growth model, which predicts that, under the assumption of diminishing marginal returns on capital, capital should flow from economies where its use yields a relatively smaller marginal return to economies where the marginal productivity of capital is higher. The ability to draw upon an international pool of resources, in turn, affects domestic investment and growth, as it allows economies to expand investment and production beyond the constraints imposed by domestic savings. In many emerging economies, the capacity to save is constrained by a low level of income. Net capital inflows can thus supplement domestic savings and increase the level of capital employed, helping the recipient country to raise its rate of economic growth and improve its living standards.

Third, it is often argued that the presence of foreign investors increases the level of productivity in the recipient country, for instance via a concomitant transfer of knowledge that is not accounted for in the capital flows themselves. A related point in favour of financial integration is that it can have a beneficial impact on the efficiency of the domestic financial system by increasing the depth and breadth of domestic financial markets and lowering costs of capital.

Fourth, there is another indirect effect – or “collateral benefit” – of cross-border financial integration, which emerges as a result of the disciplining forces that financial integration may exert on domestic economic policies and on public and corporate governance. The literature on cross-border investment typically finds that foreign investors are particularly sensitive to information asymmetries and prefer to invest in countries with sound institutions and a stable macroeconomic track record. Thus, if domestic authorities want to reap some of the above-mentioned benefits of financial integration and also want to attract foreign investment to the domestic economy, financial integration may have a disciplining impact on domestic policy-makers by encouraging them to refocus on stability-oriented and sustainable economic and monetary policies. Given that greater policy discipline translates into greater macroeconomic stability, this in itself leads to faster economic growth – as do the direct effects of financial integration – as emphasised in the recent literature on endogenous growth.

Against the background of the global financial crisis, the role of macroeconomic discipline and stability has recently moved to the centre of public debate and economic research on global financial integration. The reason for this is that, despite the undeniably beneficial effects of financial integration on growth and on general societal welfare in the long run, imbalanced capital flows can also pose considerable challenges and imply significant risks for domestic economies with unsustainable domestic policies that fail to align the objectives of external and domestic stability.

In fact, excessively prolonged and large net capital inflows can have undesirable macroeconomic effects, including rapid monetary expansion and inflationary pressures, and can thus inflate asset prices and fuel credit growth, raising the risk of boom and bust cycles. Financial flows driven by volatile factors such as herding behaviour among investors or the so-called “hunt for yield” can, in an environment of increased risk appetite, lead to a mispricing of financial assets, with the associated risk of sudden adjustments, giving rise to painful consequences for the real economy. At the same time, the impact of such speculative inflows on long-run growth may be minor if such inflows are used to finance speculative or low-quality domestic investments.

Thus the lesson that can be gleaned from the economic literature on financial integration is that balanced and sustainable macroeconomic policies are needed in order to reap the benefits of global financial integration, as they enable countries to attract stable and balanced capital inflows, which are conducive to the long-run growth of the economy. Moreover, economic policies also need to be carefully aligned with the objective of external sustainability, as the volatility that is inherent in cross-border capital flows can have a significant impact on the volatility of domestic macroeconomic variables in the absence of stability-oriented domestic economic, monetary and exchange rate policies.

Source: ECB (2012)

4.5 Empirical literature

This study is related to different strands of the literature on international financial markets which can conveniently be grouped into three areas of research. The first group are empirical studies on financial market integration, the second group are studies on financial crisis, contagion and volatility transmission, and the third group is related to studies on business cycle synchronisation. In this study, the three research areas are considered to be closely related because the study takes the view that they are linked to financial market integration. In what follows, the discussion of these research areas is considered.

4.5.1 Studies on financial market integration

The first research area dwells on the long line of empirical studies on financial market integration. However, the true process of financial market integration tends to be dynamic and difficult to measure. The empirical financial literature explaining the level of integration of previously segmented markets shows that several approaches have been pursued in contemporary financial literature. Some of these studies are closely aligned with the commonly used theory of financial integration – theory of one price. In this context, financial integration exists if the law of one price holds. Conversely, any discrepancy in prices or returns on identical assets would constitute evidence against integration. In other words, markets where assets require the same expected return regardless of their trading location are said to be integrated, while markets where the expected return of an asset depends on its location are said to be segmented (Arouri & Foulquier, 2012; Levy Yeyati, et al., 2009 and Karolyi & Stulz, 2002).

Following this theoretical framework, some empirical studies seek to establish integration of financial markets by focusing on price or return equalisation-based measures. These measures attempt to equate rate of returns on comparable assets across different countries as an indicator of financial integration. In this regard, the vanguard of testing for cross-border financial integration relies on parity conditions, [namely covered interest rate parity (CIRP), uncovered interest rate parity (UIRP), real interest parity (RIP) and purchasing power parity (PPP)], and asset pricing models (i.e. capital asset pricing model and its variants).

Along the line of parity condition, the idea is based on the belief that unrestricted capital flows, through seeking higher returns, result in equalisation of the rate of return in different markets (Kearney & Lucey, 2004). Early studies that followed this approach include Glick (1987), Cheng (1988), Glick & Hutchison (1990) and Chinn & Frankel (1995).

In one of the recent studies, Goldberg, Lothian and Okunev (2003) investigate the international integration of six major industrialised countries (namely, Canada, France, Germany, Japan, United Kingdom and United States) over the period 1957 to 2000. Using RIP based on the Fisher framework, the authors find considerable evidence of long-run financial integration across the six countries, both for the later years of Bretton Woods and during the current float system. The study also shows that real interest rate differentials between pairs of countries appear to be mean reverting and in two-third of the cases, not significantly different from zero. Ferreira and Leon-Ledesma (2007) examine evidence of RIP in a set of emerging (Argentina, Brazil, Chile, Mexico and Turkey) and developed (France, Germany, Italy, Spain and United Kingdom) countries following the framework of UIRP. Using unit root tests, the study finds evidence in support of mean reversion towards a zero interest rate differential for developed countries. The result also suggests a high degree of market integration for developed countries as well as the importance of risk premiums for emerging markets.

A study by Holmes (2002) examines the long-run RIP among the major European Union (EU) countries over the period 1979 to 1998. The study finds strong evidence of RIP occurring during the period of 1986 – 1990 and 1993 – 1998. In a related study in the EU, Arghyrou, Gregorious and Kontonikas (2009) investigate the convergence of real interest rates among the 25 EU members over the period of 1996 to 2005. Following RIP and Fisher frameworks, the study finds evidence of interest rate convergence for the majority of the countries. This, however, is found to be a gradual process subject to structural breaks.

Likewise, Cuestas and Harrison (2010) analysed the evidence of RIP in central and east European countries using monthly data over the period of 1994 to 2007. The study finds that RIP holds for most of the countries, which suggests that these markets are financially integrated with the EU.

Also, Cheung, Chinn and Fujii (2006) examined the financial integration of China, Hong Kong SAR and Taiwan with those of Japan and the United States, using monthly interbank interest rates from February 1996 to June 2002. The authors investigate whether RIP, UIP and relative purchasing power parity (RPPP) hold for all the markets. Evidence from the empirical results indicate that these parity conditions tend to hold over a long peroid for all the markets. Importantly, the Hong Kong market exhibits a higher level of integration with China. The study also shows evidence of positive integration with the United States market.

In a related study by Amornthum and Bonham (2011), the authors examine financial integration in the eleven Pacific Basin economies (countries considered include: Canada, Hong Kong, South Korea, Singapore, Taiwan, Indonesia, Malaysia, Philippines, Thailand, Australia and New Zealand) with those of the United States, Japan and the Eurozone. Using quarterly money market rates from 1985Q1 to 2006Q3, the study shows RIP holds for the Pacific Basin economies. Notably, the finding shows that real interest rates converge to the United States' rate. However, there is no evidence in support of such convergence with respect to either Japan or the Eurozone.

Another aspect of the literature that follows the above theoretical framework relies on the international asset pricing model or capital asset pricing model (CAPM). In the asset pricing domain, the logic is that in a completely segmented market, expected returns of domestic assets will mainly be influenced by domestic factors. As a result, the only risk factor that should be rewarded is the domestic risk factor. Conversely, if markets are integrated, expected asset returns are influenced by the asset's covariance with the global market portfolio. Hence, only the global risk factor should be rewarded given that domestic risk factors can be diversified internationally. Consequently, the theory predicts that if financial markets are segmented, the asset pricing relationship would vary across markets due to different domestic risk factors. But in a fully integrated market, the same asset pricing relationships exists for all markets (Beaulieu, Gagnon, & Khalaf, 2009 and Aroui et al., 2012).

Early studies that sought to test financial market integration and followed this idea include: Stehle (1977), Roll and Ross (1980), Errunza and Losq (1985), Cho, Eun and Senbet (1986), Jorion and Schwartz (1986), Gultekin, Gultekin and Penati (1989), Chen and Knez (1995) and Bekaert & Harvey (1995).

Among the contemporary literature, Ayuso and Blanco (2001) examine whether there was an increase in the stock market integration of the United States, Germany and Spain during the nineties. The authors developed a measure of integration that relies on the concept of the law of one price and a condition of no arbitrage opportunities. The result suggests that the degree of market integration between these markets increased during the nineties. In another study, Morelli (2009) examines capital markets integration of the G7 countries under the joint hypothesis of an international multi-factor asset pricing model. The study covers monthly returns of 160 securities over the period January 1990 to December 2000. The results show evidence that international common factors exist, some of which are priced and equal across some countries. Importantly, the international pricing model does not hold for all G7 countries. That is, the price of risk is not found to be the same across all countries and the hypothesis of full capital market integration does not hold for G7 countries.

Hardouvelis, Malliaropulos and Priestley (2006) explore the stock market integration among the members of European Union (EU) and European Economic and Monetary Union (EMU). The study covers 11 EMU members and the United Kingdom, which is a member of EU, over the period 1992 to 1998. The authors estimate a conditional asset pricing model with a time-varying degree of integration, which measures the importance of EU-wide market and country-specific risk. The evidence from the study shows that in the second half of the 1990s, the degree of integration gradually increased to the point where individual Eurozone country stock markets appear to be integrated into the EU market. The authors attribute the level of integration to the probability of joining the single currency and inflation differentials.

Likewise, Adler and Qi (2003) examine the integration between Mexico and North American equity markets (namely Canada and United States) over the period 1991 to 2002. The study adopted a model that combines the domestic and international versions of the CAPM to test for the power of local factors relative to that of common factors in explaining expected returns. The result shows that the degree of market integration was higher at the end of the period than at the beginning but it exhibited wide swings that are related to both common as well as local factors. On another front, Beaulieu et al. (2009) examine financial integration across North American (United States and Canada) stock markets from January 1984 to December 2003. Following the arbitrage pricing theory (APT) framework, the study shows a marked evidence of mild rather than partial or strong integration in both domestic portfolio and inter-listed stocks. In addition, the result shows that the domestic and international model have similar explanatory power, although the domestic model performs better with the Canadian inter-listed stock.

In a study by Rose (2004), the author developed a new method based on the asset pricing model to examine equity market integration of Japan over the period 1998 to 2002. The study finds that expected risk-free rates vary dramatically over time unlike short-term interest rates. In addition, the Japanese stock market does not seem to be well integrated in the sense that different portfolios of stocks are priced with different implicit risk-free rates. Similarly, Gerard, Thanyalakpark and Batten (2002) examine the integration of five East Asian Markets (namely Hong Kong, Japan, Korea, Malaysia and Thailand) with the United States and world market over the period 1985 to 1998. The study tests for a conditional international asset pricing model with both world market and domestic risk included as independent pricing factors. The result shows that exposure to world risk attracts a significant premium across all markets, but there is little evidence in support for the hypothesis that exposure to residual country risk is rewarded. Hence, the result suggests little evidence of markets segmentation in East Asia over the period of the study.

De Jong and de Roon (2005) investigate the time-varying integration and expected returns in emerging markets in Latin America, Asia and the Far East, Europe and the Middle East and Africa, over the period 1988 to 2000. The study develops an international asset pricing model with partially segmented markets, wherein assets that cannot be traded internationally are held by domestic investors only. The result shows that the expected returns in the four regions are affected not only by the level of segmentation in the region itself, but also by the global level of segmentation as measured by the composite index for the emerging market. While the emerging markets in both Europe and the Middle East and Africa are mostly affected by the level of segmentation of the country itself, the result indicates that the level of regional segmentation is more important for Asian and Far Eastern countries. For the Latin American countries, both variables are important.

Recently, a study by Claus and Lucey (2012) explored equity market integration among 10 economies in the Asian Pacific region: Australia, Hong Kong, India, Japan, South Korea, Malaysia, New Zealand, Singapore, Taiwan and Thailand over the period April to May 2006. Using the expected discount rate approach (EDRA), the authors show evidence of a limited but varying degree of stock market integration among the economies in the Pacific region. Results also show a relatively higher degree of integration for Japan, Hong Kong and New Zealand.

Arouri et al. (2012) investigate stock market integration of six major emerging markets (such as: Brazil, Korea, Malaysia, Mexico, Chile, and the Philippines) with those of developed markets like Canada, the United States and France. The study covers monthly stock returns over the period January 1973 to March 2008. Following the framework of the international capital asset pricing model (ICAPM), they find that the degree of stock market integration varies across time and that the selected emerging markets have become more integrated. Further evidence shows that local risk premium in the emerging markets constitutes the most important component of the total risk premium. However, its relative importance has declined in recent times. For the developed markets, the study finds that their total risk premium is mainly driven by the global factors. A similar study on the integration of these markets can be found in Arouri and Foulquier (2012).

In another similar study in Africa, Agyei-Ampomah (2011) examines the nature and extent of linkages among African stock markets and that of regional and the global markets using monthly stock market returns over the period 1998 to 2007. The study analysed stock markets in 10 African countries (namely, Botswana, Egypt, Ghana, Ivory Coast, Kenya, Mauritius, Morocco, Nigeria, South Africa and Tunisia) with the regional and global benchmark indices (that is, S&P/IFCG Middle East & Africa index and S&P 1200 index respectively). Following the international risk decomposition model, the study finds a low level of integration among African markets themselves and also with the regional and global markets. The result further shows that apart from South Africa, there is no evidence of integration of African markets with the global stock market.

Also, Kodongo and Ojah (2012) examine the currency and stock market integration of Nigeria and South Africa with developed financial markets over the period 1994 to 2008 with the aid of a multi-factor asset pricing model. The study finds that currency risk is partly unconditionally priced in South Africa’s stock market, with evidence of integration with the world financial markets. Conversely, currency risk is not priced in Nigeria’s equity market, which indicates evidence of no integration with the world financial markets. Further analysis revealed a significant sensitivity of their returns to both world equity markets and exchange rate volatility across the two countries.

In another study, Boamah, Watts and Loudon (2016) investigate the integration of 11 African markets (namely Botswana, Egypt, Ghana, Ivory Coast, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia and Zambia) relative to the world and emerging markets over the period 1997 to 2013 using a multi-factor asset pricing model. The findings show that world, emerging and African market factors command a significant risk premium on the African markets. The findings also support partially integrated African markets. The study further suggests that the result is generally sensitive to the period under investigation, indicating changing integration through time.

Despite the significant contribution of these studies to a better understanding of financial market integration, the models used are based on the assumptions of the law of one price. The law of one price is intuitively appealing; however, its validity has been heavily criticised in a number of studies (see Kearney & Lucey, 2004; Park & Gaidai, 2005 and Marston, 1995). One of the difficulties in applying this approach is identifying financial assets that are sufficiently homogenous in terms of risk profile across markets to allow meaningful comparison (Kearney & Lucey, 2004). Also, the law of one price operates only as an equilibrium situation. In other words, it does not indicate the process of adjustment towards equilibrium (Rejeb & Boughara, 2015 and Kearney & Lucey, 2004). The authors argue that studies that rely on the theoretical predictions of the law of one price implicitly assume that there is some degree of international integration and attempt to test integration by considering that the proportion of domestic market stocks in a well-diversified portfolio can help identify deviations from full integration.

Another main implication of this approach, however, is that the degree of integration is assumed to remain constant over time. Arguably, financial integration is a process, rather than being constant. Moreover, studies have shown that the degree of integration changes over time (Bekaert & Harvey, 1995 and Kearney & Lucey, 2004). Further concern in the literature also relates to the implicit assumption of perfect or complete financial market integration implied by the law of one price. In this situation, the parity condition requires very restrictive assumptions, like zero exchange rate risk premium, zero country premium and zero deviations from the purchasing power parity (Levy Yeyati et al., 2009; Park & Gaidai, 2005 and Lemmen, 1998). However, evidence in the literature has shown that such an assumption is unrealistic given that there are some forms of restriction which prevent markets from achieving perfect integration and that rather, one should expect partial integration (Levy Yeyati et al., 2009 and Arouri et al., 2012).[13]

In view of these limitations, a significant number of studies have examined financial integration by focusing on the evolution of equity market correlations, the extent to which common stochastic trends in returns emerge and the specification of the dynamic adjustment towards greater integration across markets. Basically, there are two strands of literature emerging from these limitations.

The first strand relies on correlations between markets as an indicator of financial market integration. The underlying argument is that the correlation is time-varying and any trend towards increased correlation across market indicates greater integration (Kearney & Lucey, 2004). Among the studies that consider this approach are: Horvath and Petrovski (2013), Graham, Kiviaho & Nikkinen (2012) and Savva & Aslanidis (2010).

However, the use of the correlation approach as a measure of integration has been criticised. As indicated by Pungulescu (2013), correlation is a simple, yet possibly misleading proxy for stock market integration. For instance, markets that are subject to common exogenous shocks will artificially appear to be correlated even to the extent that correlation will occur without integration (Kearney & Lucey, 2004). Therefore, Pungulescu (2013) notes that such a measure of integration will only be relevant if the stochastic process of common shocks remains constant. As a result, some studies have pointed out that increased correlation is not a sufficient condition to suggest greater market integration (Pungulescu, 2013 and Ayuso & Blanco, 2001).

The second strand in the literature explores the use of the co-integration technique and the error correction model (ECM) for analysing both the short-run and long-run relationship between markets. Co-integration emphasises that markets that share a common stochastic trend cannot diverge far away from each other. While potential for deviation exists in the short-run, in the long-run markets tend to converge towards their common trend, thus implying existence of a long-run relationship between the markets (Yu, Fung & Tam, 2010).

[13] Arouri et al. (2012) provide three distinct reasons why national markets could be partially integrated. Also, Ayuso & Blanco (2001) point to the existence of home-country bias as evidence against perfect integration.

The co-integration approach has emerged as the commonly used method in the literature for testing financial market integration. Also, there have been a significant number of studies on financial market integration that have followed this approach. Examples of such studies are Dunis, Sermpinis and Karampelia (2013), Gambhir & Bhandari (2011), Park & Lee (2011), Lucey & Muckley (2011), Misra & Mahakud (2009), Siddiqui (2009), Park & Gaidia (2005) and Bessler & Yang (2003).

In one of the studies that adopted this approach, Guidi and Ugur (2014) investigate integration of the South-Eastern European stock markets of Bulgaria, Croatia, Romania, Slovenia and Turkey with the developed markets of Germany, the United Kingdom and the United States. Using co-integration techniques and dynamic correlation analysis, the authors find that the markets are co-integrated with those of Germany and the United Kingdom but such co-integration does not exist with the United States. Furthermore, the analysis reveals the presence of time-varying co-integration among these markets with their developed market counterparts.

A similar study by Syriopoulos (2011) considers the integration of Balkan equity markets: Romania, Bulgaria, Croatia, Turkey, Cyprus and Greece with those of the developed markets of Germany and the United States. The author adopts the vector error correction model (VECM), Granger causality test and co-integration framework, in order to capture both the short-run and long-run dynamic linkages. The empirical findings indicate the presence of co-integration vectors, implying the presence of a long-run relationship and interdependence between these markets and the developed markets. Further analysis reveals that both domestic and external forces affect equity market behaviour, leading to a long-run equilibrium relationship.

Pascual (2003) examines integration within the European stock markets, namely the United Kingdom, France and Germany using co-integration techniques. After fixing the power of the co-integration test, the study finds no evidence of an increasing number of co-integrating vectors. In a related study, Mylonidis and Kollias (2010) examine the dynamic process of convergence among the four major European stock markets (namely Germany, France, Spain and Italy) in the first Euro-decade, using a rolling co-integration technique. The results show that, although some convergence has taken place over time, it is still largely an on-going process. Evidence also indicates a high degree of convergence in the German and French markets while the dominant position of Germany within the Eurozone is established.

Voronkova (2004) also investigates equity market integration between the emerging Central European stock market and the mature stock markets of Europe and the United States. Using co-integration techniques and VECM, the study obtains evidence of strong linkages among the Central European markets. The study shows that the Central European markets display equilibrium relations with developed markets even after controlling for structural changes. Overall results suggest greater integration of Central European markets with global markets. Similarly, Bley (2009) examines the integration process of financial markets within the Eurozone with those of the developed markets of the United Kingdom and the United States, using the co-integration technique and ECM. The empirical findings reveal the time-varying nature of the financial market integration process.

Furthermore, empirical research on stock market integration has also been extended to the Asian market. For instance, Gangadharan and Yoonus (2012) examine the level of financial market integration between India and the United States using the Johansen co-integration approach and the vector auto-regression (VAR) model. The study finds evidence of no co-integration between the two stock markets, thus suggesting that the two markets are not integrated. The study also demonstrated that the Indian stock market displays a significant feedback effect from the United States stock exchange to India, whereas the returns from the United States stock market show no significant reaction.

In a related study, Gupta and Guidi (2012) explore the co-integration relationship and time-varying co-movement among India and Asian developed stock markets (namely Hong Kong, Japan and Singapore) over the period 1999 to 2009. Using the Johansen co-integration approach, the result indicates there no evidence of a long-run relationship between the markets. The study also finds evidence of time varying correlations. Further analysis shows that conditional correlations rose dramatically during the period of crisis and return to their initial levels after the crisis. A study by Taneja (2012) examines the short-run and long-run relationship between major world financial markets and Indian stock exchanges over the period September 1999 to September 2010. The main world stock markets considered include: the United States, France, Germany, the United Kingdom, Japan, Turkey, Singapore and Taiwan. Using the co-integration technique and the Granger causality test, the study finds evidence of a significant long-run relationship of Indian stock markets with the United States, France, Japan, Taiwan and Singapore. The paper also reveals the existence of two way causality between the Indian stock market and the United States.

Similarly, Perera and Wickramanayake (2012) analyse financial market integration in major South Asian financial markets: Bangladesh, India, Pakistan and Sri Lanka, using co-integration and causality techniques. The result shows that both stock and bond returns are co-integrated, indicating the existence of common stochastic trends. Additional evidence reveals that stock market integration appears to be much stronger than the less developed bond markets in the region.

Hatemi-J (2012) investigates the degree of financial integration or segmentation of the United Arab Emirates (UAE) stock market with the United States by adopting a new causality test approach. The empirical result, based on the standard symmetric causality tests, suggests that the UAE stock market is segmented from the United States market. However, when the asymmetric causality test is implemented the result reveals that the UAE market is integrated with the United States markets. The result also indicates that the degree of integration is stronger during the downward trend than during the upward trend.

Furthermore, Chen, Chen and Lee (2014) explore the stock integration between frontier and leading markets, focusing on the period of the pre and post global financial crisis. The study covers 29 frontier and 14 leading markets across the globe over the period 2000 to 2011. The results suggest that the United States market Granger causes frontier markets, while this is comparatively less after the crisis than Asian and European frontier markets. The findings mostly support the dominance of leading markets, while the feedback and frontier market dominance are fairly present in the African and Middle East regions after the global financial crisis. The findings further reveal that frontier markets in different regions have distinct relationships with the leading markets.

Though there is a vast amount of studies on financial market integration that used this approach, only a few of them have focused on the integration of African markets with other international markets. Among the early studies in Africa following this approach, Jefferis and Okeahalam (1999) investigate the extent of linkages between three stock markets in Southern Africa, specifically Botswana, South Africa and Zimbabwe. The study also considered the linkages between these markets with emerging markets in Latin America and Asia, and developed markets (namely the United Kingdom and the United States) over the period 1989 to 1996. Using correlation and co-integration methods, the study finds that the South African market is closely related to international markets (specifically, United Kingdom and Asian markets) in the short-run. Botswana is related to the two other regional markets, while Zimbabwe shows little evidence of relationships with other markets.

In a related study by Piesse and Hearn (2002), the authors explore the integration of equity markets in three dominant markets (Botswana, Namibia and South Africa) of the Southern African Customs Union (SACU) using co-integration, Granger causality and autoregressive distributed lag (ARDL) methods. The results show presence of a co-integrating vector between Namibia and South Africa, which indicates a strong common underlying trend in the stochastic data generating process of both countries. Also, the evidence from the Granger causality test suggests that price changes in the Namibia Granger caused price changes in South Africa.

Likewise, Lamba and Otchere (2001) investigate the international linkages among African and world's major developed equity markets over the period 1988 to 2000. The study covers seven African markets (namely Botswana, Ghana, Kenya, Mauritius, Namibia, South Africa and Zimbabwe) and nine developed markets (Australia, Belgium, Canada, France, Germany, Japan, Netherland, United Kingdom and United States). Using the VAR model, the results show that African markets, except South Africa and Namibia, are segmented from the developed markets. The result also shows that the South African market has minimal influence on all other African markets, except Namibia. Wang, Yang and Bessler (2003) examine integration between five African stock markets (Egypt, Morocco, Nigeria, South Africa and Zimbabwe) and the United States over the period 1996 to 2002 using the co-integration method. The findings indicate that regional integration was weak after the 1996 – 1998 crisis. In general, the results suggest that the interdependence between the African markets and the influence of the United States on the African markets was limited over the period.

Adjasi and Biekpe (2006) investigate the links between African stock markets using co-integration and error correction methods between the period 1997 to 2005. The African markets considered in the study include Egypt, Ghana, Kenya, Mauritius, Nigeria, South Africa and Tunisia. The study documents evidence of two stable long-run relationships; one on South Africa and the other on Ghana. The result also shows evidence that dynamic short-run responses and feedback from other African markets are affecting the South African and Ghanaian stock markets in the short-run. Equilibrium correction is found to be faster in the South African model compared to the Ghanaian model.

Alagidede (2008) examines the integration of African markets into the global financial system over the period 1997 to 2006. The study covers four African markets (Egypt, Kenya, Nigeria and South Africa), two Latin American markets (Brazil and Mexico), on Asia (India) and three developed markets (Japan, United Kingdom and United States). Using the co-integration method, the results indicate that African markets share a weak trend with the rest of the world. The result further suggests that African stock markets are not significantly influenced by each other or developed stock markets. In another study by Alagidede (2009), the author examines equity market integration within the emerging and frontier stock markets of south and east Africa, and the rest of the world. The study analysed five stock markets in Africa (namely Botswana, Kenya, Mauritius, South Africa and Zimbabwe) and used the Morgan Stanley Capital International (MSCI) global index as a proxy for world stock markets over the period 1997 to 2006. The results indicate that African markets exhibit weak integration with each other and with the rest of world.

Also, Boako and Alagidede (2016) examine the convergence of eight African stock markets (Botswana, Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa and Tunisia) with the regional and global markets using income convergence hypothesis over the period 2003 to 2014. The findings show that the African markets exhibit partial deterministic convergence both regionally and globally. Similarly, Alagidede, Panagiotidis and Zhang (2011) investigate the extent of integration between African stock markets and the rest of the world using parametric and non-parametric co-integration approaches. Stock markets considered include four markets from Africa (Egypt, Kenya, Nigeria and South Africa) and five markets from the rest of the world (Brazil, India, Japan, Mexico, United Kingdom and United States). The study finds evidence of a few long-run relationships between African markets and also between Africa and the rest of the world. Further analysis shows that the correlations between African markets and other markets are lower.

Piesse and Hearn (2012) examine the price integration between Europe and major stock markets in Africa. The study considered two European stock markets (namely France and United Kingdom) and eight African markets (namely Egypt, Kenya, Mauritius, Morocco, Namibia, Nigeria, South Africa and Tunisia). The evidence from VAR and ARDL methods reveal that African markets are largely price-segmented. Also, the result shows that only markets with shared financial and economic institutions such as Namibia and South Africa, and Egypt, Tunisia and France, are price-integrated.

4.5.2 Studies on financial contagion and volatility transmission

The second research area besides empirical literature on financial market integration is studies that investigate the issue of financial contagion and volatility transmission. The number of empirical studies on financial contagion and volatility transmission has grown extensively during several crises of the 1980s and 1990s (see Claessens, Dornbusch & Park, 2001, for the survey). Many of these studies are based around the notion of correlation and co-movements in financial asset prices or returns across different markets or countries. Within these studies, the commonly shared view is that there is a breakdown in asset correlation during a financial crisis. That is, there is a significant increase in correlation during a crisis period relative to a non-crisis period.

One example from these studies is Louzis (2015), who examines the return and volatility spillover effects in Euro-area financial markets over the period 2000 to 2012. The study covers ten Eurozone countries and the United States. Using the generalised forecast error variance decomposition (GFEVD) and generalised autoregressive conditional heteroskedasticity (GARCH) model, the result suggests a high level of return and volatility spillover effects over the sample period. The study also shows that stock markets in the Eurozone countries are the main transmitter of return spillovers, with the periphery countries transmitting the largest amount of spillovers during the crisis periods.

A study by Bekiros (2013) examines the transmission mechanism as well as the nature of the volatility spillover between the United States, European Union and the BRIC markets (Brazil, Russia, India and China) over the period January 1999 to February 2011. The study also examines both dynamic linear and nonlinear causal linkage among these markets using stepwise filtering, the VAR model and the multivariate generalised autoregressive conditional heteroskedasticity (MGARCH). The empirical result shows that BRIC nations have become internationally integrated after the recent global financial crisis and evidence of contagion is also substantiated by the result. However, there is no evidence in support of the decoupling hypothesis given that some nonlinear causal links exist which could to a large extent be explained by the volatility effects.

Jin and An (2016) obtained a similar result when examining the evidence of contagion between the BRICS (Brazil, Russia, India, China, and South Africa) and the United States stock markets during the recent global financial crisis. The study employed the BEKK-MGARCH model proposed by Engel and Kroner (1995) and the volatility impulse response function (VIRF). The empirical result shows evidence of significant contagion effects from the United States to the BRICS' stock markets during the global financial crisis. However, the result suggests the degree of stock market reactions to such shock differs from one market to another, depending on the level of integration with the international markets

Conversely, the study by Dimitriou, Simos and Kenourgios (2013) examines the contagion effects of the global financial crisis within the framework of multivariate fractionally integrated asymmetric power autoregressive conditional heteroskedasiticity (FIAPARCH) and dynamic conditional correlation (DCC). The paper focuses on five major emerging markets, namely: Brazil, Russia, India, China, and South Africa (BRICS) during the period 1997 to 2012. The empirical result confirms no evidence of contagion during the early stage of the crisis, indicating signs of isolation or decoupling. However, linkages emerged (recoupling) after the collapse of Lehman Brothers, suggesting a shift in investors' risk appetite. Moreover, correlations among all the BRICS and the US increased from early 2009 onwards, implying that their dependence is larger in bullish than in bearish markets.

In a study by Rejeb and Boughrara (2015), the authors investigate the volatility and contagion relationship between emerging and developed markets over the period 1976 to 2008. The study covers seven emerging countries (Argentina, Brazil, Chile, India, Mexico, South Korea and Thailand) and two developed countries (the United States and Japan). Using the Bia and Perron (1998) structural break technique, generalised impulse response function (GIRF) and GARCH model, the authors find evidence of volatility spillover across the financial markets. The finding also suggests that geographical proximity has a greater influence in amplifying the volatility transmission. In addition, the result shows that financial liberalisation helps in amplifying the international transmission of volatility and the risk of contagion.

Another perspective to the financial crisis and contagion studies is provided by Cheung, Fung and Tsai (2010). The authors analyse the impact of the 2007-2009 global financial crisis on the relationships among the global stock markets. Countries considered in the study included the United States, the United Kingdom, Hong Kong, Japan Australia, China and Russia. The analytical frameworks include the VAR model, VECM and Granger causality test. The study documents evidence of an enhanced leadership role of the United States market in the transmission of volatility to the United Kingdom, Hong Kong, Japan, Australia, Russia and China during the crisis. It also reveals evidence of increased interdependence among stock markets during the crisis.

Also, Kenourgios & Padhi (2012) investigate financial contagion of three emerging market crises of the late 1990s, as well as the sub-prime crisis of 2007. The study focuses on the financial markets of eleven emerging economies, the United States and two global indices from January 1994 to December 2008. Using asymmetric DCC, the result shows existence of long- and short-run dynamics among emerging stock markets during the Russian and Asian crises and for both bond and stock markets during the subprime crisis, while the Argentinian crisis has no impact on any of the markets examined. Further evidence shows the global impact of the Russian crisis and the contagion effect of the subprime mortgage crisis. Importantly, the study shows that stock markets constitute a stronger transmission mechanism during the three contagious crises.

There are also studies that focus specifically on the Asian markets. For instance, Yiu, Ho and Choi (2010) investigate the dynamic correlation between eleven Asian stock markets and the United States stock market from February 1993 to March 2009. Using the asymmetric DCC, the authors document evidence of a mean shift in the estimated DCC in late 2007. This therefore, suggests evidence of contagion from the U.S. to the Asian markets. However, there is no evidence of contagion between the U.S. and individual markets in Asia during the Asian financial crisis.

Thao, Daly and Ellis (2013) investigate the transmission of the global financial crisis from the United States to the East Asian equity markets, namely Hong Kong, Japan, Singapore, Malaysia, Thailand, Taiwan and Vietnam. The study employed constant conditional correlation (CCC) and DCC based on the MGARCH model. Their empirical results show variations in the transmission of the global financial crisis into these markets. In addition, their study shows that East Asian markets exhibit higher correlations to other markets within the region than to the US market during the crisis.

Also, Chakrabarti (2011) explores the changing nature of the volatility contagion in the Asian Pacific region during the 2007–2008 financial crisis using the MGARCH framework. The study covers eight stock markets within the region, namely Australia, New Zealand, India, China, Japan, Hong Kong, Jakarta and Malaysia. The finding shows that the crisis has a significant impact on the volatility transmission in the Asian-Pacific region. This suggests that the region has witnessed financial integration with significant volatility transmission. Furthermore, the nature of the volatility spillover has been altered by the crisis. The result also indicates no evidence of asymmetric volatility transmission over the study periods.

Similarly, Jin (2015) examines evidence of volatility transmission among the Greater China stock markets (namely China, Hong Kong and Taiwan) over the period 1993 to 2013 using the BEKK-MGARCH model and VIRF. The findings reveal evidence of return and volatility spillovers among the stock markets in the Greater China region. The result also shows evidence of the positive and large impact of the global financial crisis on the expected conditional variances, but the size and dynamics of the impact is largely market specific. In addition, the evidence shows increased market integration

Other studies that considered the current financial crisis and its contagion effects include Ornberg, Nikkinen and Aijö (2013), Morales & Andreosso-O'Callaghan (2014, 2012), Min & Hwang (2012), Asongu (2012), Pandey & Kumar (2011), Samarakoon (2011), Bekaert, et al. (2011), Chudik & Fratzscher (2011) and Ahlgren & Antell (2010).

There are also studies that are mainly concerned with the issue of volatility transmission across markets without any regard to financial crisis. Their main focus is on how shocks are transmitted across markets. One example of such a study is Antoniou, Pescetto and Stevens (2007), who analyse the volatility transmission from the U.S. and 22 European stock markets to the United Kingdom. The data consist of weekly stock returns from November 4, 1988 to July 11, 2003. The authors utilised the DCC and MGARCH model and found that the United Kingdom equity market is more integrated with the European markets. Further analysis shows evidence of significant volatility spillovers between the U.S. and United Kingdom, and Europe and the United Kingdom.

Similarly, Karunanayake & Valadkhani (2011) investigate the asymmetric effects of volatility transmission across the weekly returns of stock indices of Australia, Singapore, the United Kingdom and the United States over the period January 1992 to June 2010. Using the MGARCH model, the study found significant asymmetric effect in all the markets. Evidence of unidirectional positive mean and volatility spillovers from the United States to other markets, was also found.

Also, Kim, Kim and Kim (2010) examine the transmission of stock price volatility from developed markets to the Korean stock market after the 1997 crisis using bivariate exponential-GARCH (B-EGARCH). The authors find evidence of information transmission from the United States to the Korean stock market. The study documents evidence of a strong price spillover effect from the Japanese market to the Korean market during the crisis period.

They also revealed stronger evidence of asymmetry in the spillover effect of the volatility after the crisis.

Despite the increased number of studies investigating the contagion effects of a crisis and volatility transmission in America, Asia and Europe, only very few studies have been undertaken on stock markets in Africa. For instance, Piesse and Hearn (2005) examine volatility transmission across ten stock markets in Sub-Saharan Africa (Botswana, Ghana, Kenya, Malawi, Mauritius, Namibia, Nigeria, South Africa, Zambia and Zimbabwe) using the EGARCH model over the period 1993 to 2000. The result shows that African stock exhibits volatility that is transmitted differently throughout the markets. The study also shows that the dominant markets of South Africa and Nigeria transmit their volatility to other markets. This effect is particularly significant where there are strong trade links or a share mechanism for stock trading and settlement.

In a related study, Kambadza and Chinzara (2012) analyse the returns and volatility spill-overs among the African stock markets using the factor analysis (FA), VAR and GARCH models, over the period 2000 to 2010. The study covers eight African stock markets, namely Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, Nigeria, and South Africa. The study finds evidence of limited returns and volatility interaction among the African markets except among close trading partners and large economies. More specifically, the result suggests that linkages among the African stock markets only exist along regional blocs. Also, the study shows that the South African market is both the most dominant and endogenous stock market.

Likewise, Kuttu (2014) analyses the returns and volatility dynamic among four African equity markets (namely Ghana, Kenya, Nigeria and South Africa) using MGARCH over the period 2005 to 2010. The result shows evidence of return spillover between Ghana and Kenya, and between Nigeria and South Africa. The result also shows that the South African market exhibits dominance in terms of exporting past return innovations to Kenya and Nigeria. However, Nigeria is dominant in the second moment, exporting volatility to Ghana, Kenya and South Africa.

Another perspective on the issue of contagion and volatility transmission in Africa is provided by Collins and Biekpe (2003). The authors analyse the contagion effects of the Asian crisis of 1997 (specifically, the Hong Kong crisis) on African stock markets using data from eight African countries, namely Egypt, Kenya, Mauritius, Morocco, Namibia, Nigeria, South Africa and Zimbabwe. Using two different approaches (conditional correlation and adjusted conditional correlation), the result shows evidence of no contagion in the majority of African markets, with the exemption of Egypt and South Africa.

In a study by Chinzara and Aziakpono (2009), the authors examine returns and volatility linkages between South Africa and major world equity markets (Australia, China, Germany, Japan, United Kingdom and United States) using GARCH and VAR models over the period 1997 to 2007. The result shows that both returns and volatility linkages exist between the South Africa and the major world stock markets, with Australia, China and the United States showing the greatest influence on South African returns and volatility. The finding also shows that the United Kingdom does not seem to significantly explain variations in either the returns or volatility of South Africa.

Similarly, Giovannetti and Velucchi (2013) analyse the volatility spillover from the United States, United Kingdom, and China on African financial markets (Botswana, Egypt, Kenya, Nigeria, South Africa and Tunisia) over the period 2005 to 2012. The study utilised a Multiplicative Error (ME) approach, which is a generalised GARCH-type of model, to model volatility spillover. The result shows that South Africa, the United States and China play important roles in all African markets, while the influence of events in the United Kingdom is less important. Further evidence from the impulse response analysis indicates that volatility in African markets is due to shock from either the United Kingdom or the Unites States.

Also, Sugimoto, Matsuki and Yoshida (2014) investigate the return and volatility transmission to seven African stock markets (Egypt, Mauritius, Morocco, Namibia, South Africa, Tunisia and Zambia) from the global markets (China, France, Germany, Japan, United Kingdom and the United States), commodity and currency markets during the recent global financial crisis and European sovereign debt crisis. Using spillover indices based on GFEVD, the result indicates that African markets are mostly affected by spillovers from global markets and only modestly from commodity and currency markets. The result also shows that regional spillovers with Africa are smaller than global spillovers. In addition, the result shows that aggregate spillover effects from European countries to the African markets exceed that of the United States.

Utilising a GFEVD approach, Fowowe and Shuaibu (2016) analysed the dynamic return and volatility spillovers between Nigeria, South Africa and international equity markets (Argentina, Brazil, China, France, Germany, Hong Kong, India, Japan, Singapore, South Korea, United Kingdom and the United States) over the period 2005 to 2013. The empirical result reveals a substantial volatility spillover between the Nigerian and South African markets and major international equity markets, when markets from various regions are considered together. The regional analysis shows that the Nigerian and South African markets have greater interdependence with Asian markets than the European markets. The result also suggests that the South African market is more integrated with international markets than the Nigerian market.

4.5.3 Studies on business cycle synchronisation

The third research area that is close to this study relates to the issue of business cycle synchronisation. These studies are related to the current debate that emerging markets' business cycles have decoupled from developed markets' business cycles. Studies here aim at investigating the degree of business cycle interdependence by focusing on the decoupling hypothesis. The majority of these empirical studies are based on the samples comprising markets in the G7, Europe, Asia, Latin America, and the Organisation for Economic Co-operation and Development (OECD).

In one of the studies that considered the issue of business cycle synchronisation, Trancoso (2014) examines the degree of business cycle interdependence in a global context. The study used GDP data from 102 economies over the period 1952 to 2011 and finds increasing transnational economic interdependence with and across all groups of economic development. Importantly, the result supports the evidence of a trend towards economic development clustering, as business cycles tend to be connected. Hence, the result supports the existence of business cycle synchronisation.

Levy Yeyati & Williams (2012) examine real and financial business cycle co-movements between 24 emerging market economies and the G7. The study documents evidence of the gradual decoupling of emerging markets' business cycles from those in advanced economies. Also, it finds that the cross-market co-movements remain high or had grown higher in the years before the 2007 financial crisis. In a similar study by WäIti (2012), the paper tested for the existence of a decoupling hypothesis between 30 emerging markets economies and the G7, over the period 1980 to 2008. Using annual GDP data series, the study rejects the decoupling hypothesis and stresses that the degree of business cycle interdependence has grown stronger.

Also, Kizys & Pierdzioch (2013) examine whether the decoupling or recoupling hypothesis holds for seven equity markets in Latin America, with that of the United States, over the period January 2001 to September 2011. The empirical findings support evidence of the decoupling of Latin American markets from the United States.

Finally, Genc, Jubain and Al-Mutairi (2010) consider the business cycle synchronisation between the two largest economies within the Gulf Co-operation Council (GCC), namely Saudi Arabia and the UAE, with the United States. The study utilises annual GDP data, covering the period 1950 to 2008. The empirical findings show that the business cycles of the two GCC members are not synchronised with that of the United States. Therefore, the results point to the business cycle of these markets having decoupled from the United States. Other empirical studies on this issue can be found in Nachane & Dubey (2013), Felices & Wieladek (2012), Fidrmuc & Korhonen (2010) and Dooley & Hutchison (2009).

4.6 Conclusion

The examination of financial market integration is of crucial importance for the understanding of financial crises and their transmission channels. However, recent literature is still dominated by controversies on the international transmission of a crisis. In particular, they focus on whether the international transmission of a crisis is as a result of integration of financial markets or whether one should simply refer to the contagious effects per se. To this end, this chapter set out to provide a review of both theoretical and empirical literature on the issue of financial market integration, contagion, volatility transmission and business cycle synchronisation. It also provided a discussion on the basic concepts of financial globalisation, financial integration and contagion. The main objective of the chapter was to identify the weaknesses of the previous studies in this area and to position the study within current strand of existing literature, as well as to facilitate a better understanding of this study by defining and discussing the basic concepts.

Given the various definitions of financial market integration presented above, the strict definition of integration offers intuitively appealing predictions about integration. However, it has been criticised due to the rigid assumptions of complete integration implied by the definition. Moreover, empirical evidence suggests that markets are not perfectly integrated into the world market (Arouri & Foulquier, 2012). As a result, the present study adopts the broad definition, which simply refers to an individual financial market's linkage to international financial markets (Herrero and Wooldridge, 2007 and Prasad et al., 2007). The adoption of this definition is in line with the objective of this study since it underlines interdependence or partial integration of markets through trade and financial flows. Also, the definition offers more realistic assumptions that can be applied to all markets. In particular, it does not ignore the evolutionary and gradual character of financial integration. That is, it views financial integration as a process.

The review of empirical studies on financial market integration shows that different measures have been used to investigate the issue of financial market integration. One measure is based on price or return equalisation, which relies on parity condition and asset pricing models. However, a number of criticisms have been levelled against this approach but two important criticisms stand out in relation to the application of such an approach to African markets. First, the liquidity effect, which affect the capacity to perform arbitrage due to infrequent trading and it might cause stock prices to be sensitive to trading in a given stock when the market is not deep enough. Second, capital controls on cross-border capital flows affect the cross-market premium (Levy Yeyati et al., 2009). Such controls affect asset prices by limiting investors to directly hold asset with country-specific risk. With limited liquidity and some capital controls in African markets, as noted in Chapter 2, the scope for arbitrage is limited and there might be a liquidity premium, or cross-market premium, that prevents prices from equalising across markets.

In view of these criticisms, the co-integration approach has emerged as one of the commonly used methods in the literature for testing financial market integration. This approach has the advantage of being simple and dynamic. Its simplicity is due to the fact that it imposes few restrictions. In terms of its dynamic character, it has the capacity to capture the common stochastic trends between different markets and the specification of their dynamic adjustment towards greater integration. Therefore, the present study follows this approach.

On the issue of contagion, the present study builds on the very restrictive definition of contagion, which views contagion as a significant increase in correlations of asset returns across markets during a crisis period relative to the correlations during a pre-crisis period. However, in order to account for diverse views expressed in the literature, this study provides two conditions as benchmarks for analysing evidence of contagion. First, if two markets are integrated before a crisis, any increase in correlation during the crisis period cannot be considered as contagion unless the correlation between the markets increased significantly. Based on this condition, if two markets are integrated and exhibit a considerably high correlation during the pre-crisis period, even if the markets remained highly correlated during crisis period, this may not be considered as contagion. This is because the correlation may be as a result of the integration of the two markets. Hence, it is only contagion when the correlation increases significantly during crisis period. This condition requires a good understanding of the historical correlation as well as the correlation during the pre-crisis and crisis periods. Moreover, this condition is consistent with the view expressed by the non-crisis contingent literature.

Second, contagion exists if the markets are not integrated before the crisis and there is evidence of significant increase in correlation during the crisis period relative to the pre-crisis period. In this context, if two markets are moderately correlated during the pre-crisis period and a shock to one markets leads to a significant increase in correlation, this can be viewed as contagion. According to this condition, contagion does not require direct linkages of macroeconomic fundamentals for shocks to be transmitted across markets. That is, contagion can be transmitted indirectly through other markets. Moreover, the correlation of markets that share common economic linkages can be rationalised on the basis of economic theory. However, such an economic theory is not that convincing in accounting for the increased correlation among financial markets that are weakly related. In this way, these two conditions account for the influence of integration and contagion separately. Therefore, these conditions provide a basis for analysing contagion in this study.

The analysis of the empirical studies on contagion and volatility transmission show divergent findings on contagion, which can be largely attributed to how contagion is defined and the approaches adopted in the empirical testing. The different and inconsistent findings of these studies using various empirical frameworks make it difficult to compare results and to draw meaningful conclusions. However, one important observation emerges from the existing studies and that is that most of them did not consider African stock markets in their analyses. Previous studies on this issue have concentrated predominantly on the emerging and developed markets in other regions, thus creating a huge gap in the literature. From an African perspective, it is pertinent to wonder whether the 2007 global financial crisis did in fact generate the contagion effect on African economies, or whether markets in Africa were just reacting to their integration with other markets. Another important observation emerging from the existing studies is the fact that the majority of these studies tend to consider the issues of financial integration, contagion, volatility transmission or the business cycle synchronisation in isolation, instead of taking a comprehensive view or dealing with them jointly.

Against this background, this study differs from the extant literature in the following aspects. First, the study takes a joint approach in dealing with the issue of financial integration, contagion, volatility transmission and business cycle synchronisation. Following this line of thinking, this study intends to open a new line of thought that would permit a better definition of what can be considered as 'contagion'. Second, the study expands the current empirical research on the pattern of dynamic integration and contagion to African equity markets, instead of focusing on the developed and emerging markets in other regions. In this framework, the study elucidates how vulnerable African markets are to the both emerging and global market shocks. Third, a comparative analysis is undertaken with equity markets grouped into different markets (Africa, emerging and developed markets) in order to identify possible divergence in their behavioural patterns. This is important given the existing debate on decoupling hypothesis. To fill these gaps in the literature, the next chapter will focus on the empirical framework (the methodology) that was used in addressing the objectives of this study.

CHAPTER FIVE

RESEARCH METHODOLOGY

5.1 Introduction

This chapter provides the analytical frameworks used in addressing the objectives of this study as highlighted in Chapter One. The analytical frameworks considered in this chapter are consistent with the existing literature on financial market integration, contagion and volatility transmission and they can be summarised into two groups. The first analytical framework deals with the relationship or financial integration between African stock markets and major international stock markets by means of a co-integration test, Granger causality test, generalised impulse response function (GIRF) and generalised forecast error variance decomposition (GFEVD) analysis. The second framework, then, deals with testing for contagion and volatility transmission using the dynamic conditional correlation of generalised autoregressive conditional heteroskedasticity (DCC-GARCH) model and the aggregate shock (AS) model.

The present chapter is organised and presented in six sections. However, the chapter follows a standard practice in the literature by dealing with the issue of unit root and stationarity tests in the first section. The second section focuses on modelling stock market integration. The third section provides the analytical framework for modelling contagion and volatility transmission. The fourth section provides the description of data and their sources. The fifth section deals with the scope of the study and the last section provides a summary for the chapter.

5.2 Unit root and stationarity tests

One of the key concepts underlying time series analysis is whether a data set is stationary or non-stationary. In time series analysis, it may not be reasonable to assume that the underlying data series is stationary because time series data has the tendency to grow over time. As a result, regressing one time series variable on another time series variable could sometimes produce a high R-squared without any meaningful relationship between the variables when they are non-stationary (Asteriou & Hall, 2011). This situation suggests a spurious relationship between the variables. Such a spurious relationship arises when the variables experience sustained upward or downward trends. In the presence of non-stationarity (unit root), the observed high R-squared does not reflect the true relationship. In other words, when the time series is non-stationarity, the standard ordinary least square (OLS) regression procedures can lead to incorrect conclusions. This is because the OLS estimate is inconsistent and the tests for statistical inference are not valid (Asteriou & Hall, 2011).

The basic idea behind stationarity is that if for instance, the stock market return series is stationary, the growth path will rest along the long-run deterministic trend and any shock to the series will cause a temporal departure from the trend line. Eventually, the effects of the shock will die out and the series will revert towards the long-run trend. As such, it will be possible to accurately predict the behaviour of the series. Conversely, if the series is non-stationary, any shock to the series will cause deviations from the deterministic trend and shock will persist (Asteriou & Hall, 2011).

To test for the stationarity of the stock market returns series, this study employs two commonly used approaches for unit root testing, namely Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. The study also utilised a stationarity test by Kwiatkowski, Phillips, Schmidt and Shin (1992), commonly known as KPSS test.

5.2.1 Augmented Dickey-Fuller (ADF) test

A formal procedure for testing the stationarity or unit root in time series was devised by Dickey and Fuller (1979). Thereafter, Said and Dickey (1984) developed a modified version of the Dickey-Fuller (DF) test in order to account for autocorrelation in the disturbance (error) terms and this modified version is known as the ADF test. The modified DF test (ADF) defers from the original version in that it suggests the possibility that the error terms may be autocorrelated when the model does not have sufficient lag terms to capture the behaviour of the series. That is, to ensure that the regression gives an unbiased estimate of the lag coefficients, the number of lags included in the ADF test is optimised by minimising the information criterion in order to deal with the problem of autocorrelation (Bley, 2009). The ADF test has three possible models of a data generating process as:

Model 1: with drift

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{1}$$

Model 2: with drift and deterministic trend

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \lambda t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (2)$$

Model 3: without drift or deterministic trend

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \qquad (3)$$

where y_t is log of stock returns, α_0 is drift term, λ is the coefficient on a deterministic trend, Δy_t is the change in the log of stock returns and y_{t-1} is the log of past or lagged value of the stock returns. The change in the log of past value of stock returns is expressed as $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$, $\Delta y_{t-2} = (y_{t-2} - y_{t-3})$, ……. The hypothesis for unit root is expressed in terms of ρ. The null hypothesis is that log of stock returns contain a unit root when $\rho = 1$ and therefore it is non-stationary, is tested against the alternative that it has no unit root when $\rho < 1$. The hypothesis can be formally expressed as:

$$H_0: \rho = 1 \sim I(1) \rightarrow (has\ a\ unit\ root)$$

$$H_1: \rho < 1 \sim I(0) \rightarrow (has\ no\ unit\ root)$$

Stated in this form, the null hypothesis indicates that the series has a unit root; hence, it is integrated of order one or $I(1)$. Conversely, the alternative hypothesis indicates that the series does not contain a unit root, as such it is integrated of order zero or $I(0)$.

5.2.2 Phillips-Perron (PP) test

Following the development of the ADF test, Phillips and Perron (1988) developed a more generalised form of ADF testing procedure. Although PP test is similar to the ADF test, they differ in terms of how they deal with the issue of serial correlation and heteroskedasticity. While the ADF test accounts for serial correlation by using more lags of the first differenced dependent variable, the PP test corrects for this problem non-parametrically by directly modifying the Dickey-Fuller test statistics. Consequently, the PP test is generally more robust in the presence of heteroskedasticity than the ADF test. Like the ADF test, the PP test can be performed following the three possible models as identified above; with the drift and deterministic trend, with drift or without the drift and deterministic trend. The test regression for the PP test can be specified as an autoregressive process of order one or AR(1):

$$\Delta y_{t-1} = \alpha_0 + \rho y_{t-1} + u_t \tag{4}$$

where Δy_{t-1} is the change in past value of stock market returns, α_0 represents the drift term, u_t represents the error term and may be heteroskedastic. The null hypothesis in the PP test follows the same decision rule as in the case of ADF test where the null hypothesis is that $\rho = 1$ against the alternative that $\rho < 1$.

While the ADF and PP tests are commonly used approaches for testing the presence of unit root, both tests have been criticised because of their low power when a process is stationary but with a root that is close to the non-stationary boundary (Bley, 2009). In other words, these tests may not accurately differentiate between a very highly persistent stationary process and non-stationary process. Also, the power of these tests is reduced as deterministic terms are added to the test equations. That is, a model that includes a drift term and deterministic terms has less power than a model that includes only the drift term (Brooks, 2008). To overcome some of these weaknesses, a confirmatory or stationarity test has been proposed and the testing procedure is outlined below.

5.2.3 Stationarity test

Following the low power of unit root tests, the stationarity test was developed to complement these tests. Unlike the unit root tests discussed above, the stationarity test follows the null hypothesis that the stock market returns is *I(0),* against the alternative that it is *I(1).* That is, it tests the null hypothesis of stationarity against the alternative hypothesis of non-stationary. The most commonly used stationarity test was developed by Kwiatkowski et al. (1992), and the test equation is derived from the model below.

$$y_t = \lambda' D_t + \mu_t + u_t \tag{5}$$

$$\mu_t = \mu_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon^2)$$

where D_t contains deterministic components (drift or drift plus deterministic trend), u_t is *I(0)* and may be heteroskedastic and μ_t is a pure random walk with innovation variance σ_ε^2. The null hypothesis that y_t is I (0) implies stationarity is formulated as $H_0 \colon \sigma_\varepsilon^2 = 0$ while the alternative hypothesis is that $H_1 \colon \sigma_\varepsilon^2 > 0$, implies non-stationary.

Finally, it is worth noting that the sequential testing procedure will be followed in this study when testing for the presence of unit root or otherwise in log-level and first-difference using the ADF and PP tests. This procedure requires testing for unit root using the three data generating processes - model with drift (Model 1), model with drift and deterministic trend (Model 2) and model with neither drift nor deterministic trend (Model 3). For the stationarity test (KPSS test), the test is carried out using Model 1 and Model 2.

5.3 Modelling stock market integration

The study of financial integration has long been of interest to financial and economic literature following the severe financial turbulence in the 1970s, especially the oil shocks of 1973 and 1979 (Rejeb & Boughrara, 2015). Several approaches have been adopted in the literature for this purpose based on the strict and broad definitions of market integration as discussed in Chapter Four. Under the strict definition, financial market integration is measured by the equalisation of price or return of similar assets across markets. This is done by evaluating the parity condition and the implied asset pricing model. However, the validity of these approaches has been questioned due to the restrictive condition of full integration implied by the models (see Marston, 1995; and Lemmen, 1998).

Consequently, a growing number of studies have relied on the broad definition as a way of modelling financial market integration. This is largely based on the incomplete integration assumption implied by the definition. As a result, the current study focuses on the broad definition in which financial market integration is viewed as a convergence or co-movement of asset returns across markets. In this context, integration emphasises that markets that share a common stochastic trend cannot diverge far away from each other. Though potential for deviation may exist in the short-run, in the long-run markets tend to converge towards their common trend, thus implying the existence of long-run relationship between the markets (Yu, Fung & Tam, 2010). Therefore, the following section considers the co-integration approach as a method of modelling financial markets integration.

5.3.1 Co-integration test

The empirical finding that many financial variables may contain a unit root (non-stationary) prompted the evolution theory of non-stationary time series analysis. Engle and Granger (1987) show that a linear combination of two or more non-stationary variables may produce an innovative term that is stationary. Since this landmark finding, it has become common-place to examine the long-run relationship between two financial variables. Literature refers to the co-integration approach as one of the most extensively used methods to examine the long-run relationship between two financial variables (Gangadharan & Yoonus, 2012 and Yang, 2012).

The co-integration approach was first popularised by Engle and Granger (1987). In their study, the authors noted that, when variables are co-integrated, it indicates that they share common stochastic trends. In other words, the variables move together through time and despite following their individual paths, will not drift apart since they are linked to some common trends. Following this idea, Engle and Granger (1987) developed a method of testing for co-integration between two variables. The method is based on analysing the stationarity of error term obtained from the equation derived with level values of time series that are non-stationary in level but become stationary after taken their first difference. Unfortunately, the Engle-Granger approach has many drawbacks. Commonly listed drawbacks include the sensitivity of the critical values to the sample size; the restrictive assumption that designates one of the variables as exogenous (endogeneity problem); and the assumption of one co-integrating vector when there are more than two variables in the model (Park & Gaidai, 2005; Sjo, 2008; and Asteriou & Hall, 2011).

To overcome most of these weaknesses, Johansen (1988) developed a new approach based on the vector autoregression (VAR) framework which is capable of capturing multiple long-run relationships. The Johansen's co-integration technique can be viewed as a reduced rank regression based on a maximum likelihood estimation procedure. This test applies primarily to variables that are integrated of order one or commonly denoted as $I(1)$. With this test, it is possible to estimate all co-integrating vectors when there are more than two variables. Therefore, in order to explore the international integration of African stock markets with the globally developed and emerging stock markets, the Johansen's co-integration approach is used and the model is presented below.

The Johansen's co-integration technique takes its starting point in the VAR model of the order p. In empirical studies, the VAR model is commonly used to evaluate the dynamic influence of random shocks on the system of variables. The model involves a system of equations whereby all the variables are modelled as endogenous variables and each endogenous variable is expressed as a function of its own lagged values and the lagged values of all other variables in the system (Sims, 1980). This approach allows for a systematic means of addressing dynamics in multiple time series. To find out which variables adjust, and which do not adjust, to the long-run co-integration relations, an analysis of the full system of equations is required. The $VAR(p)$ model in levels can be specified as:

$$y_t = \mu_0 + A_1 y_{t-1} + ... + A_p y_{t-p} + \delta_t + \varepsilon_t \qquad (t = 1, ..., T) \tag{6}$$

where y_t is an $n \times 1$ vector of stock market returns that are integrated of order one – commonly denoted as *I(1)*; $A_1, ..., A_p$ are $n \times n$ coefficient matrices; μ is an $n \times 1$ vector of constant; δ_t is a vector of trend coefficients; p is assumed to be the optimal lag length required to eliminate autocorrelation in the residuals and ε_t is an $n \times 1$ vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lag and any of the right hand side variables.

As a necessary condition before testing for co-integration, the optimal number of lags in $VAR(p)$ required to capture the dynamics in the data series needs to be determined. This is to ensure that the error term is standard normal and does not suffer from non-normality, autocorrelation and hetroskedasticity problems (Asteriou & Hall, 2011). Basically, the point is to select the number of parameters that minimise the value of the information criteria and to ensure that the model estimated is parsimonious (Brooks, 2008). To determine the optimal lag length of the $VAR(p)$, this study employed the Akaike information criterion (AIC), Schwarz Bayesian criterion (SBIC) and the Hannan-Quinn information criterion (HQIC). These tests can be algebraically expressed as:

$$AIC = \ln(\hat{\sigma}^2) + \frac{2k}{T} \tag{7}$$

$$SBIC = \ln(\hat{\sigma}^2) + \frac{k}{T}\ln T \tag{8}$$

$$HQIC = \ln(\hat{\sigma}^2) + \frac{2k}{T}\ln(\ln(t)) \tag{9}$$

where $\hat{\sigma}^2$ is the residual variance which is equivalent to the residual sum of squares divided by the number of observations T and k is the number of parameters. The point here is to select the number of parameters which minimise the value of the information criteria in order to ensure that the estimated model is parsimonious (Brooks, 2008).

However, there is the possibility that the number of lags suggested by different information criteria might differ for a particular relationship. This can be attributed to differences in weight assigned to the penalty term for the number of parameter (Brooks, 2008 and Lutkepohl, 2005). Moreover, evidence in the literature has shown that Johansen's co-integration test is sensitive to the number of lags used in the estimation of the VAR model (Stock & Watson, 1993). Hence, to ensure the robustness of the selected lag length, the residual is tested for series autocorrelation using the Lagrange multiplier (LM) test. However, where the residual from the suggested model is found to be serially correlated, the model is re-estimated using a higher lag length and the residual from the model is again tested for serial correlation until the appropriate model is determined.

The next step in Johansen co-integration procedure is to transform the VAR in levels to a vector error correction model (VECM) as:

$$\Delta y_t = \mu_0 + \Gamma_1 \Delta y_{t-1} + ... + \Gamma_{p-1} \Delta y_{t-p+1} + \Pi y_{t-1} + \varepsilon_t \tag{10}$$

$$\varepsilon_t \sim iid(0, \Omega_\varepsilon)$$

In a more compact form, the VECM in equation (10) can be re-written as:

$$\Delta y_t = \mu_0 + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \tag{11}$$

where μ_0 is a vector of constants; y_t is an $n \times 1$ vector of endogenous variables; ε_t is a vector of residuals and, Γ and Π are $n \times n$ matrices, with $\Pi = \sum_{i=1}^{p} A_i - I$ and $\Gamma = -\sum_{j=i+1}^{p} A_j$.
The matrix Π can be decomposed as $\Pi = \alpha\beta'$; where the relevant elements of α matrix are the adjustment parameters in the vector error correction model and the β vector or matrix contains the co-integrating vectors. As interest lies in α and β, the number of co-integrating vectors is identical to the number of stationary relationships in the $\Pi -$matrix. For instance, if the matrix Π equals is zero, that is $\Pi = 0$, then the variables are not co-integrated (non-stationary) and the relationship reduces to the VAR in first differences. At this point, the conclusion is that modelling should take place in first difference. However, if there are stationary variables in Π then some parameters in the matrix will be non-zero and co-integration is present.

Furthermore, the rank of Π matrix determines the number of independent rows in $\Pi,$ and the number of co-integrating vectors. If the Π matrix has a full rank, that is $\Pi = p,$ then all the variables in model must be stationary. If Π has a reduced rank, $0 < r < p$, there are co-integrating relations among the variables, where r is the number of the co-integrating vector and $p-r$ the number of common trends. The rank of Π is given by the number of significant eigenvalues found in $\hat{\Pi},$ which represent a co-integrating relation. To test whether $\Pi = 0,$ or otherwise, Johansen (1988) provides two simple techniques for determining significant eigenvalues that are based on the likelihood ratio test. These tests are nested in nature and are presented below.

One method of testing the number of significant eigenvalues or the number of co-integrating vectors is by the use of the maximum eigenvalues test. The maximum eigenvalue test examines whether the largest eigenvalue is zero relative to the alternative that the next largest eigenvalue is zero. The maximum eigenvalue test is constructed as:

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \tag{12}$$

where T is the sample size and $\hat{\lambda}_i$ is the *i*th largest canonical correlation. The test statistics are based on the characteristic root obtained from the estimation procedure known as maximal eigenvalue. The null hypothesis that the rank $\Pi = 0$ is tested against the alternative that the rank is $\Pi = 1$. In other words, if the rank of the matrix is zero, the largest eigenvalue is zero, there is no co-integration among the variables and the test ends. However, if the largest eigenvalue λ_1 is not zero, then the rank of the matrix is at least one or more. The test continues until the null hypothesis of an eigenvalue equal to zero cannot be rejected.

The second test is the trace statistic, which tests the null hypothesis that the rank of $\Pi = r.$ The test statistic considers whether the trace is increasing by adding more eigenvalues beyond the *r*th. The trace test statistic is computed as:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_i) \tag{13}$$

The null hypothesis that the rank of $\Pi = r$ is tested against the alternative that $r < rank(\Pi) \le n$ (where n is maximum number of possible co-integrating vectors). If the null hypothesis is rejected, the next null hypothesis is that rank $\Pi = r_0 + 1$ and the alternative hypothesis is that $r_0 + 1 < rank(\Pi) \leq n.$

Generally, the co-integration method provides a useful way of analysing the dynamic relationship between variables in a system. However, it is often difficult to interpret the cointegration relations directly, especially if there are two or more cointegrating relations (Lutkepohl & Reimers, 1992; and Lutkepohl & Saikkonen, 1997). For instance, one may establish the existence of a relationship between two stock markets using the co-integration approach but may not establish whether one stock market is the pace-setter and the other a follower (i.e. the lead-lag relationship). In this situation, the price change in the leading market would be driving the prices in the other market. As such, the leading stock market is assumed to be exogenous to the other market. Alternatively, neither of the markets might be more important than the other if bidirectional causality exists between them.

In addition, studies have argued that a shock to a given variable may not only affect the variable itself but also be transmitted to other variables in the system through the dynamic lag structure of the model (Lutkepohl & Reimers, 1992 and Lamba & Otchere, 2001). Therefore, to overcome these weaknesses, a range of different approaches have been proposed in the literature that aid an understanding of the relationship between variables of a system. These approaches include the Granger causality test (Granger, 1969), impulse response function and forecast error variance decomposition. The construction of these tests is presented in the section below.

5.3.2 Granger causality test

One of the most important features of a VAR model is that it allows one to examine causal linkages among different stock markets (direction of causality). In particular, it provides an avenue for exploring the predictive power of one stock market with respect to another. Therefore, to identify any causal relationship among the major global stock markets with the developing stock markets in Africa, the study uses the conventional approach to causality testing known as the Granger causality test (see Granger, 1969). The Granger causality test is based on a VAR framework. In a bivariate system of stationary variables x_t and y_t (where each variable represents a particular stock market), the VAR connecting these markets can be formally described as:

$$\Delta x_t = \mu_1 + \sum_{i=1}^{q} \alpha_{1i} \Delta x_{t-i} + \sum_{j=1}^{p} \psi_{1j} \Delta y_{t-j} + \varepsilon_{1t} \tag{14}$$

$$\Delta y_t = \mu_2 + \sum_{i=1}^{q} \alpha_{2i} \Delta x_{t-i} + \sum_{j=1}^{p} \psi_{2j} \Delta y_{t-j} + \varepsilon_{2t} \tag{15}$$

where q and p are the lag order of the respective variables, ε_{1t} and ε_{2t} are assumed to be uncorrelated white-noise error terms in the system. To test whether y strictly Granger causes x is simply a test of the joint restriction that all coefficients (ψ) in equation (14) are zero. While, a test of whether x strictly Granger causes y is a test of the joint restriction that all coefficient (α) in equation (15) are zero. In a unidirectional situation, the null hypothesis of no causality is rejected if the restriction is rejected. Furthermore, if both ψ and α joint significance test are different from zero, the stock markets are bi-directionally related.

The causality test indicates which of the variables in the model have a statistically significant effect on the other variables in the system. However, it does not provide information as to whether a change in a given variable has a positive or negative effect and how long it would take for the effect to work through the system. Such information is provided by the impulse response functions and forecast error variance decompositions. The next two sections explore these tests.

5.3.3 Generalised impulse response functions (GIRF)

Given the interest in understanding how shocks in the major global markets can affect stock markets in Africa or vice versa, an impulse response function is adopted. The impulse response function traces the response of one variable to an impulse or shock from another variable in a system that involves a number of variables (Ben-Kaabia, Gil & Chebbi, 2002). To analyse the dynamic response of a given system, the VAR model in equation (6) is typically transformed into its infinite moving average (MA) representation as:

$$y_t = \sum_{i=0}^{\infty} \Phi_i \varepsilon_{t-i}, \tag{16}$$

where $\Phi_0 = I_K$ and the $k \times k$ coefficient matrices Φ_i can be obtained using the following recursive relations as:

$$\Phi_n = (\varphi_{ik,n}) = \sum_{j=1}^{n} \Phi_{n-j} A_j \qquad n = 1,2.....,\tag{17}$$

with $A_j = 0$ for $j > p$, and $\varphi_{ik,n}$ is the *ik*th element of Φ_n which represents the response of variable y_i to a unit shock in variable k, n periods ago. Typically, the computation of the dynamic analysis of the VAR model routinely relies on the orthogonalised impulse responses. Here, the underlying shocks in the system are orthogonalised using the Cholesky decomposition before the impulse responses or forecast error variance decompositions are computed (Pesaran & Shin, 1998). However, this approach has been heavily criticised for being sensitive to ordering of variables in the VAR model when the covariance matrix of the error term is non-diagonal (Pesaran & Shin, 1998; Ben-Kaabia et al., 2002; Bley, 2009; and Rejab & Boughrara, 2015).

As a result, an alternative approach to impulse response, which is not sensitive to the ordering of the variables in VAR has been proposed by Pesaran and Shin (1998) based on the work of Koop, Pesaran and Potter (1996). This approach is known as the generalised impulse response function (GIRF). Following Pesaran and Shin (1998), the GIRF of y_t to the shock δ at horizon n is defined as:

$$GIRF_y(n, \delta, \Omega_{t-1}) = E[y_{t+n} | \varepsilon_t = \delta, \Omega_{t-1}] - E[y_{t+n} | \Omega_{t-1}] \tag{18}$$

$$n = 0, 1, 2, ...,$$

where δ is some known vector of shocks occurring at time t compared with the baseline profile $t+n$. $E[y_{t+n} | \varepsilon_t = \delta, \Omega_{t-1}]$ means taking the expectations conditional on the information set, Ω_{t-i} and for a fixed value of the *ith* shock at time t. Using equation (18) and (16) the VAR process is $GIRF_y(n, \delta, \Omega_{t-1}) = \Phi_n \delta$ which is independent of Ω_{t-i}, but depends on the composition of shocks given by δ.

As an alternative to applying shock to all elements of ε_t, equation (18) can be used directly by shocking one element such that $\varepsilon_{jt} = \delta_j$. Therefore, the GIRF can be redefined as:

$$GIRF_y(n, \delta_j, \Omega_{t-1}) = E\left[y_{t+n} | \varepsilon_{jt} = \delta_j, \Omega_{t-1}\right] - E\left[y_{t-n} | \Omega_{t-1}\right] \tag{19}$$

Suppose $\delta_j = \sqrt{\sigma_{jj}}$, the standard deviation of ε_{jt}, and ε_t is assumed to be Gaussian, the scaled GIRF is given by:

$$E\left[\varepsilon_t \middle| \varepsilon_{jt} = \sqrt{\sigma_{jj}}\right] = \sigma_{jj}^{-1/2} \Phi_n \sum e_j \tag{20}$$

Equation (20) measures the response in $y_{t=n}$ from a one standard deviation shock to ε_{jt}, where the correlation between ε_{jt} and ε_{it} are accounted for. The GIRF has been adopted in some studies like; Papapetrou, (2001), Ben-Kaabia et al., (2002), Cong, Wei, Jiao & Fan, (2008), Bley, (2009), and Rejab & Boughrara, (2015). Following these studies, the current study employs the GIRF to analyse the short-run dynamics of the stock markets.

5.3.4 Generalised forecast error variance decompositions (GFEVD)

The forecast error variance decomposition (FEVD) is one of the prominent tools for interpreting dynamic relationships in a system. It provides information about the proportion of the movements in a given variable due to its own shocks and shocks from other variables in the system (Papapetrou, 2001). More precisely, the FEVD can be defined as the proportion of the n-step ahead forecast error variance of variable i which is accounted for by the innovation in the variable j in the system (Pesaran & Shin, 1998). Following equation (19), the GFEVD can be defined as:

$$\Theta_{ij}(n) = \frac{\sigma_{ii}^{-1} \sum_{l=0}^{n} (e_i^{'} A_l \sum e_j)^2}{\sum_{l=0}^{n} e_i^{'} A_i \sum A_l^{'} e_i} \tag{21}$$

$$n = 0, 1, 2, \ldots,$$

where, the denominator is the mean squared error (forecast error variance) of an n-step forecast of the i th variable, σ_{ii} is the i th diagonal element of $\sum$ and e_i is a selection vector, whose i th element takes the value of one and all other elements are zeros.

5.4 Modelling financial contagion and volatility transmission

One of the main stylised facts about a period of financial crisis is that the fundamental relationships between asset returns appear to break down across different markets and asset classes (Dungey & Martin, 2007). In effect, this suggests that the correlation between asset returns and volatility of asset returns usually increases during a crisis period, relative to non-crisis period (Forbes & Rigobon, 2002). As such, testing for contagion and volatility transmission requires modelling the dynamics of multiple markets or assets as well as their correlations and volatilities during a financial crisis period. However, there is a large body of empirical literature on the issue of financial contagion and volatility transmission and a wide range of empirical frameworks have been proposed in the literature based on different definitions of contagion (see Dungey, Fry, Gonzalez-Hermosillo and Martin, 2005 for a review of empirical methodologies). Cheung et al., (2009) summarised empirical f rameworks used in the literature for testing the presence of contagion into three groups; namely latent factor model, co-movement analysis and models of asymmetries and nonlinearities (see Figure 5.1 in Appendix A for details).

However, given the stylised fact that financial markets during the periods of crisis tend to exhibit high correlation and volatility, models which fail to incorporate these features are more likely to be misleading. Moreover, volatility is a measure of information flow and change in volatility is associated with the arrival of new information (Ross 1989). The arrival of new information allows investors to change their prior beliefs about the market, which leads to price changes. This therefore, suggests that any empirical framework used in modelling evidence of contagion and volatility transmission should account for these important features. Consequently, examining the behaviour of correlation and volatility provides a good basis for testing the evidence of contagion. Following this view as well as the evidence in the literature, this study adopts two empirical frameworks that account for these features; namely, the dynamic conditional correlation analysis (DCC) and the aggregate shock (AS) model. These empirical frameworks are discussed below.

5.4.1 The dynamic conditional correlation (DCC) model

The behaviour of correlation and volatility provides a critical input in examining evidence of contagion. As a result, correlation analysis is the most widely used measure for testing the evidence of contagion. The correlation approach offers a straightforward way of testing for cross market contagion. However, evidence in the literature points to bias in the simple correlation (unconditional) coefficient due to the presence of heteroskedasticity in the stock market returns (Forbes & Rigobon, 2002). The authors show that in the presence of heteroskedasticity, the estimated cross-market unconditional correlation coefficients would be biased upward during a crisis period. Dungey et al. (2005) argue that the weakness of unconditional correlation coefficient is because crisis periods are usually characterised by high volatility and correlations are a positive function of volatility.

In order to overcome this weakness in the unconditional correlation approach as well as recognising that the constant correlation coefficients are not able to capture the dynamic market conditions in response to innovations, studies have proposed a variety of dynamic covariance models and dynamic correlation models. The original autoregressive conditional heteroskedasticity (ARCH) model popularised by Engle (1982), and its generalised form the GARCH model introduced by Bollerslev (1986), provides a convenient way of modelling dynamics in volatility. More recently, the GARCH model has been extended to multivariate GARCH (MGARCH) models in order to capture simultaneously the dynamic processes of conditional volatility and conditional correlation.

Importantly, the use of MGARCH helps in examining the pattern of correlations in the second moment across markets and asset classes. Hence, the models provide a superior measure of correlation than the adjusted correlation test, since the volatility is adjusted and the time-varying correlation is not biased by the volatility (Cho & Parhizgari, 2008). Moreover, the specification of the model overcomes the problem with omitted variables, as they are modelled as the unobservable common shocks (Billio & Pelizzon, 2003). Another advantage of the MGARCH model is that the model accounts for heteroskedasticity directly by estimating the correlation coefficient of the standardised residual (Chiang, et al, 2007)

Different classes of MGARCH models have been proposed in the literature, which differ in their specification of the conditional variance matrix of the stochastic vector process (Kuper & Lestano, 2007). For instance, Bollerslev, Engle and Wooldridge (1988) propose a diagonal representation in which the variance depends on its own past squared errors and covariance on its past cross-product of errors. Engle and Kroner (1995), consequently, proposed a reparameterised version that easily imposes positiveness and this model is commonly known as the Baba, Engle, Kraft and Kroner (BEKK) model.

However, a problem with the above specifications of MGARCH models is that the number of parameters increases rapidly as the dimension of the correlated series increases (Trancoso, 2014). As a result, Engle (2002) proposes a class of MGARCH models, known as DCC-GARCH, as a convenient way to parameterised the conditional correlations directly. The model has the flexibility of the univariate GARCH models coupled with a parsimonious parametric model for the correlations. In the model, the number of parameters to be estimated in the correlation process is not a function of the number of series to be correlated (Engle, 2002).

The application of the DCC-GARCH model to financial contagion in general, and to African financial markets in particular, is fairly recent. Engle (2002) proposes a two-stage approach for estimating the DCC-GARCH model. In the first stage, the conditional variance is estimated by fitting the simple univariate GARCH model to each stock market return. In the second stage, the estimated standardised residuals from the first stage are used to estimate the parameters of the conditional correlations utilising the DCC-GARCH model.

To formally specify the DCC-GARCH model, let the stock market returns in two different stock markets at time t be given by the following conditional mean equation as:

$$\Delta y_t = \mu_0 + \phi_1 \Delta y_{t-1} + \varepsilon_t \qquad \varepsilon_t | I_{t-1} \sim N(0, H_t) \tag{22}$$

where y_t is the stock market returns at time t, y_{t-1} denotes the stock market returns at time $t-1$ and Δ is a first-difference operator. The market innovation, which is conditional on the information set available at time $t-1$ is denoted by $\varepsilon_t | I_{t-1}$. The constant is given by μ and the parameter ϕ_1 shows the impact of past information on the current stock market returns. The conditional mean equation (22) is assumed to follow an autoregressive process of the first-order AR(1). The model can easily be generalised to a higher-order autoregressive process; however, a first-order autocorrelation structure is usually sufficient for most financial returns (Dungey & Martin, 2007).

The error processes from equation (22) are conditionally multivariate normally distributed with zero mean and conditional variance-covariance matrix, and can be specified as:

$$H_t \equiv D_t R_t D_t \tag{23}$$

where H_t is a $k \times k$ matrix of time varying variances, R_t is the time-varying conditional correlation matrix and D_t is the diagonal matrix of the conditional standard deviations from the simple GARCH model with $\sqrt{h_{i,t}}$ as the ith element on the diagonal. The diagonal matrix D_t is obtained from estimating the univariate GARCH model. However, to capture the asymmetry in stock markets, this study assumes that each stock market return series follows the asymmetric GARCH model proposed by Glosten, Jagannthan and Runkle (1993), which is commonly known as the GJR-GARCH model. The GJR-GARCH (p,q) model is represented as follows:

$$h_{it} = \omega_i + \sum_{p=1}^{p_i} \psi_{ip} \varepsilon_{it-p}^2 + \sum_{q=1}^{q_i} \varphi_{iq} h_{it-q} + \gamma_i I_{t-1} \varepsilon_{t-1}^2 \tag{24}$$

where ω_i is the constant, and ψ_i and φ_i are the ARCH and GARCH coefficients respectively. The usual non-negativity assumption of the variance requires that $\omega > 0$, $\psi_i \geq 0$, $\psi_i + \gamma \geq 0$ and $\varphi_i \geq 0$ be satisfied. If these conditions are satisfied, H_t will be positive definite for all t. $I_t(\varepsilon_{t-1} < 0)$ is a dummy variable that takes the value of 1 if $\varepsilon_{t-1} < 0$ and zero otherwise. The parameter γ reflects the asymmetric effect of a lagged shock on the current market volatility. When $\gamma > 0$, previous negative shocks yield a higher volatility than do positive shocks.

Once the GARCH model is estimated, the time-varying conditional correlation matrix R_t is computed using the standardised residuals obtained from the GJR-GARCH estimation. The evolution of the conditional correlation matrix, R_t in the standard DCC model according to Engle (2002) is given by:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{25}$$

where $Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha \delta_{t-1} \delta'_{t-1} + \beta Q_{t-1}$, $\delta_{i,t} = \dfrac{\varepsilon_{i,t}}{\sqrt{h_{i,t}}}$, and $\overline{Q} = E[\delta_t, \delta'_t]$, and α and β are non-negative scalar parameters, satisfying the $\alpha \geq 0$, $\beta \geq 0$ and $\alpha + \beta < 1$ constraint to ensure the stability of the conditional variances and to guarantee the positive definiteness of the conditional covariance matrix. The α coefficient measures the short-run volatility impact of a given shock, indicating the persistence of the standardised residuals from the previous period. The β coefficient captures the lingering effect of shock on the conditional correlation, which indicates the persistency of the dynamic correlation. $Q_t = \left| q_{ij,t} \right|$ denotes the variance-covariance matrix of $\delta_{i,t}$ and $Q_t^* = \sqrt{q_{ij,t}}$ is a diagonal matrix including the square root of the main elements of Q_t. Accordingly, the conditional correlation matrix can also be specified as:

$$R_t = (diag(Q_t))^{-1/2} Q_t (diag(Q_t))^{-1/2} \tag{26}$$

$$diag(Q_t))^{-1/2} = diag\left(\frac{1}{\sqrt{q_{11,t}}}, ..., \frac{1}{\sqrt{q_{kk,t}}} \right) \tag{27}$$

Thus, the dynamic conditional correlation at time t can be defined as:

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \qquad i, j = 1, ..., n, \text{and } i \neq j \tag{28}$$

where $q_{ij,t}$ is the element of the ith line and jth column of the matrix Q_t.

Following equation (25) through (28), the conditional correlation can be expressed as:

$$\rho_{ij,t} = \frac{(1-\alpha-\beta)\bar{q}_{ij} + \alpha\delta_{t-1}\delta'_{t-1} + \beta q_{ij,t-1}}{\sqrt{(1-\alpha-\beta)\bar{q}_{ii} + \alpha\delta_{t-1}\delta'_{t-1} + \beta q_{ii,t-1}}\sqrt{(1-\alpha-\beta)\bar{q}_{jj} + \alpha\delta_{t-1}\delta'_{t-1} + \beta q_{jj,t-1}}} \tag{29}$$

where $\rho_{ij,t}$ is the dynamic conditional correlation between stock return series for two markets i and j at time t. Specifically, $\rho_{ij,t}$ measures the direction and strength of correlation between the two markets. If the estimated $\rho_{ij,t}$ is positive, the correlation between the two markets is rising and moving is the same direction. However, when $\rho_{ij,t}$ is negative the correlation is declining and both markets are moving in opposite direction.

Under the assumption of normality, the parameters in equation (29) can be estimated using the quasi-maximum likelihood method (QML) proposed by Bollerslev, Engle and Wooldridge (1992). Let the parameters in D_t be denoted as θ and ϕ denotes parameters in R_t. The log-likelihood function can be expressed as the sum of a volatility part and a correlation part as:

$$l_t(\theta, \phi) = \left[-\frac{1}{2} \sum_{t=1}^{T} (n \log(2\pi) + \log|D_t|^2 + \varepsilon'_t D_t^{-1} \varepsilon'_t) \right] + \left[-\frac{1}{2} \sum_{t=1}^{T} (\log|R_t| + \delta'_t R_t^{-1} \delta_t - \delta'_t \delta_t) \right] \tag{30}$$

where n is the number of equations and T is the number of observations. The formulation of the log-likelihood function in equation (30) allows the DCC model to be easily estimated in two stages by separating the estimation procedures. The first stage of the equation (30) is the volatility part, which is the sum of individual GARCH likelihoods. The log-likelihoods are jointly maximised by separately maximising each term. The second stage is the correlation part; the DCC parameters are conditional on the first stage GARCH parameter estimates. The parameter estimates of the two-stage DCC estimator have been shown to be consistent and asymptotic (Engle & Sheppard, 2001).

Finally, in order to examine the evidence of contagion between the two stock markets, the dynamic conditional correlation obtained in equation (29) for the markets is tested for evidence of significant increase in correlation during the crisis period using the t-statistics. The use of t-statistics is motivated by the evidence in the literature (Hemche, et al, 2016; Celik, 2012; Kenourgios & Padhi, 2012; and Kenourgios, et al, 2011). The t-statistics tests the null hypothesis against the alternative that during crisis period correlation increased and contagion spreads as:

$$H_0 : \mu_\rho^{crisis} = \mu_\rho^{pre-crisis} = \text{ no contagion}$$

$$H_1 : \mu_\rho^{crisis} \neq \mu_\rho^{pre-crisis} = \text{ contagion}$$

where μ_ρ^{Crisis} and $\mu_\rho^{Pre-crisis}$ are the means of the dynamic conditional correlation coefficient in the crisis and pre-crisis periods respectively. The t-statistics is computed as:

$$t = \frac{\left(\hat{\rho}_{ij}^{crisis} - \hat{\rho}_{ij}^{pre-crisis}\right) - \left(\mu_\rho^{crisis} - \mu_\rho^{pre-crisis}\right)}{\sqrt{\frac{s_{crisis}^2}{n} + \frac{s_{pre-crisis}^2}{n}}} \tag{31}$$

where $\hat{\rho}_{ij}$ denotes the estimated mean of dynamic correlation coefficients between the two stock markets during the pre-crisis and crisis periods. The number of observations is given by n and s^2 is the variance of these coefficients, which is computed as:

$$s^2 = \frac{1}{n-1} \sum_{t=1}^{n} \left(\rho_{ijt} - \hat{\rho}_{ij} \right)^2 \tag{32}$$

5.4.2 Aggregate shock model (AS)

Another empirical approach that allows for some improvement in methodologies used in modelling mean and volatility spillover effects is the aggregate shock model (AS) proposed by Lin, Engle and Ito (1994). The approach involves testing for mean and volatility spillover effects using the residuals generated from the simple GARCH model. The testing procedure follows a two-stage GARCH estimation process, which is asymptotically equivalent to a multivariate procedure when the conditional mean equations are correctly specified (Lin et al., 1994). The first stage involves the use of the unexpected return of a foreign stock market in the estimation of the domestic stock market returns. The second stage involves the application of the GARCH model to both the foreign and domestic stock market returns. At this stage, the domestic return is estimated along with the unexpected foreign shock in the mean equation and the foreign conditional variance is used in the variance equation of domestic markets as a measure of foreign shock.

Following Lin et al., (1994), this study employs a variant of the AS model where the conditional variance equation is assumed to follow the exponential-GARCH (AS-EGARCH) process proposed by Nelson (1991). One advantage of the EGARCH model over the simple GARCH model is that the latter enforces a symmetric response of volatility to negative and positive shocks. Thus, it fails to account for the asymmetric response, discovered by Black (1976). Moreover, evidence in the literature suggests that there is a tendency for a negative shock to cause more volatility than a positive shock of equal magnitude (Black, 1976). Another advantage of the EGARCH specification is that it does not impose non-negativity restrictions on the values of the GARCH parameters to be estimated unlike the GJR-GARCH specification.

In the EGARCH model, the foreign stock market return is assumed to follow an AR(1) process as:

$$\Delta y_{f,t} = \alpha_f + \rho_1 \Delta y_{f,t-1} + \varepsilon_{f,t} \quad \varepsilon_{f,t} | I_{t-1} \sim N(0, h_{f,t}) \tag{33}$$

where, $y_{f,t}$ is the foreign stock market returns, α_f is a constant, $y_{f,t-1}$ is past value of foreign stock market returns and Δ is a first-difference operator. The subscript f is used to identify foreign stock market returns. $\varepsilon_{f,t}$ is that part of foreign stock market return that cannot be predicted based on publicly available information (unexpected shock) and it is assumed to be normally distributed with zero mean and constant variance, and $h_{f,t}$ is the conditional variance. In order to obtain $h_{f,t}$, the following EGARCH (p, q) model is estimated:

$$\log(h_{f,t}^2) = \omega_0 + \varphi_{11}\log(h_{f,t-1}^2) + \psi_{11}\left|\frac{\varepsilon_{f,t-1}}{h_{f,t-1}}\right| + \lambda_{11}\frac{\varepsilon_{f,t-1}}{h_{f,t-1}} \tag{34}$$

where ω_0 is the constant, $\varepsilon_{f,t-1}$ is the lag value of the error term from the mean equation (33), and $h_{f,t-1}^2$ is the lagged value of the $h_{f,t}$ term. Note that the EGARCH model follows the logarithm of the conditional variance, which means that the restrictions on the parameters to ensure $h_{f,t} > 0$ are no longer required. The presence of an asymmetric, or leverage effect, is tested by examining the hypothesis that $\lambda < 0$. The impact is asymmetric if $\lambda \neq 0$. The optimal lags p and q are chosen using information criteria AIC, SBIC and HQIC.

However, the main focus of this study is on the influence of foreign shocks on the domestic stock market return and volatility. This study assumes that the spillover effects are unidirectional from the emerging and developed markets to the African markets. Here, African stock markets are considered as the domestic markets, while the emerging and developed markets are the foreign markets. The domestic stock market return equation is assume to follow an AR(1) and can be specified as:

$$\Delta y_{d,t} = \alpha_d + \rho_2 \Delta y_{d,t-1} + \sigma\varepsilon_t + \upsilon_t \qquad \upsilon_t | I_{t-1} \sim N(0, h_{d,t}) \tag{35}$$

where $y_{d,t}$ is the domestic stock market return at time t, α_d is the a constant, $y_{d,t-1}$ is past value of the domestic stock market return and Δ is a first-difference operator. ε_t represents foreign market shocks. The parameter σ is the estimated residual from equation (33). The parameter represents the relationship between the domestic market returns and foreign market return. In other words, it measures the effects of unexpected shocks from a given foreign market on mean returns of African markets (mean spillover effects). The domestic market idiosyncratic shock is given by υ_t and it is assumed to be normally distributed with a zero mean and a variance that follows the EGARCH(p, q) process as:

$$\log(h_{d,t}^2) = \omega_d + \varphi_{22}\log(h_{d,t-1}^2) + \psi_{22}\left|\frac{\upsilon_{t-1}}{h_{d,t-1}}\right| + \lambda_{22}\frac{\upsilon_{t-1}}{h_{d,t-1}} + \eta_i h_{f,t}^2 \tag{36}$$

The specification of domestic markets variance equation (36) includes an additional parameter, η_i, rather than the usual parameters as in equation (34). The parameter η_i is the conditional variance from equation (34) and it captures the relationship between domestic and foreign market volatilities. That is, it allows for testing the effect of foreign market volatility on African market volatility (volatility spillover effects).

5.5 Data description and sources

The datasets used in this study consist of dividend-unadjusted weekly closing stock price indices. The choice of data for this study is motivated by the evidence in the literature (see Boamah, 2017; Boamah et al., 2016; Boako & Alagidede, 2016; Hemche et al., 2016; Mollah et al., 2016; and Morales & Andreosso-O'Callaghan, 2014). Moreover, Yang (2012), shows that using price indices that exclude dividends in the co-integration approach is not appropriate. With the exception of Ghana, all the stock price indices are denominated in local currency. This is to restrict changes in the indices to movements in the stock prices, thus controlling for the effect of exchange rate depreciations or appreciation (Kenourgios & Padhi, 2012; and Syllignakis & Kouretas, 2011)[14]. The stock price index is further transformed into weekly stock market returns. The weekly stock market returns is computed as $y_t = \log(P_t) - \log(P_{t-1})$, where y_t is the stock market return, P_t is the closing stock index on day t and P_{t-1} is the closing stock index on day $t-1$.

Consistent with the existing literature, weekly stock market return data is preferred given that a low frequency data series, such as monthly data, has the tendency of ignoring temporal responses to shocks that last for a few days (Jin & An, 2016; Jin, 2015 and Kuper & Lestano, 2007). Evidence in the literature suggests that high frequency data are more appropriate for studying international correlation or volatility spillovers than low frequency data (Karoyi & Stulz, 1996; and Eun & Shin, 1989). However, high frequency data such as daily or intraday data are very noisy (Heymans & da Camara, 2013; and Sylliignakis & Kouretas, 2011), while

[14] Most studies in Africa relied on the US dollar or UK pond sterling denominated stock price indices (see Boamah, 2017; Boamah et al., 2016; Boako & Alagidede, 2016 and Piesse & Hearn, 2012). As a result, using local currency denominated price indices in this study adds a new perspective to the existing literature in African markets.

very low frequency data are not capable of capturing temporal movement. Moreover, using weekly data helps to avoid the possibility of bias due to the small size and thin trading in most African markets (Lamba & Otchere, 2001). It also helps to overcome problems associated with overlapping and non-synchronous trading across markets that can lead to downward bias in the estimation of correlation (Heymans & da Camara, 2013 and Martens & Poon, 2001).

Also, the closing stock returns are used as opposed to opening stock returns due to the capacity of closing stock returns in capturing all the information that was made available during the day. The datasets used in this study are obtained from Thomson Reuters Datastream and Bloomberg. The total data sample spans a time period from 3 January 2003 to 26 December 2014. However, the coverage in time and across markets is limited by the availability of the required data (See Table 5.1 below for details).

Following Chiang et al., (2007) and Syllignakis and Kouretas (2011), when data are unavailable due to national holidays, or for any other reason, while other markets are open on that day, stock prices are assumed to be the same as the previous week's value. This reflects the fact that the stock price will not change or react to any information available in that particular week when the market is closed. This by the definition of stock market returns as stated above, means a zero or no change in stock return in such a week.

In order to put the study into perspective, it is important to identify the appropriate timeline or cut-off dates for pre-crisis/stable and crisis periods so as to avoid sample selection bias. This is particularly due to the sensitivity of contagion test to the definition of crisis period (Kenourgios, 2014). However, evidence in the literature presents three main approaches for identifying crisis timelines (Kenourgios, 2014). The first approach is the ad hoc approach which is based on economic and financial news events. This approach was adopted by Hemcheet al., (2016); Yiu et al. (2010); and Chiang et al. (2007). The second approach is the statistical approach, which identifies a crisis period endogenously (see Dajcman, 2013). The third approach is the combination of an ad hoc and statistical approach. Kenourgios, (2014), Morales and Andreosso-O'Callaghan (2014) and Bekiros, (2013) are among the studies that adopted this combined approach.

However, the period under investigation in this study covers two major economic events; namely the global financial crisis and Eurozone sovereign debt crisis. Moreover, different views have been expressed in the literature about the specific point in time in which these crises started (see for example Kenourgios, 2014; Morales and Andreosso-O'Callaghan, 2014; Bekiros, 2013 and Arghyrou & Kontonikas, 2012). As a result, a combination of the ad hoc and statistical approach is utilised in this study. Consistent with the studies by Kenourgios, (2014) and Arghyrou & Kontonikas, (2012), the following timelines have been defined for this study: full sample period from January 2003 to December 2014; pre-crisis/stable period from January 2003 to July 2007; global financial crisis period from August 2007 to February 2010; and Eurozone crisis period from March 2010 to December 2014. Although the major focus is on the 2007/08 global financial crisis, this study also considered the Eurozone crisis.

Furthermore, in order to overcome sample selection bias and ensure the robustness of these timelines, a Chow test is used to determine the appropriate breakpoint and division of subsamples. In addition to the use of a Chow test, dummy variables are used to test for structural stability. The results from both tests suggest the following timeline: full sample (3 January 2003 – 26 December 2014); pre-crisis/stable period (3 January 2003 – 6 July 2007); global financial crisis period (13 July 2007 – 16 April 2010); and Eurozone crisis (23 April 2010 – 26 December 2014). Appendix B contains detailed results and explanations of the Chow test and dummy variable test for structural stability. This timeline information is used in the implementation of all the tests adopted in this study. Splitting the estimation procedure into these four samples helps to account for differences in patterns of relationships that may exist between stock markets under different market conditions. This also allows for a direct comparison of the more recent stock market behaviour with the previous behaviour. Consequently, all the tests identified above are carried out across the four sample periods as identified above.

5.6 The scope of the study

This study covers 27 stock markets, which are grouped into three different markets as: Africa markets; developed markets; and emerging markets. Specifically, this study focuses on 13 stock markets in Africa[15], 10 major developed stock markets of the world and four major emerging markets (Brazil, Russia, India and China, popularly known as BRIC countries). The choice of which African markets to examine is mainly determined by data availability and

[15] See Chapter Two section 2.4 for more details.

reliability. Table 5.1 below provides a detailed description of the various stock markets and index coverage.

For the developed markets, countries considered for this study include: Australia, Canada, France, Germany, Hong Kong, Japan, Singapore, Switzerland, United Kingdom and United States. These countries are selected based on the recent financial system development index ranking by the World Economic Forum. The index ranks 62 of the world's leading financial systems (see World Economic Forum, 2012).[16] Arguably, these markets provide a reasonable proxy for the developed Asian, European and American stock markets respectively in depicting possible financial integration with African markets. In addition, some of these countries have colonial ties with Africa. As such, given the international dominance of these markets, it is reasonable to expect these markets to play a significant role in international stock market co-movements and volatility transmission to other markets, including stock markets in Africa.

Furthermore, this study specifically focuses on stock markets rather than other aspects of financial markets. This is because a stock market is argued to be the barometer for measuring economic performance (Cong, Wei, Jiao and Fan, 2008). For instance, equity securities not only represent the real assets but also the fundamentals of an economy such as growth rates, labour costs, competitiveness and institutional setting including profitability, liquidity and taxation. As a result, stock price behaviour captures aggregate sentiments about an economy as well as different sectoral compositions of such an economy. In addition, stock markets not only help in mobilising savings but also in producing information, revealing prices, sharing risk, providing liquidity, promoting contractual efficiency, promoting good governance, and facilitating global integration (World Bank, 2007). Therefore, the examination of financial markets integration, contagion and volatility transmission will focus specifically on the stock markets.

5.7 Conclusion

This chapter set out to outline the analytical frameworks that will be used to investigate the financial market integration, contagion and volatility transmission between the African stock

[16] Based on the Financial System Development Index, these countries are ranked in the following order: 1) Hong Kong; 2) United States; 3) United Kingdom; 4) Singapore; 5) Australia; 6) Canada; 7) Japan; 8) Switzerland; 11) France; and 12) Germany. These countries are ranked among the top ten except France and Germany (see World Economic Forum, 2012).

markets and the globally developed and emerging stock markets. The choice of empirical frameworks in this study is motivated by the evidence in the literature. The chapter also explained the reasons for adopting each of the analytical frameworks that will be used to estimate the dynamic relationships.

The first section of this chapter outlined the frameworks for testing for whether individual stock markets are characterised by unit root (non-stationary) or not, using the ADF, PP and KPSS tests. In carrying out the unit root tests (ADF and PP), a sequential testing procedure was followed, where the presence of unit root or otherwise was tested using the three data generating processes – model with both drift and deterministic trend (Model 1), model with drift (Model 2) and model with neither drift nor deterministic trend (Model 3). For the stationarity test (KPSS test), the test is carried out using Model 1 and Model 2. This estimation procedure facilitates a comparison of the results across different models. However, following the sequential testing procedure could give rise to disagreement or inconsistent results among the models. In such a situation, the decision to reject the null hypothesis is based on the common outcome among the models. For instance, if Model 1 fails to reject the null hypothesis while the other two models reject the null hypothesis, then the conclusion will be based on the latter two models.

The second section of this chapter discussed the empirical frameworks for assessing the financial markets integration between African, emerging and developed stock markets. The Johansen co-integration method was chosen based on the ability of the model to account for multiple long-run relationships. However, when applying the Johansen co-integration procedure, the appropriate deterministic components to include in the co-integrating relationship have to be determined. Moreover, studies have shown that the asymptotic distribution of the test depends on which deterministic term is present in the data generating process (Johansen, 1995 and Hansen & Juselius, 1995). In other words, the power of the test depends on the whether the deterministic terms are allowed in the model or not (Demetrescu, Lutkepohl & Saikkonen, 2009). Likewise, the power of the model may suffer substantially when the deterministic term is over-specified (Saikkonen & Lutkepohl, 2000; and Doornik, Hendry & Nielsen, 1998).

To address this problem, this study employed the so-called “Pantula principle” proposed by Johansen (1992) for selecting the appropriate specification of the deterministic term in a model. This principle involves the estimating all the three models starting with Model 2 (with only intercept in the co-integrating equation but no intercept or trend in VAR), Model 3 (with only intercept in the co-integrating equation and with intercept and trend in VAR), and Model 4 (with intercept and trend in the co-integrating equation and only trend in VAR). The testing procedure is to move from the most restrictive model (Model 2) to the least restrictive model (Model 4) and comparing their trace and maximum eigenvalue statistic to their critical value. A model is selected only when the null hypothesis of no co-integration is not rejected for the first time.

The section also proposed the use of Granger causality, GIRF and GFEVD tests. On the one hand, the Granger causality test measures the causal linkages between African, emerging and developed stock markets. The Granger causality methodology was used to determine the direction of causal linkages. On the other hand, the GIRF and GFEVD were used to quantify the nature of response and proportion of African market to shocks from a given global stock market.

The third section proposed two empirical frameworks that were used to model financial contagion and volatility transmission, namely DCC-GARCH and AS model. The DCC was used to identify the dynamic co-movement between African markets and those of the emerging and developed markets stock markets. The AS model on the other hand, was used to investigate any evidence of mean and volatility spillover effects between the markets. The AS model helps in identifying the direct effect from each of the major global market to African stock markets. However, the results from these two models allowed comparison and yielded robust conclusions on the nature of contagion and volatility transmission.

The chapter also looked at the nature of the data to be used and provides justifications for using weekly stock price indices. In addition, the time frames for the analyses were identified using a Chow test and dummy variable test for structural break; namely, full sample (3 January 2003 – 26 December 2014); pre-crisis/stable period (3 January 2003 – 6 July 2007); global financial crisis period (13 July 2007 – 16 April 2010); and Eurozone crisis (23 April 2010 – 26 December 2014). The chapter concluded by outlining the scope of the study.

Furthermore, it worth noting at this point that in analysing the linkages between African markets and the major global stock markets, a bivariate testing procedure was applied, by pairing individual African markets with another market. This is because it makes little sense to include all the markets in one model given the differences in the relative size of the markets. Besides, including all the markets in one model would erode the degrees of freedom, thus making the parameter estimates less reliable. Moreover, data on different African markets is available for different periods (see Table 5.1). Consequently, this study examine the linkages for each African markets with other markets separately across all the four sample periods. This helps to put the study into perspective and also identifies how the pattern of the relationship is evolving over time between each pair of stock market across different time periods.

Finally, given that the empirical frameworks outlined in this chapter are grouped into two (empirical tests for stock market integration and tests for contagion and volatility transmission), the estimation of these tests is covered in two chapters. As a result, Chapter Six will empirically test for stock markets integration, while Chapter Seven will test for the evidence of contagion and volatility transmission.

Table 5. 1: List of countries and stock markets under analysis

No	Country	Index name	Acronym	Data coverage	
	African Markets			**Starting Date**	**End Date**
1	Botswana	Domestic company index / Foreign company index	DCI/FCI	03/01/2003	26/12/2014
2	BRVM	Abidjan securities exchange composite index	BRVMCI	03/01/2003	26/12/2014
3	Egypt	Egyptian exchange 30 index	EGX30	03/01/2003	26/12/2014
4	Ghana	Ghana stock exchange composite index	GSECI	03/01/2003	27/12/2013
5	Kenya	Nairobi securities exchange 20 share index	NSE20	03/01/2003	26/12/2014
6	Mauritius	Stock exchange of Mauritius index	SEMDEX	03/01/2003	26/12/2014
7	Morocco	Casablanca securities exchange all share index	MASI	03/01/2003	26/12/2014
8	Namibia	Namibian stock exchange overall index	OVRLNM	03/01/2003	26/12/2014
9	Nigeria	Nigerian stock exchange all share index	NGSEINDX	03/01/2003	26/12/2014
10	South Africa	Johannesburg stock exchange all share index	JALSH	03/01/2003	26/12/2014
11	Tunisia	Tunis stock exchange weighted capitalisation index	TUNINDEX	03/01/2003	26/12/2014
13	Uganda	Uganda securities exchange all share index	ALSIUG	06/01/2004	26/12/2014
13	Zambia	Lusaka all share index	LASILZ	03/01/2003	26/12/2014
	Emerging Markets				
14	Brazil	Sao Paulo stock exchange (Bovespa) index	BVSP	03/01/2003	26/12/2014
15	China	Shanghai stock exchange A share index	SSEA	03/01/2003	26/12/2014
16	India	S&P Bombay stock exchange sensitive index	SENSEX	03/01/2003	26/12/2014
17	Russia	Moscow exchange composite index	MICEX	03/01/2003	26/12/2014
	Developed Markets				
18	Australia	S&P/ASX 200 index	AXJO	03/01/2003	26/12/2014
19	Canada	S&P Toronto stock exchange composite index	S&PTSX	03/01/2003	26/12/2014
20	France	CAC 40 index	CAC40	03/01/2003	26/12/2014
21	Germany	Deutsche Boerse DAX index	DAX	03/01/2003	26/12/2014
22	Hong Kong	Hang Seng index	HSI	03/01/2003	26/12/2014
23	Japan	Nikkei 225 index	N225	03/01/2003	26/12/2014
24	Singapore	Strait Times Index	STI	03/01/2003	26/12/2014
25	Switzerland	SIX Swiss Exchange	SMI	03/01/2003	26/12/2014
26	United Kingdom	FTSE 100 index	FTSE	03/01/2003	26/12/2014
27	United States	S&P 500 Index	SPX	03/01/2003	26/12/2014

Source: Compiled by the Author

CHAPTER SIX

ESTIMATION OF STOCK MARKET INTEGRATION

6.1 Introduction

The objective of this chapter is to empirically investigate the dynamics and contemporaneous interactions and linkages between African stock markets and the major emerging and developed stock markets. However, in order to facilitate a good understanding of the chapter, the analyses are presented under different sample periods as identified in Chapter Five, namely full-sample period (3 January 2003 – 26 December 2014), pre-crisis/stable period (3 January 2003 – 6 July 2007), global financial crisis period (13 July 2007 – 16 April 2010) and Eurozone crisis period (23 April 2010 – 26 December 2014). Understanding the behaviour of the African markets in relation to the major global stock markets across these four periods helps to put the study into perspective. It also helps to identify different patterns of relationships that may exist between these stock markets across different time periods.

The analyses in this chapter are presented in of four sections. The first section deals with the preliminary results by presenting and the analysing the descriptive statistical properties and unconditional correlation of the stock markets. The second section involves testing whether the individual stock markets are characterised by unit root (nonstationary) or not and determining their order of integration using the ADF, PP and KPSS tests. The third section provides the results of various tests used to examine the dynamic relationships between African markets and the major global stock markets; namely the co-integration test, Granger causality test, GIRF test and GFEVD test. The fourth section provides the summary and conclusion of the results from the various models.

6.2 Preliminary results

As a preliminary section, this provides an analysis of the stylised facts of the various stock markets under review by highlighting the summary statistical properties of the data series. The section also deals with the correlation analysis of African stock markets with their global counterparts across all the sample periods.

6.2.1 Descriptive statistics

This section focuses on the analysis of the basic statistical properties; namely the mean, maximum, minimum, standard deviation, skewness, kurtosis and the Jarque-bera test for normality, across the four sample periods. Tables 6.1 – 6.4 report the summarised statistical properties of various stock markets across all the sample periods. The reports in Table 6.1 reveal that the average weekly stock market returns over the full-sample period is higher in Africa (apart from Ghana) and emerging stock markets relative to the developed markets. As expected, the average weekly stock returns during the pre-crisis/stable period appear to be higher across all market compared to both crisis periods (see Table 6.2). Specifically, Egypt and Zambia are the best performing markets with the highest average stock market return of approximately 1.3% over this period. However, Table 6.3 shows that during the period of the global financial crisis, the best stock markets, especially the developed stock markets, witnessed negative stock market returns. This indicates the negative effect of the crisis on stock market performance over this period. The analysis during the Eurozone crisis period, as shown in Table 6.4, indicates that all the stock markets returned to positive gains (except Ghana, Morocco and Brazil).

The unconditional volatility of stock market return, as measured by the standard deviation across different sample periods, indicates a high standard deviation across all markets during the global financial crisis period compared to any other periods. However, the stock market volatility appears to have declined dramatically during the Eurozone crisis period. The increased stock market volatility during the global financial crisis period indicates the effect of the global financial crisis on stock market performance.

The skewness coefficient, which defines the symmetric behaviour of the stock market returns, indicates different distributions across time and markets. For instance, the skewness coefficient shows there are more tendencies of obtaining a negative stock return in the developed market compared to Africa and emerging markets across all periods. The skewness coefficients for Africa show that the possibility of realising negative returns was high during the full-sample and Eurozone crisis periods than other periods (see Tables 6.1 – 6.4). Also, the kurtosis coefficients across all the markets and sample periods are larger than normal, which implies leptokurtic distribution of stock market returns. This result not only suggests the presence of fat tails and the possibility that extreme observations of either sign are more likely to be present, but also that the stock market returns may not be normally distributed

(Syllignakis & Kouretas, 2011 and Chiang et al., 2007). Accordingly, the Jarque-Bera test statistic rejected normality across all markets and sample periods.

Evidence from the preceding analyses shows that stock market returns are higher during the pre-crisis period while stock market return volatility appears to be higher during the global financial crisis period. These observations are consistent with the stylised facts about crisis periods, which are usually characterised by high stock market return volatility (Forbes & Rigobon, 2002 and Dungey & Martin, 2007). Further evidence of these stylised facts can be visualised in Figure 6.1 of Appendix C that plots the stock market returns over the full-sample period for each stock market. Clearly, the figure shows an increase in stock market volatility during the global financial crisis period. This increase in volatility is indicated by spikes in stock market returns around the global financial crisis period. However, during the Eurozone crisis period, the figure appears to suggest that the majority of African and emerging markets did not witness an increase in volatility. The developed markets on the other hand appear to be volatile during this period. The observed behaviour of stock market returns over these crisis periods could be an indication of co-movement between these markets. In order to better appraise the behaviour of individual stock market returns, the section below considers the correlation between African markets and major global markets.

6.2.2 Correlation analysis

To further examine the behaviour of stock markets returns, the unconditional correlation analysis between African and the major global market stock markets is carried out. The unconditional correlation coefficients provide some useful information regarding the relationship between the stock markets. Tables 6.5 – 6.8 below provide the correlation coefficients of all the markets across different time periods.

Table 6.5 presents the results of the correlation analysis over the full-sample period. The table shows that Egypt, Mauritius, Morocco, Namibia, South Africa and Uganda are more correlated with other African markets. It also shows that Egypt, Mauritius, Morocco, Namibia and South Africa are more correlated with the emerging markets than any other African market during this period. The further evidence from the table shows that Egypt, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia are more correlated with the developed stock markets. The analysis over this period also shows that most African markets are positively correlated with the emerging and developed stock markets.

Table 6. 1: Summary statistics during the full-sample period

African Markets	Mean (%)	Maximum (%)	Minimum (%)	Standard Deviation (%)	Skewness	Kurtosis	Jarque-bera
Botswana	0.22	14.87	-6.51	1.31	2.03	30.06	19495.86*
BRVM	0.23	25.68	-16.95	2.55	1.53	28.98	17814.15*
Egypt	0.55	16.79	-19.71	4.30	-0.53	6.15	287.35*
Ghana	-0.02	15.32	-86.45	4.17	-15.44	322.61	2461538.00*
Kenya	0.24	15.96	-13.65	2.74	0.68	10.00	1325.51*
Mauritius	0.28	9.11	-14.55	2.00	-0.39	11.06	1705.85*
Morocco	0.21	8.21	-9.34	1.99	-0.27	5.99	240.57*
Namibia	0.26	17.11	-13.66	3.19	-0.17	5.77	202.61*
Nigeria	0.22	13.90	-13.27	3.24	-0.07	6.15	259.19*
South Africa	0.30	17.40	-9.19	2.63	0.19	7.70	578.12*
Tunisia	0.26	8.87	-12.74	1.54	-0.80	17.35	5428.47*
Uganda	0.38	25.85	-18.54	3.63	0.62	11.17	1543.69*
Zambia	0.63	192.02	-8.92	7.98	22.18	532.49	7352161.00*
Emerging Markets							
Brazil	0.30	18.35	-20.01	3.66	-0.18	6.06	247.43*
China	0.20	14.96	-13.84	3.41	0.23	5.14	125.37*
India	0.39	14.08	-15.95	3.17	-0.31	5.60	186.33*
Russia	0.34	42.51	-24.25	4.61	0.63	16.20	4578.62*
Developed Markets							
Australia	0.12	9.54	-15.65	2.19	-0.90	8.85	976.71*
Canada	0.15	13.67	-16.09	2.34	-0.83	11.73	2057.53*
France	0.09	13.24	-22.16	2.93	-0.90	9.60	1219.52*
Germany	0.24	16.12	-21.61	3.12	-0.54	9.16	1018.01*
Hong Kong	0.19	12.43	-16.32	3.00	-0.12	6.01	237.80*
Japan	0.16	12.13	-24.33	3.02	-1.03	10.30	1497.33*
Singapore	0.18	16.56	-15.18	2.56	-0.11	10.07	1303.31*
Switzerland	0.13	14.07	-22.28	2.50	-0.94	17.26	5387.64*
United Kingdom	0.13	12.87	-20.19	2.40	-0.95	14.00	3245.00*
United States	0.16	12.03	-18.20	2.42	-0.57	10.59	1532.70*

Note: * denotes significance at 5% level:

Source: Author’s computation

Table 6. 2: Summary statistics during the pre-crisis/stable period

African Markets	Mean (%)	Maximum (%)	Minimum (%)	Standard Deviation (%)	Skewness	Kurtosis	Jarque-bera
Botswana	0.59	14.87	-4.07	1.52	3.71	35.33	10772.47*
BRVM	0.40	25.68	-16.95	3.36	1.45	24.35	4545.78*
Egypt	1.28	14.85	-15.98	4.10	0.02	4.78	30.94*
Ghana	0.54	8.42	-6.91	1.78	1.14	7.80	276.96*
Kenya	0.60	15.96	-13.65	2.99	0.99	11.01	667.32*
Mauritius	0.57	9.11	-7.68	1.75	0.70	7.97	260.83*
Morocco	0.61	8.21	-8.46	2.30	-0.48	5.64	77.36*
Namibia	0.54	7.64	-8.34	2.78	-0.36	3.27	5.67
Nigeria	0.66	12.68	-12.24	2.93	0.02	7.11	165.62*
South Africa	0.51	7.44	-7.43	2.33	-0.57	3.78	18.57*
Tunisia	0.36	7.03	-3.15	1.26	1.06	7.56	248.09*
Uganda	0.67	15.45	-15.05	3.89	0.36	6.76	92.73*
Zambia	1.31	192.02	-8.92	12.65	14.68	221.81	477260.40*
Emerging Markets							
Brazil	0.73	8.38	-9.19	3.36	-0.40	2.91	6.30*
China	0.50	14.16	-7.26	3.13	0.60	5.06	55.51*
India	0.68	7.06	-10.96	2.72	-0.78	4.75	53.70*
Russia	0.81	11.13	-14.68	4.17	-0.61	4.06	25.53*
Developed Markets							
Australia	0.32	4.13	-4.32	1.29	-0.73	4.57	45.17*
Canada	0.32	3.67	-4.89	1.51	-0.71	3.82	26.48*
France	0.30	6.41	-6.51	2.02	-0.38	3.77	11.42*
Germany	0.44	12.98	-7.15	2.56	0.04	5.46	59.24*
Hong Kong	0.39	4.82	-6.13	2.08	-0.25	2.83	2.83
Japan	0.35	5.75	-6.58	2.28	-0.35	3.04	4.69
Singapore	0.44	7.39	-7.05	2.00	-0.16	4.63	26.99*
Switzerland	0.29	10.91	-6.46	1.90	0.13	7.90	235.42*
United Kingdom	0.26	6.84	-5.16	1.60	-0.20	4.55	25.04*
United States	0.23	7.50	-4.48	1.58	0.04	4.71	28.62*

Note: * denotes significance at 5% level

Source: Author’s computation

Table 6. 3: Summary statistics during the global financial crisis period

African Markets	Mean (%)	Maximum (%)	Minimum (%)	Standard Deviation (%)	Skewness	Kurtosis	Jarque-bera
Botswana	-0.17	5.15	-5.80	1.43	-0.15	5.92	52.06*
BRVM	-0.05	10.38	-5.23	2.25	0.89	5.85	68.35*
Egypt	0.08	11.17	-19.71	5.08	-1.28	5.94	91.72*
Ghana	-0.15	15.32	-9.34	3.03	0.39	9.08	227.16*
Kenya	-0.09	15.71	-10.45	3.55	0.43	5.66	47.47*
Mauritius	0.15	8.23	-14.55	3.20	-0.61	5.90	59.90*
Morocco	0.05	5.02	-9.34	2.21	-0.48	5.34	38.56*
Namibia	-0.00	17.11	-13.66	4.74	0.02	4.16	8.17*
Nigeria	-0.31	13.90	-13.27	4.58	0.03	3.57	1.99
South Africa	0.07	17.40	-9.19	3.90	0.62	6.05	65.39*
Tunisia	0.45	8.87	-6.53	1.63	0.26	9.35	245.36*
Uganda	0.16	25.85	-18.54	4.54	1.10	12.27	548.69*
Zambia	0.02	12.81	-8.67	2.93	0.81	6.99	111.99*
Emerging Markets							
Brazil	0.27	18.35	-20.01	4.97	-0.15	6.10	58.70*
China	-0.01	14.96	-13.84	4.81	0.04	3.58	2.12
India	0.22	14.08	-15.95	4.72	-0.15	3.86	4.99
Russia	0.14	42.51	-24.25	7.05	1.06	11.98	514.83*
Developed Markets							
Australia	-0.11	9.54	-15.65	3.36	-0.64	5.50	47.84*
Canada	-0.04	13.67	-16.09	3.79	-0.54	6.78	93.44*
France	-0.21	13.24	-22.16	4.14	-0.90	8.16	180.28*
Germany	-0.09	16.12	-21.61	4.25	-0.54	8.45	186.84*
Hong Kong	0.09	12.43	-16.32	4.61	-0.07	3.80	3.99
Japan	-0.25	12.13	-24.33	4.19	-1.21	10.00	331.36*
Singapore	-0.02	16.56	-15.18	4.04	0.04	6.25	64.04*
Switzerland	-0.13	14.07	-22.28	3.76	-0.87	12.71	587.88*
United Kingdom	-0.04	12.88	-20.19	3.67	-0.81	9.78	293.45*
United States	-0.10	12.03	-18.20	3.71	-0.45	7.15	109.18*

Note: * denotes significance at 5% level

Source: Author’s computation

Table 6. 4: Summary statistics during the Eurozone crisis period

African Markets	Mean (%)	Maximum (%)	Minimum (%)	Standard Deviation (%)	Skewness	Kurtosis	Jarque-bera
Botswana	0.10	2.75	-6.51	0.86	-2.03	17.52	2321.26*
BRVM	0.23	7.67	-4.65	1.66	0.72	5.92	108.22*
Egypt	0.13	16.79	-15.70	3.89	-0.10	6.46	122.63*
Ghana	-0.61	5.00	-86.45	6.36	-12.83	173.80	239899.90*
Kenya	0.10	5.31	-5.65	1.72	-0.32	3.97	13.72*
Mauritius	0.09	5.30	-3.49	1.07	0.61	5.76	93.04*
Morocco	-0.08	5.11	-4.85	1.39	0.09	4.25	16.19*
Namibia	0.14	6.39	-9.42	2.29	-0.22	4.06	13.52*
Nigeria	0.11	13.60	-11.52	2.44	0.20	8.29	286.92*
South Africa	0.24	4.78	-7.41	1.89	-0.34	3.88	12.75*
Tunisia	0.05	7.93	-12.74	1.70	-1.98	21.69	3725.36*
Uganda	0.34	8.84	-12.61	2.76	-0.31	5.42	63.59*
Zambia	0.33	9.18	-5.36	1.85	0.46	6.02	102.05*
Emerging Markets							
Brazil	-0.09	8.33	-9.99	2.93	0.00	3.51	2.69
China	0.04	9.50	-6.66	2.56	0.40	3.84	13.78*
India	0.21	7.34	-4.90	2.31	0.21	2.87	2.03
Russia	0.02	7.83	-12.19	2.82	-0.74	5.12	68.12*
Developed Markets							
Australia	0.05	7.62	-7.21	1.97	-0.53	5.06	54.74*
Canada	0.09	5.37	-6.53	1.81	-0.56	4.29	29.61*
France	0.07	10.78	-11.12	2.87	-0.48	4.85	44.22*
Germany	0.23	10.70	-12.89	2.78	-0.51	5.36	67.56*
Hong Kong	0.06	11.06	-9.18	2.50	0.09	4.71	30.28*
Japan	0.23	7.66	-10.22	2.80	-0.35	3.51	7.66*
Singapore	0.06	7.13	-6.10	1.76	-0.17	4.72	31.23*
Switzerland	0.13	5.99	-10.57	2.02	-0.75	5.72	98.78*
United Kingdom	0.10	7.34	-9.88	2.08	-0.68	5.95	108.20*
United States	0.25	7.39	-7.19	2.10	-0.27	4.52	26.47*

Note: * denotes significance at 5% level

Source: Author's computation

The correlation analysis during the pre-crisis/stable period as shown in Table 6.6 indicates that, apart from the correlation between Kenya and Uganda, and Namibia and South Africa, African markets have a very low correlation among them. The table also shows that Egypt, Morocco, Namibia, South Africa and Tunisia are more correlated with the emerging and developed markets than any other African market. The report in the table further shows that BRVM, Ghana, Kenya and Uganda are mainly negatively correlated with developed markets, while other African markets appear to be more positively correlated with emerging and developed markets.

Noticeably, the correlation analysis during the global financial crisis period, as shown in Table 6.7, indicates a significant increase in correlation coefficients between African, emerging and developed stock markets compared to any other period. The correlation result over this period shows that Egypt, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia are more correlated with other African, emerging and developed stock markets. Further evidence from the table shows that Botswana, BRVM and Zambia are more negatively correlated with the emerging and developed markets. In contrast, the correlation analysis during the Eurozone crisis period, as shown in Table 6.8, indicates a decrease in correlation coefficients among the markets. However, Egypt, Mauritius, Namibia and South Africa are shown to be more correlated with the emerging and developed stock markets over this period. The result also shows that most African markets appear to be positively correlated with the emerging and developed stock markets except for Ghana and Tunisia.

In general, apart from Namibia and South Africa, and to some extent Egypt, the correlation of African markets with the major global stock markets is lower across all periods. The low correlations among African, emerging and developed markets is consistent with the evidence in the studies by Boamah et al., (2016), Kodongo and Ojah (2012) and Collins and Biekpe (2003). The existence of low correlations, combined with negative correlation among and between some African markets and other markets, suggests a possible diversification opportunity to institutional and individual investors. However, most African stock markets appear to be more positively correlated with the major global markets. This positive correlation suggests an existence of a positive relationship between African and major global markets. Consequently, any movement in stock market returns in emerging or developed markets in any direction is expected to have the same effect on African markets.

Furthermore, there is evidence of increased correlation between African and the major global stock markets during the global financial crisis period. This observed increase in the correlation of returns is consistent with the evidence in the literature (Forbes & Rigobon, 2002). The increase in correlation during the crisis period can be considered as evidence of co-movement between markets, and therefore indicating evidence of contagion. However, studies have argued against the use of unconditional correlation as a method of investigating evidence of contagion (Forbes & Rigobon, 2002). In this study, evidence of contagion is tested using other more robust approaches (see Chapter Seven).

Although correlation analysis provides useful insight into the relationships between stock markets, several studies have argued that correlations analysis is insufficient to reach firm conclusions about the degree of financial market integration (Hemche et al., 2016; Pukthuanthong & Roll, 2009; and Carrieri, Errunza and Hogan, 2007). In particular, Jefferis and Okeahalam (1999) argue that there is a high chance that any long-run relationships between the markets may be obscured by short term trading noise. In order to investigate the relationships more fully, and in particular, to explore whether there is any long-run relationship between African markets and the major global markets, it is necessary to test for financial integration more rigorously using the Johansen co-integration technique. Hence, the following section considers the order of integration of each stock market which is a necessary condition for examining the long-run relationship between markets. This involves testing whether the individual stock markets are characterised by a unit root/non-stationary processes or not.

6.3 Unit root and stationarity test results

This section examines the order of integration of the various stock market series considered in this study. As a consequence, the unit root and stationarity tests are applied to the log-level and log-return (first difference) series. In doing this, the ADF, PP and KPSS tests are used to identify the order of integration of each series across different sample periods. Specifically, the point here is to have a non-stationary series so as to determine the co-integrating relationship among them and avoid the problem of spurious regressions. Moreover, testing for co-integrating relationship using the Johansen co-integration technique requires that the variables be integrated of order one. Therefore, the results of the unit root and stationary tests are presented and discussed below.

Table 6. 5: Correlation of stock markets returns during the full-sample period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1.00												
BRVM	0.11	1.00											
Egypt	0.01	0.03	1.00										
Ghana	-0.02	-0.08	0.01	1.00									
Kenya	-0.03	0.03	0.24	-0.05	1.00								
Mauritius	0.00	-0.01	0.27	-0.04	0.22	1.00							
Morocco	-0.00	0.07	0.20	-0.05	0.06	0.12	1.00						
Namibia	0.01	-0.02	0.19	-0.01	0.07	0.18	0.09	1.00					
Nigeria	0.08	0.02	0.15	-0.05	0.08	0.12	0.10	-0.01	1.00				
South Africa	0.01	-0.01	0.20	0.01	0.05	0.19	0.12	0.91	0.02	1.00			
Tunisia	0.01	-0.04	0.10	-0.03	0.05	0.09	0.08	0.06	-0.05	0.04	1.00		
Uganda	-0.05	0.01	0.15	-0.10	0.55	0.17	0.04	0.07	0.10	0.02	-0.00	1.00	
Zambia	0.03	0.13	0.05	-0.00	0.05	0.05	0.10	-0.01	0.07	-0.02	-0.00	0.05	1.00
Emerging Markets													
Brazil	-0.02	-0.06	0.23	0.00	0.11	0.23	0.13	0.60	0.02	0.64	0.12	-0.01	0.05
China	0.04	-0.01	0.13	-0.02	0.09	0.18	0.04	0.15	0.06	0.14	0.01	0.12	0.04
India	0.02	-0.01	0.29	0.05	0.10	0.27	0.18	0.48	0.04	0.51	0.09	0.03	0.02
Russia	-0.03	-0.08	0.27	0.01	0.08	0.16	0.15	0.55	0.02	0.59	0.09	-0.05	-0.00
Developed Markets													
Australia	0.02	-0.05	0.29	0.02	0.10	0.32	0.13	0.62	0.03	0.64	0.12	0.02	-0.02
Canada	0.01	-0.05	0.25	0.03	0.10	0.25	0.15	0.67	0.07	0.71	0.10	0.03	0.03
France	0.01	-0.04	0.25	-0.01	0.08	0.25	0.10	0.65	0.07	0.69	0.10	0.02	0.03
Germany	0.01	-0.03	0.24	0.00	0.08	0.24	0.12	0.64	0.06	0.68	0.13	-0.01	0.01
Hong Kong	0.02	0.01	0.29	-0.03	0.16	0.29	0.12	0.55	0.07	0.57	0.08	0.02	-0.00
Japan	-0.02	-0.03	0.28	-0.03	0.12	0.28	0.12	0.53	0.06	0.55	0.13	0.06	0.00
Singapore	-0.00	-0.05	0.28	-0.03	0.16	0.28	0.14	0.57	0.06	0.57	0.13	0.04	0.02
Switzerland	0.04	-0.03	0.26	-0.01	0.07	0.36	0.12	0.58	0.03	0.61	0.15	0.02	-0.01
United Kingdom	-0.01	-0.05	0.25	-0.01	0.09	0.22	0.12	0.70	0.06	0.74	0.13	0.01	-0.00
United States	0.00	-0.02	0.21	-0.01	0.11	0.25	0.09	0.60	0.04	0.64	0.12	-0.01	0.02

Source: Author’s computation

Table 6. 6: Correlation of stock markets returns during the pre-crisis/stable period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1.00												
BRVM	0.13	1.00											
Egypt	0.05	0.01	1.00										
Ghana	0.02	0.07	-0.05	1.00									
Kenya	-0.05	-0.02	0.07	-0.02	1.00								
Mauritius	-0.04	-0.06	0.09	-0.03	0.10	1.00							
Morocco	0.03	0.07	0.18	-0.01	-0.01	0.01	1.00						
Namibia	0.00	0.05	0.08	-0.10	-0.07	0.04	0.12	1.00					
Nigeria	0.08	-0.06	0.05	0.04	-0.01	0.03	0.06	-0.00	1.00				
South Africa	0.02	0.05	0.10	-0.11	-0.06	0.04	0.16	0.94	-0.00	1.00			
Tunisia	0.08	-0.05	-0.00	-0.05	-0.01	0.02	0.07	-0.02	-0.01	-0.00	1.00		
Uganda	-0.11	-0.02	0.02	-0.16	0.53	0.14	-0.01	0.05	-0.00	0.08	-0.00	1.00	
Zambia	-0.01	0.16	0.09	-0.06	0.02	0.03	0.10	0.00	0.02	-0.00	0.03	0.04	1.00
Emerging Markets													
Brazil	-0.07	-0.06	0.11	0.09	0.04	0.05	0.09	0.42	0.01	0.44	0.04	-0.07	0.10
China	0.02	-0.09	0.13	0.00	0.08	0.15	0.10	0.23	0.01	0.23	-0.02	0.08	0.08
India	0.03	0.01	0.17	-0.04	-0.06	0.10	0.26	0.46	0.03	0.52	0.07	0.03	0.03
Russia	-0.09	-0.12	0.16	-0.04	-0.05	-0.03	0.16	0.37	0.03	0.41	0.02	-0.04	-0.02
Developed Markets													
Australia	-0.00	-0.05	0.12	-0.02	0.01	0.07	0.18	0.47	0.05	0.56	0.16	0.05	-0.03
Canada	-0.02	0.02	0.12	-0.04	-0.05	-0.02	0.10	0.60	-0.01	0.65	0.07	0.02	0.08
France	0.02	-0.01	0.08	-0.03	-0.04	0.02	0.08	0.56	0.06	0.59	0.12	-0.03	0.07
Germany	0.04	-0.01	0.10	0.00	-0.06	0.02	0.12	0.51	0.03	0.53	0.18	-0.08	0.02
Hong Kong	0.06	-0.01	0.13	-0.05	0.05	0.05	0.13	0.38	0.09	0.43	0.07	-0.00	0.06
Japan	-0.03	-0.03	0.12	0.03	-0.08	-0.06	0.13	0.46	0.02	0.50	0.10	0.02	0.01
Singapore	0.00	-0.10	0.11	-0.02	-0.03	0.03	0.16	0.44	0.07	0.48	0.15	-0.07	0.05
Switzerland	0.04	-0.02	0.10	-0.04	-0.08	0.03	0.15	0.51	0.06	0.54	0.17	-0.02	0.01
United Kingdom	-0.02	-0.05	0.05	-0.03	-0.04	-0.04	0.12	0.60	0.04	0.63	0.11	-0.02	0.02
United States	-0.02	-0.01	0.05	0.03	0.02	0.04	0.10	0.51	0.01	0.54	0.12	-0.03	0.07

Source: Author's computation

Table 6. 7: Correlation of stock markets returns during the global financial crisis period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1.00												
BRVM	0.05	1.00											
Egypt	-0.08	-0.09	1.00										
Ghana	0.00	-0.01	0.06	1.00									
Kenya	-0.06	0.04	0.42	-0.01	1.00								
Mauritius	0.01	-0.01	0.50	-0.06	0.32	1.00							
Morocco	-0.15	0.03	0.27	-0.03	0.14	0.22	1.00						
Namibia	-0.02	-0.17	0.32	0.03	0.18	0.28	0.05	1.00					
Nigeria	0.00	-0.06	0.23	0.06	0.04	0.12	0.19	-0.04	1.00				
South Africa	-0.04	-0.15	0.33	0.05	0.13	0.29	0.09	0.89	-0.00	1.00			
Tunisia	-0.05	-0.04	0.35	0.08	0.16	0.26	0.28	0.20	0.01	0.16	1.00		
Uganda	-0.08	-0.03	0.32	0.03	0.58	0.20	0.07	0.10	0.11	-0.01	-0.01	1.00	
Zambia	0.14	0.02	0.08	-0.06	0.16	0.07	0.17	-0.09	0.23	-0.09	0.00	0.08	1.00
Emerging Markets													
Brazil	-0.06	-0.14	0.37	0.04	0.17	0.38	0.17	0.72	-0.01	0.80	0.30	-0.04	-0.03
China	0.03	0.03	0.13	-0.07	0.10	0.25	0.01	0.02	0.06	0.01	0.03	0.13	-0.01
India	-0.02	-0.07	0.45	-0.05	0.24	0.39	0.15	0.50	0.03	0.49	0.19	0.03	0.02
Russia	-0.06	-0.10	0.40	0.07	0.20	0.27	0.17	0.64	-0.02	0.70	0.25	-0.09	0.01
Developed Markets													
Australia	-0.02	-0.10	0.48	0.09	0.20	0.47	0.14	0.67	0.00	0.66	0.35	0.04	-0.09
Canada	0.00	-0.19	0.38	0.08	0.21	0.39	0.20	0.71	0.06	0.74	0.28	0.04	-0.08
France	-0.02	-0.18	0.46	0.11	0.19	0.40	0.13	0.70	0.02	0.75	0.31	0.03	-0.08
Germany	-0.02	-0.15	0.45	0.08	0.22	0.39	0.14	0.71	0.01	0.76	0.31	0.01	-0.04
Hong Kong	-0.04	-0.00	0.42	0.04	0.22	0.42	0.14	0.62	-0.01	0.63	0.22	0.00	-0.10
Japan	-0.07	-0.12	0.48	0.02	0.28	0.48	0.19	0.62	0.04	0.63	0.36	0.06	-0.08
Singapore	-0.04	-0.08	0.43	0.05	0.31	0.40	0.16	0.63	-0.00	0.61	0.26	0.08	-0.02
Switzerland	0.02	-0.10	0.48	0.05	0.19	0.47	0.12	0.59	-0.05	0.61	0.35	0.00	-0.08
United Kingdom	-0.06	-0.15	0.45	0.10	0.20	0.36	0.13	0.72	0.02	0.78	0.33	0.00	-0.08
United States	-0.01	-0.10	0.35	0.04	0.19	0.37	0.11	0.63	-0.01	0.67	0.32	-0.03	-0.05

Source: Author’s computation

Table 6. 8: Correlation of stock markets returns during the Eurozone crisis period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1.00												
BRVM	0.08	1.00											
Egypt	-0.06	0.16	1.00										
Ghana	-0.08	-0.24	-0.00	1.00									
Kenya	-0.08	0.16	0.19	-0.15	1.00								
Mauritius	-0.05	0.10	0.02	-0.11	0.17	1.00							
Morocco	-0.02	0.08	0.11	-0.14	0.04	0.05	1.00						
Namibia	-0.00	0.00	0.07	-0.03	0.05	0.05	0.10	1.00					
Nigeria	0.10	0.21	0.11	-0.18	0.30	0.23	-0.02	0.03	1.00				
South Africa	-0.02	0.07	0.10	0.02	0.06	0.05	0.08	0.91	0.05	1.00			
Tunisia	-0.06	-0.05	-0.02	-0.07	0.00	-0.09	-0.11	-0.03	-0.15	-0.06	1.00		
Uganda	-0.03	0.11	0.00	-0.19	0.52	0.13	0.04	0.02	0.12	0.00	-0.02	1.00	
Zambia	-0.00	0.02	-0.13	0.02	-0.02	0.10	-0.02	0.00	0.05	-0.02	-0.09	0.08	1.00
Emerging Markets													
Brazil	0.04	0.03	0.13	-0.03	0.11	0.06	0.11	0.61	0.06	0.61	-0.00	0.08	-0.02
China	0.02	0.08	0.12	-0.04	0.07	-0.00	-0.06	0.32	0.08	0.31	0.03	0.05	0.02
India	-0.02	0.04	0.12	0.12	0.05	0.14	0.05	0.46	0.03	0.53	0.01	-0.01	-0.07
Russia	0.08	0.03	0.19	-0.01	0.03	0.08	0.07	0.57	0.07	0.57	-0.04	-0.01	-0.06
Developed Markets													
Australia	0.02	-0.03	0.15	0.02	-0.02	0.13	0.09	0.67	0.05	0.71	-0.10	-0.04	0.01
Canada	0.01	0.01	0.15	0.05	0.01	0.08	0.14	0.65	0.08	0.71	-0.08	0.01	-0.00
France	-0.02	0.06	0.13	-0.05	-0.01	0.15	0.09	0.67	0.14	0.70	-0.06	0.02	0.07
Germany	-0.03	0.05	0.09	-0.02	0.03	0.16	0.06	0.65	0.16	0.70	-0.04	0.01	0.04
Hong Kong	0.02	0.06	0.24	-0.08	0.17	0.20	0.08	0.58	0.19	0.59	-0.06	0.04	-0.06
Japan	0.01	0.06	0.17	-0.08	0.06	0.23	0.03	0.44	0.09	0.47	-0.02	0.08	0.09
Singapore	-0.04	0.04	0.21	-0.09	0.12	0.22	0.07	0.55	0.17	0.56	-0.02	0.01	-0.06
Switzerland	0.03	0.03	0.08	-0.04	-0.01	0.17	0.10	0.65	0.15	0.68	-0.05	0.07	0.02
United Kingdom	-0.01	0.06	0.13	-0.05	0.01	0.09	0.11	0.75	0.13	0.80	-0.03	0.04	0.03
United States	0.01	0.05	0.15	-0.04	0.05	0.14	0.07	0.63	0.12	0.70	-0.03	0.06	0.02

Source: Author's computation

Tables 6.9 – 6.14 below present both the ADF and PP test results for the three data generating processes in log-level and first-difference across difference sample periods. The evidence emerging from the ADF test, as indicated in the tables, show that the null hypothesis of a unit root in log-level cannot be rejected for all the markets and across all the sample periods. This result suggests that the stock market returns may be integrated of order one and any shock that affects the stock market return series will persist into the future. When the ADF test is applied to the log-returns (first-difference), the results rejected the null hypothesis of unit root across all markets and samples. Similarly, the PP test results presented in the tables also show there is a presence of unit root in log-level for all the stock markets and across all samples since the null hypothesis of unit root cannot be rejected. Moreover, in the first difference, the null hypothesis of unit root is rejected across all the markets and samples. This result is consistent with the ADF test result suggesting that the stock market series across all the markets and sample is integrated of order one or *I(1)*, which is a necessary condition for carrying out a co-integration analysis.

To ensure the validity of the above test results, a confirmatory test is carried out using the KPSS test. The results of the KPSS test, shown in Tables 6.13 and 6.14, appear to be consistent with ADF and PP test results in the log-level for all the stock market series and across the samples. The results in log-level show the null hypothesis of stationarity can be rejected at 5% level of significance, suggesting that the stock markets series may be characterised by a higher order of integration. In first-difference, the test results appear inconsistent not only across the models but also with the evidence from the ADF and PP tests. For instance, the KPSS test results for model 1 and 2 consistently rejected the null hypothesis of stationarity for Egypt in first difference over the full-sample period. They also rejected stationarity for Ghana and China over the pre-crisis/stable period, Botswana during the global financial crisis and China during the Eurozone crisis period.

Although the KPSS test results differ to some extent from that of the ADF and PP tests in first-difference, there is overwhelming evidence in support of stationary process in first-difference. Based on the evidence from the ADF and PP test results, all the stock market series are first differenced stationary. This means that the stock market series are *I(1)* series, which has an implication for the analysis of co-integration and to avoid the problem of spurious regression. Therefore, the next section is going to deal with the co-integration between African stock markets and the major global stock markets.

Table 6. 9: Unit root test result during the full-sample period

Country	Unit root test in level						Unit root test in first difference					
	ADF test			Phillips-Perron test			ADF test			Phillips-Perron test		
African Markets	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Botswana	-1.61	-1.10	2.42	-1.42	-1.20	2.08	-11.89*	-11.96*	-11.57*	-22.60*	-22.56*	-22.84*
BRVM	-0.90	-1.43	1.87	-0.92	-1.48	1.82	-25.05*	-25.03*	-24.92*	-25.06*	-25.04*	-25.00*
Egypt	-3.79*	-2.78	2.31	-3.54*	-2.79	1.89	-23.56*	-23.78*	-23.34*	-23.91*	-23.98*	-23.87*
Ghana	-0.20	-2.24	-0.68	-0.28	-2.25	-0.66	-23.59*	-23.74*	-23.59*	-23.61*	-23.74*	-23.62*
Kenya	-3.58*	-3.05	1.78	-3.46*	-3.04	1.54	-23.65*	-23.71*	-23.56*	-23.80*	-23.81*	-23.75*
Mauritius	-2.44	-1.64	2.58	-2.36	-1.86	2.20	-21.53*	-21.66*	-21.24*	-22.33*	-22.22*	-22.46*
Morocco	-3.02*	-1.20	1.97	-2.77	-1.26	1.83	-22.35*	-22.65*	-22.19*	-22.61*	-22.78*	-22.59*
Namibia	-1.70	-1.95	1.59	-1.70	-1.84	1.50	-27.41*	-27.42*	-27.31*	-27.42*	-27.43*	-27.30*
Nigeria	-2.27	-1.92	1.20	-2.35	-2.12	0.89	-23.28*	-23.32*	-23.25*	-24.22*	-24.21*	-24.23*
South Africa	-1.17	-1.84	2.47	-1.17	-1.73	2.61	-27.52*	-27.52*	-27.23*	-27.50*	-27.51*	-27.18*
Tunisia	-1.70	-0.56	3.80	-1.57	-0.81	3.21	-22.79*	-22.87*	-22.31*	-23.02*	-23.04*	-22.92*
Uganda	-1.86	-2.56	1.94	-1.84	-2.53	2.04	-25.24*	-25.23*	-25.05*	-25.19*	-25.19*	-24.99*
Zambia	-1.41	-1.38	2.23	-1.41	-1.45	2.13	-24.42*	-24.43*	-24.21*	-24.43*	-24.44*	-24.78*
Emerging Markets												
Brazil	-2.85	-1.90	1.46	-2.86*	-1.90	1.43	-26.91*	-27.09*	-26.82*	-26.84*	-27.00*	-26.78*
China	-1.27	-1.31	0.96	-1.53	-1.62	0.76	-23.40*	-23.38*	-23.39*	-23.85*	-23.83*	23.84*
India	-1.92	-2.33	2.02	-1.91	-2.23	2.18	-14.74*	-14.77*	-14.54*	-24.23*	-24.24*	-24.18*
Russia	-2.61	-2.16	1.13	-2.60	-2.29	1.00	-23.72*	-23.78*	-23.64*	-23.81*	-23.84*	-23.80*
Developed Markets												
Australia	-1.98	-1.88	0.98	-1.95	-1.85	1.02	-25.73*	-25.73*	-25.71*	-25.74*	-25.74*	-25.72*
Canada	-2.13	-2.19	1.39	-2.16	-2.29	1.33	-27.86*	-27.86*	-27.79*	-27.76*	-27.77*	-27.66*
France	-1.91	-1.93	0.42	-1.96	-1.98	0.40	-28.25*	-28.24*	-28.27*	-28.26*	-28.24*	-28.28*
Germany	-1.55	-2.35	1.42	-1.50	-2.27	1.53	-27.83*	-27.82*	-27.74*	-27.78*	-27.76*	-27.65*
Hong Kong	-2.20	-2.36	1.12	-2.22	-2.46	1.09	-25.29*	-25.30*	-25.25*	-25.30*	-25.31*	-25.28*
Japan	-1.39	-1.40	0.91	-1.44	-1.45	0.92	-25.15*	-25.13*	-25.13*	-25.15*	-25.13*	-25.14*
Singapore	-2.31	-2.25	1.40	-2.33	-2.45	1.23	-24.34*	-24.36*	-24.28*	-24.50*	-24.51*	-24.50*
Switzerland	-1.61	-1.70	1.09	-1.52	-1.66	1.06	-17.41*	-17.40*	-17.37*	-30.57*	-30.54*	-30.47*
United Kingdom	-1.99	-2.41	0.96	-1.89	-2.26	1.03	-27.34*	-27.32*	-27.31*	-27.32*	-27.31	-27.34*
United States	-0.93	-1.53	1.34	-0.85	-1.46	1.41	-26.63*	-26.62*	-26.57*	-26.61*	-26.60*	-26.54*

Note: *denotes significance at 5%. Model 1 = Drift, Model 2 = drift and trend, and Model 3 = No drift and trend. The critical values at 5% level of significance for these models are -2.87, -3.97 and -1.94 respectively (both for the ADF and PP test). The decision to reject the null hypothesis is made at 5% level of significance. The lag length selection for ADF test is based on Schwarz's information criterion while the bandwidth for PP test is based on Newey-West.

Source: Author's computation

Table 6. 10: Unit root test result during the pre-crisis/stable period

Country	Unit root test in level						Unit root test in first difference					
	ADF test			Phillips-Perron test			ADF test			Phillips-Perron test		
African Markets	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Botswana	5.39	0.44	4.44	5.88	0.60	4.89	-8.45*	-9.68*	-3.45*	-15.33*	-16.76*	-14.56*
BRVM	0.05	-2.95	1.60	0.05	-2.78	1.60	-16.92*	-16.99*	-16.75*	-16.96*	-16.99*	-16.80*
Egypt	-2.02	-0.97	4.23	-1.99	-1.01	3.95	-14.41*	-14.48*	-13.38*	-14.41*	-14.57*	-13.73*
Ghana	-3.22*	-2.27	1.20	-3.17*	-1.93	1.78	-4.10*	-5.70*	-3.88*	-9.52*	-10.51*	-9.00*
Kenya	-2.32	-2.93	2.81	-2.28	-3.08	2.64	-15.51*	-15.55*	-15.09*	-15.49*	-15.53*	-15.13*
Mauritius	0.18	-1.34	4.85	0.19	-1.37	4.92	-14.06*	-14.05*	-12.97*	-14.02*	-14.01*	-12.93*
Morocco	0.44	-1.27	3.87	0.44	-1.38	3.87	-13.36*	-13.37*	-12.70*	-13.38*	-13.39*	-12.77*
Namibia	0.64	-3.48*	3.27	0.91	-3.21	3.70	-18.05*	-18.11*	-17.41*	-18.63*	-18.81*	-17.42*
Nigeria	-0.18	-1.03	3.21	-0.31	-1.27	2.89	-15.28*	-15.27*	-14.71*	-15.36*	-15.34*	-15.00*
South Africa	0.71	-3.99*	3.21	0.84	-4.00*	3.45	-16.52*	-16.63*	-15.82*	-16.52*	-16.65*	-15.82*
Tunisia	0.81	-1.73	4.29	0.46	-2.01	3.35	-12.74*	-12.79*	-5.97*	-12.98*	-13.01*	-12.59*
Uganda	-1.75	-1.33	1.80	-1.81	-1.19	1.80	-13.85*	-14.00*	-13.53*	-13.85*	-14.16*	-13.56*
Zambia	0.34	-1.50	2.00	0.34	-1.51	1.98	-15.17*	-15.24*	-14.96*	-15.17*	-15.24*	-14.96
Emerging Markets												
Brazil	-0.71	-2.57	3.04	-0.69	-2.57	3.16	-17.15*	-17.11*	-16.49*	-17.04*	-17.01*	-16.50*
China	1.81	0.63	2.30	1.48	0.50	1.90	-14.57*	-15.04*	-14.34*	-14.81*	-15.06*	-14.66*
India	-0.43	-2.18	3.54	-0.49	-2.53	3.13	-13.66*	-13.63*	-13.06*	-13.66*	-13.63*	-13.24*
Russia	-0.76	-2.26	2.56	-0.75	-2.34	2.62	-14.38*	-14.35*	-14.02*	-14.35*	-14.32*	-14.03*
Developed Markets												
Australia	0.59	-4.16*	3.71	0.57	-4.20*	3.60	-15.26*	-15.31*	-14.47*	-15.27*	-15.31*	-14.57*
Canada	-0.36	-3.17*	3.15	-0.32	-3.30	3.35	-16.59*	-16.55*	-15.90*	-16.56*	-16.53*	-15.93*
France	0.08	-4.12*	2.55	0.14	-4.89*	2.57	-18.55*	-18.54*	-18.16*	-18.80*	-18.80*	-18.10*
Germany	0.25	-3.15*	2.95	0.27	-3.28	2.82	-18.36*	-18.36*	-17.83*	-18.35*	-18.36*	-17.64*
Hong Kong	-0.14	-2.39	2.68	-0.07	-2.33	2.85	-16.35*	-16.34*	-15.88*	-16.33*	-16.32*	-15.87*
Japan	-0.77	-2.44	2.12	-0.75	-2.54	2.17	-16.22*	-16.18*	-15.91*	-16.20*	-16.17*	-15.91*
Singapore	-0.18	-2.32	3.20	-0.07	-2.32	3.61	-15.76*	-15.73*	-15.13*	-15.85*	-15.82*	-15.13*
Switzerland	-0.16	-3.14	2.19	-0.12	-3.28	2.28	-16.75*	-16.74*	-16.41*	-16.72*	-16.70*	-16.37*
United Kingdom	-0.36	-4.16*	2.37	-0.22	-4.19*	2.79	-16.67*	-16.64*	-16.27*	-16.91*	-16.87*	-16.35*
United States	-0.84	-2.90	2.14	-0.76	-2.79	2.36	-17.63*	-17.59*	-17.30*	-17.60*	-17.56*	-17.20*

Note: *denotes significance at 5%. Model 1 = Drift, Model 2 = drift and trend, and Model 3 = No drift and trend. The critical values at 5% level of significance for these models are -2.87, -3.97 and -1.94 respectively (both for the ADF and PP test). The decision to reject the null hypothesis is made at 5% level of significance. The lag length selection for ADF test is based on Schwarz's information criterion while the bandwidth for PP test is based on Newey-West.

Source: Author's computation

Table 6. 11: Unit root test result during the global financial crisis period

Country	Unit root test in level						Unit root test in first difference					
	ADF test			Phillips-Perron test			ADF test			Phillips-Perron test		
African Markets	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Botswana	1.40	-3.77*	3.02	1.03	-3.90*	2.35	-12.84*	-13.33*	-3.68*	-12.92*	-13.45*	-12.72*
BRVM	-0.13	-3.00	1.17	-0.42	-3.43*	1.07	-18.45*	-18.53*	-18.39*	-18.30*	-18.50*	-18.07*
Egypt	-0.24	-2.43	5.16	-0.24	-2.57	5.25	-11.16*	-11.12*	-9.61*	-11.14*	-11.10*	-9.75*
Ghana	-0.82	-1.86	-0.41	-0.72	-1.73	-0.45	-5.10*	-5.19*	-5.10*	-8.04*	-8.13*	-8.04*
Kenya	-1.31	-1.79	2.41	-2.04	-2.53	2.47	-11.58*	-11.56*	-11.13*	-11.64*	-11.63*	-11.34*
Mauritius	-1.40	-2.11	4.58	-1.35	-2.28	4.19	-10.93*	-10.93*	-9.78*	-10.92*	-10.92*	-10.01*
Morocco	-1.62	-2.32	2.57	-1.62	-2.18	2.57	-9.77*	-9.77*	-9.43*	-9.74*	-9.72*	-9.43*
Namibia	-0.27	-3.44	1.57	-0.11	-3.38	1.76	-14.08*	-14.10*	-13.83*	-14.04*	-14.06*	-13.78*
Nigeria	-1.99	-1.37	1.88	-1.96	-1.45	1.71	-11.91*	-12.01*	-11.68*	-11.95*	-12.03*	-11.79*
South Africa	0.50	-3.23	1.98	0.47	-3.30	1.93	-12.98*	-13.16*	-7.11*	-12.96*	-13.12*	-12.71*
Tunisia	-0.10	-2.03	2.51	-0.36	-2.59	2.02	-10.12*	-10.09*	-9.78*	-10.26*	-10.24*	-10.05*
Uganda	-1.66	-1.82	0.19	-1.62	-1.85	0.19	-13.07*	-13.03*	-13.11*	-13.05*	-13.01*	-13.09*
Zambia	-3.41*	-3.12	1.68	-3.41*	-3.11	1.83	-16.58*	-16.86*	-16.38*	-17.26*	-18.69*	-16.56*
Emerging Markets												
Brazil	-1.17	-1.82	2.15	-1.17	-1.91	2.50	-12.97*	-12.94*	-12.60*	-12.94*	-12.90*	-12.66*
China	-0.88	-2.69	-0.43	-0.93	-2.75	-0.42	-12.05*	-12.08*	-12.07*	-12.05*	-12.08*	-12.07*
India	-0.19	-1.42	2.94	-0.38	-1.80	2.42	-10.25*	-10.22*	-9.78*	-10.39*	-10.36*	-10.13*
Russia	-1.23	-2.30	1.90	-1.27	-2.41	1.86	-10.82*	-10.78*	-10.61*	-10.78*	-10.74*	-10.61*
Developed Markets												
Australia	0.23	-3.74*	2.55	0.15	-3.90*	2.38	-10.84*	-10.86*	-10.43*	-10.93*	-10.95*	-10.70*
Canada	-0.31	-2.36	2.57	-0.28	-2.48	2.67	-12.38*	-12.33*	-11.84*	-12.38*	-12.34*	-11.98*
France	-0.07	-3.63*	1.73	-0.06	-3.70*	1.70	-14.05*	-14.07*	-13.85*	-14.19*	-14.21*	-13.85*
Germany	-0.68	-2.52	1.43	-0.55	-2.61	1.60	-14.15*	-14.11*	-13.94*	-14.12*	-14.07*	-13.83*
Hong Kong	-1.01	-1.80	1.67	-0.99	-1.77	1.73	-12.61*	-12.57*	-12.40*	-12.61*	-12.56*	-12.40*
Japan	-1.02	-2.03	1.54	-0.99	-2.10	1.61	-12.57*	-12.52*	-12.38*	-12.54*	-12.52*	-12.37*
Singapore	-1.13	-2.19	2.10	-1.10	-2.26	2.40	-11.51*	-11.48*	-11.22*	-11.57*	-11.55*	-11.22*
Switzerland	-0.22	-2.41	1.44	-0.16	-2.55	1.50	-13.02*	-13.05*	-12.85*	-13.00*	-13.03*	-12.82*
United Kingdom	-0.46	-3.02	1.77	-0.46	-3.07	1.85	-11.97*	-11.94*	-11.74*	-11.98*	-11.94*	-11.73*
United States	-1.44	-1.99	1.33	-1.42	-1.93	1.42	-13.09*	-13.07*	-12.97*	-13.08*	-13.06*	-12.94*

Note: *denotes significance at 5%. Model 1 = Drift, Model 2 = drift and trend, and Model 3 = No drift and trend. The critical values at 5% level of significance for these models are -2.87, -3.97 and -1.94 respectively (both for the ADF and PP test). The decision to reject the null hypothesis is made at 5% level of significance. The lag length selection for ADF test is based on Schwarz's information criterion while the bandwidth for PP test is based on Newey-West.

Source: Author's computation

Table 6. 12: Unit root test result during the Eurozone crisis period

Country	Unit root test in level						Unit root test in first difference					
	ADF test			Phillips-Perron test			ADF test			Phillips-Perron test		
African Markets	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Botswana	4.30	-0.88	4.34	4.23	-0.86	4.86	-8.58*	-9.65*	-3.79*	-15.57*	-16.51*	-15.33*
BRVM	0.61	-2.46	1.93	0.61	-2.27	2.04	-17.02*	-17.17*	-16.79*	-17.08*	-17.18*	-16.79*
Egypt	-2.19	-0.89	4.16	-2.15	-0.93	3.86	-14.55*	-14.76*	-13.58*	-14.55*	-14.76*	-13.90*
Ghana	-1.90	-1.90	-1.41	-1.89	-1.89	-1.43	-14.02*	-14.04*	-13.95*	-14.02*	-14.04*	-13.95*
Kenya	-2.21	-3.09	2.96	-2.17	-3.21	2.82	-15.69*	-15.71*	-15.24*	-15.68*	-15.69*	-15.29*
Mauritius	-0.16	-1.61	4.75	-0.15	-1.63	4.84	-14.43*	-14.41*	-13.38*	-14.40*	-14.37*	-13.35*
Morocco	0.81	-1.09	4.18	0.81	-1.21	4.18	-13.42*	-13.51*	-12.72*	-13.51*	-13.53*	-12.80*
Namibia	-0.10	-3.70*	2.45	0.15	-3.50*	3.15	-17.80*	-17.78*	-17.33*	-18.31*	-18.32*	-17.34*
Nigeria	-0.35	-1.19	3.19	-0.45	-1.36	2.91	-15.36*	-15.33*	-14.80*	-15.43*	-15.40*	-15.09*
South Africa	0.28	-4.10*	2.96	0.36	-4.07*	3.15	-16.46*	-16.49*	-15.89*	-16.48*	-16.51*	-15.89*
Tunisia	0.44	-1.82	4.18	0.17	-2.12	3.25	-13.07*	-13.07*	-6.13*	-13.31*	-13.31*	-12.96*
Uganda	-0.43	-1.37	1.65	-0.43	-1.38	1.67	-16.05*	-16.05*	-15.92*	-16.04*	-16.05*	-15.91*
Zambia	0.28	-1.61	2.04	0.27	-1.61	2.03	-15.46*	-15.51*	-15.24*	-15.46*	-15.51*	-15.24*
Emerging Markets												
Brazil	-0.99	-2.70	2.84	-0.98	-2.73	3.02	-17.48*	-17.45*	-16.91*	-17.38*	-17.36*	-16.87*
China	3.13	1.44	2.97	2.88	1.41	2.42	-14.58*	-15.35*	-14.21*	-14.86*	-15.36*	-14.72*
India	-0.48	-2.23	3.55	-0.52	-2.59	3.22	-13.79*	-13.77*	-13.21*	-13.79*	-13.76*	-13.33*
Russia	-1.02	-2.20	2.43	-1.02	-2.29	2.42	-14.64*	-14.62*	-14.33*	-14.61*	-14.59*	-14.33*
Developed Markets												
Australia	0.12	-4.49*	3.21	0.18	-4.55*	3.41	-15.55*	-15.55*	-14.97*	-15.58*	-15.57*	-14.97*
Canada	-0.77	-3.11	2.82	-0.77	-3.25	2.82	-16.53*	-16.50*	-16.02*	-16.54*	-16.50*	-16.02*
France	-0.73	-4.02*	1.94	-0.72	-4.25*	1.89	-18.04*	-18.00*	-17.83*	-18.13*	-18.10*	-17.83*
Germany	-0.47	-3.42*	2.18	-0.37	-3.60*	2.47	-18.29*	-18.26*	-17.89*	-18.28*	-18.24*	-17.74*
Hong Kong	-0.07	-2.55	2.60	0.11	-2.48	2.98	-16.48*	-16.48*	-16.06*	-16.60*	-16.59*	-16.05*
Japan	-1.30	-2.12	1.65	-1.29	-2.24	1.69	-16.58*	-16.59*	-16.40*	-16.56*	-15.56*	-16.38*
Singapore	-0.55	-2.71	2.91	-0.47	-2.66	3.33	-16.14*	-16.11*	-15.61*	-16.25*	-16.21*	-15.61*
Switzerland	-0.60	-2.78	1.91	-0.59	-2.99	1.95	-16.69*	-16.65*	-16.44*	-16.66*	-16.63*	-16.43*
United Kingdom	-0.93	-3.49*	1.95	-0.88	-3.54*	2.19	-16.54*	-16.51*	-16.29*	-16.66*	-16.66*	-16.29*
United States	-1.29	-3.01	1.84	-1.27	-2.90	1.96	-17.42*	-17.39*	-17.19*	-17.41*	-17.39*	-17.17*

Note: *denotes significance at 5%. Model 1 = Drift, Model 2 = drift and trend, and Model 3 = No drift and trend. The critical values at 5% level of significance for these models are -2.87, -3.97 and -1.94 respectively (both for the ADF and PP test). The decision to reject the null hypothesis is made at 5% level of significance. The lag length selection for ADF test is based on Schwarz's information criterion while the bandwidth for PP test is based on Newey-West.

Source: Author's computation

Table 6. 13: KPSS test result during the full-sample and pre-crisis/stable periods

Country	Panel A: Full-sample period				Panel B: Pre-crisis/stable period			
	Test statistic in level		Test statistic in first-difference		Test statistic in level		Test statistic in first-difference	
African Markets	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Botswana	2.17*	0.53*	0.23	0.11	1.84*	0.44*	1.59*	0.14
BRVM	1.94*	0.37*	0.12	0.12	1.94*	0.15*	0.14	0.05
Egypt	1.29*	0.51*	0.66*	0.20*	1.97*	0.43*	0.39	0.06
Ghana	1.85*	0.61*	0.48*	0.07	0.82*	0.43*	0.89*	0.24*
Kenya	0.99*	0.33*	0.39	0.17*	1.93*	0.13	0.23	0.06
Mauritius	2.48*	0.50*	0.34	0.05	1.92*	0.21*	0.16	0.13
Morocco	1.73*	0.67*	0.85*	0.09	1.88*	0.39*	0.19	0.08
Namibia	2.06*	0.36*	0.12	0.07	2.01*	0.39*	0.23	0.04
Nigeria	0.51*	0.30*	0.22	0.12	1.52*	0.22*	0.19	0.18*
South Africa	2.52*	0.39*	0.10	0.06	2.03*	0.32*	0.25	0.06
Tunisia	2.75*	0.58*	0.32	0.09	1.93*	0.44*	0.18	0.05
Uganda	2.08*	0.20*	0.14	0.12	1.30*	0.31*	0.27	0.05
Zambia	2.44*	0.48*	0.18	0.08	1.69*	0.41*	0.22	0.04
Emerging Markets								
Brazil	2.06*	0.61*	0.46*	0.03	1.95*	0.17*	0.05	0.05
China	0.92*	0.38*	0.12	0.10	0.74*	0.42*	0.71*	0.21*
India	2.38*	0.45*	0.18	0.06	1.98*	0.09	0.04	0.04
Russia	1.60*	0.39*	0.23	0.05	1.95*	0.25*	0.05	0.05
Developed Markets								
Australia	0.79*	0.34*	0.16	0.11	2.05*	0.13	0.13	0.04
Canada	1.57*	0.31*	0.14	0.07	2.02*	0.09	0.03	0.03
France	0.33	0.31*	0.11	0.10	2.01*	0.09	0.09	0.04
Germany	1.98*	0.26*	0.08	0.07	1.97*	0.12	0.10	0.04
Hong Kong	1.86*	0.34*	0.12	0.04	1.90*	0.15*	0.07	0.06
Japan	0.29	0.30*	0.17	0.17*	1.90*	0.11	0.05	0.05
Singapore	1.73*	0.26*	0.15	0.06	1.93*	0.16*	0.08	0.07
Switzerland	0.59*	0.30*	0.13	0.13	1.96*	0.18*	0.09	0.05
United Kingdom	1.40*	0.23*	0.07	0.06	2.03*	0.08	0.04	0.03
United States	1.19*	0.33*	0.14	0.11	1.88*	0.19*	0.04	0.04

Note: *denotes significance at 5%. Model 1 = Drift, and Model 2 = drift and trend. The critical values at 5% level of significance for these models are 0.46 and 0.15 respectively The decision to reject the null hypothesis of stationary is made at 5% level of significance. The bandwidth is based on Newey-West.

Source: Author’s computation

Table 6. 14: KPSS test result during the global financial crisis and Eurozone crisis periods

Country	**Panel A: Global financial crisis period**				**Panel B: Eurozone crisis period**			
	Test statistic in level		Test statistic in first-difference		Test statistic in level		Test statistic in first-difference	
African Markets	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Botswana	1.33*	0.12	0.48*	0.21*	1.77*	0.44*	1.36*	0.09
BRVM	1.23*	0.18*	0.18	0.07	1.86*	0.14	0.25	0.06
Egypt	1.40*	0.16*	0.05	0.05	1.88*	0.43*	0.45	0.06
Ghana	0.78*	0.29*	0.29	0.15*	1.13*	0.30*	0.14	0.04
Kenya	1.22*	0.20*	0.19	0.08	1.87*	0.14	0.21	0.06
Mauritius	1.38*	0.29*	0.15	0.06	1.86*	0.23*	0.11	0.10
Morocco	1.20*	0.27*	0.19	0.09	1.84*	0.39*	0.21	0.07
Namibia	1.32*	0.07	0.10	0.05	1.93*	0.36*	0.13	0.07
Nigeria	0.92*	0.31*	0.31	0.10	1.50*	0.23*	0.17	0.16*
South Africa	1.32*	0.11	0.23	0.07	1.95*	0.29*	0.17	0.08
Tunisia	1.27*	0.13	0.06	0.04	1.87*	0.39*	0.14	0.07
Uganda	0.65*	0.15*	0.12	0.11	1.40*	0.27*	0.15	0.10
Zambia	1.24*	0.31*	0.45	0.04	1.67*	0.40*	0.21	0.05
Emerging Markets								
Brazil	1.24*	0.27*	0.10	0.06	1.87*	0.16*	0.06	0.04
China	0.92*	0.25*	0.21	0.07	0.86*	0.43*	1.02*	0.25*
India	1.22*	0.15*	0.09	0.09	1.91*	0.08	0.04	0.04
Russia	1.25*	0.21*	0.08	0.07	1.89*	0.22*	0.07	0.06
Developed Markets								
Australia	1.38*	0.17*	0.13	0.05	1.96*	0.11	0.08	0.04
Canada	1.32*	0.15*	0.07	0.06	1.93*	0.11	0.04	0.03
France	1.29*	0.16*	0.12	0.08	1.92*	0.07	0.07	0.07
Germany	1.20*	0.21*	0.07	0.07	1.89*	0.12	0.04	0.04
Hong Kong	1.18*	0.20*	0.09	0.07	1.84*	0.16*	0.09	0.06
Japan	1.09*	0.24*	0.07	0.07	1.82*	0.10	0.10	0.06
Singapore	1.28*	0.22*	0.09	0.05	1.86*	0.16*	0.05	0.05
Switzerland	1.15*	0.18*	0.13	0.09	1.89*	0.15*	0.08	0.08
United Kingdom	1.30*	0.15*	0.05	0.05	1.94*	0.08	0.06	0.05
United States	1.20*	0.27*	0.11	0.04	1.81*	0.18*	0.05	0.03

Note: *denotes significance at 5%. Model 1 = Drift, and Model 2 = drift and trend. The critical values at 5% level of significance for these models are 0.46 and 0.15 respectively The decision to reject the null hypothesis of stationary is made at 5% level of significance. The bandwidth is based on Newey-West.

Source: Author’s computation

6.4 Estimation of stock market integration

This section presents and discusses the results of the long-run relationship between African stock markets and those of the major global stock markets. It also considers the lead-lag relationships between these markets as well as the impact of individual stock markets on the stock market returns of another market. In this section, a bivariate testing procedure is followed by pairing each African market with another African market, or any emerging and developed market. This is to easily identify the dynamic linkage among African markets and between them and the emerging and developed markets.

6.4.1 Co-integration test results

The Johansen co-integration technique is employed as outlined in Chapter Five. The co-integration analysis in this study is carried out both within the African markets and between these African markets and the emerging and developed markets. In doing that, the bivariate testing procedure is applied to the log-level of all the stock market series across the four sample periods in order to identify whether the dynamic relationship between markets has been changing over time.

One of the necessary conditions for testing co-integrating relationship between two or more series is that the series be integrated of order one or *I(1)* (Mylonidis & Kollias, 2010). As shown in the previous section, all the stock markets series are found to be *I(1)* across all the samples. In addition, the co-integration test requires a VAR model with Gaussian errors. Consequently, it is necessary to determine the optimal lag length of the VAR(p) model. The objective is to ensure that the error term is standard normal and does not suffer from non-normality, autocorrelation and hetroskedasticity problems (Asteriou & Hall, 2011). The optimal lag length in this study is determined using the AIC, SBIC and HQIC as explained in Chapter Five. The detailed results for the bivariate Johansen co-integration test are presented the in Appendix D for individual African stock markets across all the sample periods. However, the summary results of the bivariate Johansen co-integration test for all the stock markets over the four sample periods are reported in Tables 6.15 – 6.18 below.

Table 6.15 summarises the results of the bivariate co-integration test over the full-sample period. Evidence from the table shows there is an existence of a co-integrating relationship among African markets and between African markets and the major global markets. Within the African stock markets, Botswana, BRVM, Egypt, Kenya, Mauritius, South Africa, Tunisia and Zambia are shown to be more co-integrated with the rest of African markets. On the other hand, Ghana, Morocco, Nigeria, Namibia and Uganda are found to be the least co-integrated with other African markets. Between Africa and the emerging markets, the table shows that Botswana, BRVM, Mauritius, Tunisia and Zambia are more co-integrated with the emerging markets than other African markets. In particular, the result suggests that African markets are more co-integrated with Brazil, India and Russia than China. Additionally, African markets such as Botswana, BRVM, Egypt, Kenya, Morocco, Nigeria, South Africa and Zambia appear more co-integrated with the developed markets. The presence of a co-integrating relationship provides evidence of financial integration between these African markets and the major global markets. However, Ghana, Mauritius, Namibia, Tunisia and Uganda appear not to be co-integrated with the developed markets over this period.

Table 6.16 shows the summary results of the bivariate co-integration test during the pre-crisis/stable period. As reported in the table, there is presence of a co-integrating relationship among most African markets. Apart from BRVM and Uganda, other African markets appear to be more co-integrated with one another. The table also reveals that, apart from Morocco and Zambia, most African markets are co-integrated with the emerging markets. Again, African markets are found to be more co-integrated with Brazil, India and Russia. Furthermore, evidence from the table shows that African markets such as Botswana, BRVM, Egypt, Ghana, Kenya, Mauritius and South Africa are more co-integrated with the developed market than other African markets. This result suggests the existence of a long run-relationship between African markets and the emerging and developed markets before the 2007 global financial crisis.

However, the evidence during the global financial crisis period shows a dramatic reversal in the co-integrating relationship among African markets and between them and the major global markets. As shown in Table 6.17, with the exception of Botswana, Egypt, Kenya and Mauritius there is limited evidence of co-integrating relationship between African, emerging and developed markets during the global financial crisis period. The limited evidence of co-integrating relationships during this period indicates that the global financial crisis had an effect on the relationship between African markets and the major global markets. Also, the result suggests evidence of a decoupling relationship between African markets and the major global markets over this period.

Unlike the period of the global financial crisis, the evidence during the Eurozone crisis period, as reported in Table 6.18, shows that the relationship between African, emerging and developed stock markets appear to have recovered over this period. In particular, apart from Ghana, Morocco, Namibia, Nigeria, Uganda and Zambia, other African markets appear to be more co-integrated with other markets. However, the number of co-integrating relationships over this period is lower compare to the pre-crisis period.

In summary, the evidence emerging from the Johansen co-integration test above shows that there is a significant degree of financial integration among African stock markets and between them and the major global markets prior to the global financial crisis and during the Eurozone crisis period. In other words, there is evidence of long-run relationships between Africa, emerging and developed stock markets over the full-sample and pre-crisis and Eurozone crisis period. This evidence suggests that, although these markets may follow their individual paths in the short-run, they will not trend far apart from each other in long-run (Gupta & Guidi, 2012). This result is consistent with the existing studies by Piesse and Hearn (2012) and Boamah et al., (2016), who found some evidence of co-integrating relationship between African markets and the major global markets.

However, during the global financial crisis period, the results show a dramatic reduction in the number of co-integrating relationships between African markets and the major global stock markets. This is clearly visible from the number of co-integrating relationships over this period. This evidence suggests a trend reversal towards disintegration and it may also suggest a decoupling relationship between African markets and the major global markets. In addition, the analysis of the long-run relationships across different sample periods indicates that the degree of financial integration is time varying. In other words, the degree of financial integration of African stock markets with the major global markets is not constant over time.

Lastly, to further understand the dynamic relationship between African and the major global stock markets, it is necessary to examine the short-run dynamic relationship between the markets. In particular, it is necessary to consider the causal or the lead-lag relationships between these markets, in order to understand the direction of causality. Therefore, the following section considers the Granger causality test.

Table 6. 15: Summary of bivariate co-integration test results during the full-sample period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana													
BRVM	X												
Egypt	√	√											
Ghana	X	X	X										
Kenya	√	√	√	X									
Mauritius	X	√	X	X	√								
Morocco	X	X	√	X	√	√							
Namibia	√	√	√	X	X	X	X						
Nigeria	X	X	√	X	√	X	X	X					
South Africa	√	√	√	X	√	√	X	X	√				
Tunisia	X	√	√	√	√	√	√	√	√	√			
Uganda	√	X	X	X	X	X	X	X	X	√	√		
Zambia	√	X	√	X	√	√	X	√	X	√	√	√	
Emerging Markets													
Brazil	√	√	√	X	√	√	√	X	X	X	√	X	√
China	X	X	X	X	X	√	X	X	X	X	X	X	X
India	√	√	√	X	X	√	X	X	X	√	√	X	√
Russia	√	√	X	X	√	√	√	√	X	√	√	X	√
Developed Markets													
Australia	X	√	√	X	√	X	√	X	√	X	X	X	√
Canada	√	√	√	X	√	X	X	√	X	√	X	X	√
France	X	√	X	X	X	X	√	X	√	√	X	X	√
Germany	√	√	X	X	X	√	X	X	√	√	X	X	√
Hong Kong	√	√	√	X	X	√	√	X	X	X	√	X	√
Japan	√	X	√	X	X	X	√	X	√	X	X	X	X
Singapore	√	√	√	X	X	√	X	√	X	√	X	X	√
Switzerland	√	√	X	X	√	X	√	X	√	X	X	X	√
United Kingdom	X	√	X	X	√	X	√	X	√	√	X	X	√
United States	X	√	X	X	√	X	X	X	X	√	X	X	X

Note: √ denotes integration and X denotes no integration.

Source: Author's computation

Table 6. 16: Summary of bivariate co-integration test results during the pre-crisis/stable period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana													
BRVM	√												
Egypt	√	√											
Ghana	√	X	√										
Kenya	√	X	X	√									
Mauritius	√	√	√	√	√								
Morocco	√	X	√	X	√	√							
Namibia	√	√	√	√	√	√	√						
Nigeria	√	X	√	X	X	X	√	√					
South Africa	√	√	√	√	√	√	X	X	√				
Tunisia	√	X	√	√	√	√	√	√	√	√			
Uganda	√	X	√	X	X	√	X	√	√	√	X		
Zambia	√	X	√	X	X	√	√	√	X	√	√	X	
Emerging Markets													
Brazil	√	√	√	√	√	√	X	√	√	√	√	X	X
China	X	X	√	X	X	X	X	√	√	√	X	√	X
India	√	X	√	√	√	√	X	√	X	√	X	X	X
Russia	√	√	√	√	X	√	√	√	√	√	√	√	X
Developed Markets													
Australia	√	√	√	√	√	√	X	X	√	√	√	√	X
Canada	√	√	√	√	√	√	X	X	√	√	√	√	X
France	√	√	√	√	√	√	X	X	X	√	X	X	X
Germany	√	√	√	√	√	√	X	√	X	√	X	√	X
Hong Kong	√	X	√	√	√	√	X	X	√	√	√	√	X
Japan	√	X	√	X	√	√	X	X	X	X	X	X	X
Singapore	√	√	√	√	√	√	X	X	X	√	√	X	X
Switzerland	√	X	√	√	√	√	√	√	X	√	X	X	X
United Kingdom	√	√	√	√	√	√	X	√	√	√	√	√	X
United States	√	X	√	√	X	√	X	√	X	√	X	X	X

Note: √ denotes integration and X denotes no integration.

Source: Author’s computation

Table 6. 17: Summary of bivariate co-integration test results during the global financial crisis period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana													
BRVM	X												
Egypt	√	√											
Ghana	X	√	X										
Kenya	√	X	√	X									
Mauritius	√	√	X	X	√								
Morocco	√	X	√	X	√	√							
Namibia	X	X	√	X	X	√	X						
Nigeria	√	X	√	√	X	X	X	X					
South Africa	X	X	√	X	X	√	X	X	X				
Tunisia	√	X	√	X	X	√	X	√	X	√			
Uganda	X	X	X	X	X	X	X	X	X	X	X		
Zambia	X	X	X	√	X	X	X	X	X	X	X	X	
Emerging Markets													
Brazil	√	X	√	X	X	√	X	X	X	X	X	X	√
China	X	X	X	X	X	X	X	X	X	X	X	X	X
India	√	X	X	X	√	√	X	X	X	X	√	X	X
Russia	√	X	√	X	√	√	X	X	X	X	X	√	X
Developed Markets													
Australia	X	X	√	X	X	X	X	X	X	X	X	X	√
Canada	√	X	X	X	√	√	X	X	X	X	√	X	X
France	√	X	√	X	√	√	√	X	X	X	X	X	X
Germany	√	X	√	X	√	√	X	X	X	X	X	X	X
Hong Kong	√	X	√	X	X	√	X	X	X	X	X	X	X
Japan	√	X	√	X	√	X	X	X	X	X	X	X	X
Singapore	√	X	√	X	√	√	X	X	X	X	X	X	X
Switzerland	√	X	√	X	√	√	√	X	X	X	X	X	√
United Kingdom	√	X	√	X	X	√	X	X	√	√	X	X	X
United States	√	X	√	X	√	√	X	X	X	X	X	X	X

Note: √ denotes integration and X denotes no integration.

Source: Author’s computation

Table 6. 18: Summary of bivariate co-integration test results during the Eurozone crisis period

African Markets	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana													
BRVM	√												
Egypt	√	√											
Ghana	X	X	X										
Kenya	√	√	√	X									
Mauritius	√	√	√	X	√								
Morocco	√	X	√	X	√	√							
Namibia	√	√	√	X	√	√	√						
Nigeria	√	X	√	X	X	√	√	√					
South Africa	√	√	√	X	√	√	X	X	√				
Tunisia	√	X	√	X	√	√	√	√	√	√			
Uganda	X	X	X	X	X	X	X	X	X	X	X		
Zambia	√	X	√	X	√	√	√	X	X	√	X	X	
Emerging Markets													
Brazil	√	√	√	X	√	√	√	√	X	√	√	X	X
China	√	√	√	X	√	√	√	√	√	√	√	X	√
India	√	X	√	X	√	√	X	X	√	√	X	X	X
Russia	√	X	√	X	√	√	√	√	√	√	√	X	X
Developed Markets													
Australia	√	√	√	X	√	√	X	X	√	√	√	X	X
Canada	√	√	√	X	√	√	X	X	X	√	√	X	X
France	√	X	√	X	√	√	X	X	X	√	X	X	X
Germany	√	√	√	X	√	√	X	X	√	√	X	X	X
Hong Kong	√	√	√	X	√	√	√	X	√	X	√	X	X
Japan	√	X	√	X	√	√	X	X	X	X	X	X	X
Singapore	√	√	√	X	√	√	√	√	X	X	√	√	X
Switzerland	√	X	√	X	√	√	√	X	X	√	X	√	X
United Kingdom	√	X	√	X	√	√	X	√	√	√	√	X	X
United States	√	X	√	X	X	√	X	√	X	√	X	X	X

Note: √ denotes integration and X denotes no integration.

Source: Author’s computation

6.4.2 Granger causality test results

This section considers the causal relationship among stock market returns in Africa and those of the major global emerging and developed stock markets on a pairwise basis across the four sample periods. Given that the data series are difference stationary series, the Granger causality test is applied to the log-return (first difference) in order to determine the dynamic short-run lead-lag relationship between stock market returns in Africa, emerging and developed markets. In estimating the result, the optimal lag length identified in the previous section was used. The results of the Granger causality test are provided Tables 6.19 – 6.30 below. Specifically, only causal relationship among African markets and between African, emerging and developed markets are considered in this study. In addition, only the significant Granger causality relationships are shown in the tables across all the four periods.

The results of the Granger causality test, depicted in Table 6.19, show evidence of a strong short-run interdependence between African stock markets over the full-sample period. The inspection of the stock market return linkages in African over the full-sample period indicates that Egypt, Kenya, Morocco, Namibia, Nigeria, South Africa and Uganda have significant return linkages with other African markets. This result suggests that stock returns from these seven markets drive stock returns in most of African markets. Further evidence from the results over this period shows the existence of bidirectional causality between Botswana and BRVM, BRVM and Uganda, BRVM and Morocco, Kenya and Namibia, Kenya and South Africa, Kenya and Uganda, Mauritius and Nigeria, Morocco and Namibia, Morocco and South Africa, Namibia and Uganda, South Africa and Uganda.

However, the analysis of short-run interdependence prior to the 2007 global financial crisis shows a low level of causal linkages among African stock markets. This is evident from the number of significant causal linkages in Table 6.20. Nevertheless, the results during the global financial crisis and Eurozone crisis periods show significant increase in the number of causal relationships among African stock markets (see Tables 6.21 and 6.22). In comparison with the Granger causality test results during the pre-crisis period, the analysis reveals the emergence of new causal linkages among African stock markets during the global financial crisis and Eurozone crisis. Importantly, the finding reveals the strengthening of causal relationships among African markets over the two crisis periods, particularly during the global financial crisis.

In terms of the causal relationship between African and emerging stock markets, the results shown in Tables 6.23 – 6.26 indicate evidence of several causal linkages. Specifically, the estimated results in Table 6.23 show that stock market returns in Botswana, Egypt, Mauritius, Morocco, Namibia, South Africa, and Uganda have a significant influence on the returns in the emerging market over the full-sample period. The result also shows that the Brazilian, Indian and Russian markets have a strong influence on African stock market returns. Conversely, the test results during the pre-crisis period, as shown in Table 6.24, indicate weak causal linkages. The table shows that only Mauritius, Morocco and Nigeria indicate Granger cause returns in emerging markets. At the same time, the stock market return in Kenya is strongly influenced by those of the emerging markets over this period.

In contrast to the pre-crisis period, the Granger causality test result shows that there is an increase in the number of causal linkages between African markets and the emerging markets during the global financial crisis period (see Table 6.25). The analysis over this period shows that African stock markets such as Botswana, Egypt, Morocco, Namibia, Nigeria, South Africa and Uganda have a significant influence on the emerging market stock returns. The results also revealed that the stock market returns from emerging markets exert a significant influence on most African markets. However, the test result during the Eurozone crisis period indicates a weak stock market return interdependence between Africa and emerging market (see Table 6.26).

In addition, the analysis of short-run interdependence between African markets and the emerging markets reveal that stock returns in African markets are significantly influenced by the Brazilian, Indian and Russian stock market returns, while, stock returns from the Chinese stock market has a limited influence on African markets. In addition, there is evidence of varying degree of causal relationships between the African and emerging market stock returns over the periods. For instance, there is evidence of more causal linkages during the full-sample period compared to any other periods. At the same time, there is more evidence of causal linkage during the global financial crisis period compared to the pre-crisis and Eurozone crisis period.

Furthermore, the analysis of Granger causality test result between African and developed markets shows a strong interdependence among these markets (see Tables 6.27 – 6.30). Over the full-sample period, the Granger causality test identified 119 significant causal linkages out of 260 (13*10*2) potential linkages between Africa and developed markets (see Table

6.27). Such a high causal linkage is an indicative of interdependence between these markets. Interestingly, African stock markets such as Egypt, Kenya, Morocco, Namibia, South Africa and Uganda are shown to have a strong influence on the majority of the developed market stock returns (see Table 6.27). This indicates that stock returns in these six African markets are more interlinked with those of the developed markets.

Another interesting result emerging from Table 6.27 is the dominant influence of the developed stock markets on the African stock markets. This is evident from the number of African markets that are caused by the developed markets. However, the analysis reveals also that stock returns in Ghana, Tunisia and Zambia are not influenced by changes in stock returns from developed markets. This illustrates the independence of stock market returns in these markets to movement in developed markets.

On another front, the causal linkages over the pre-crisis period show that a limited interaction between African and developed markets (see Table 6.30). Over this period, there are 25 causal linkages between Africa and developed markets. The test results also show that stock market returns in Egypt and Kenya are mostly influenced by the movement of stock returns in developed markets, while, the movement of stock returns in Egypt, Namibia, South Africa and Tunisia exerted significant influence on some developed markets over this period.

Again, the analysis of the Granger causality test over the two crisis periods indicates that new causal linkages emerged. According to the results in Tables 6.29 and 6.30, there are 74 and 51 causal linkages respectively, between Africa and developed markets. This finding suggests that interdependence between stock markets returns increased during the periods of crises relative to the pre-crisis period. Furthermore, the causality analysis during the period of the global financial crisis indicates that movements of stock returns in Egypt, Nigeria and Uganda exert a strong influence on most developed stock markets. While there is a strong influence from the developed markets to Africa, the United States market has the most significant influence on African markets over this period (Table 6.29). On the other hand, the analysis during the Eurozone crisis period shows that Uganda is more interlinked with the developed stock markets than any other African market (Table 6.30). In addition, the analysis of the Eurozone crisis period shows that developed markets such as Australia, Germany, United Kingdom and United States exert more influence on African market than other developed markets.

In a nutshell, it stands out from the entire analysis of the Granger causality test between Africa, emerging and developed stock markets that there is a high degree of interdependence between these markets. It also stands out from the tables that stock returns in Africa markets Granger cause stock returns in the emerging and developed markets. Moreover, there is also evidence of both bidirectional and unidirectional causality between these markets. Such a high level of interdependence is indicative of the sensitivity of stock returns in Africa to the movements in the global market stock returns. This finding is very interesting in that shocks originating from either the developed or emerging markets can spillover into the African markets and vice versa. The high level of causal linkages between these markets supports the inferences from the co-integration analysis about the existence of long-run relationships between the markets, as identified in the previous section.

Furthermore, the analysis shows there is clear evidence of a dramatic increase in causal linkages during the two crisis periods compared to the pre-crisis period. This important development is mirrored across all the markets considered, suggesting that the new causal linkages emerged between these markets during periods of crisis. It also suggests that the crisis may have created a new path instead of following the existing path. Accordingly, shocks from one market can be transmitted through new channels during crisis periods.

Finally, it is worth emphasising that the evidence from Granger causality test results indicates the existence of dynamic interaction and linkages among African stock markets and between them and emerging and developed stock markets. This finding suggests that stock market returns in Africa react to shocks emanating from either the emerging or developed markets. By and large, the causal linkages between Africa, emerging and developed markets could help amplify the transmission of shocks across these markets. However, to better appraise the magnitude of each stock market reaction to its own shocks and to other markets' shocks, as well as how long it will take for such shocks to die out, the analysis of individual markets' reactions is very informative. In this study, such analysis is carried out by having recourse to the generalised impulse response function. In what follows, the study considers the results from the impulse response function.

Table 6. 19: Granger causality test results between African stock markets during the full-sample period

African Markets: Null Hypothesis	F-Statistic	Probability	**African Markets**: Null Hypothesis	F-Statistic	Probability
Botswana does not Granger cause BRVM	2.17*	0.04	Namibia does not Granger cause Kenya	7.39*	0.00
Botswana does not Granger cause Mauritius	3.14*	0.00	Namibia does not Granger cause Mauritius	7.07*	0.00
BRVM does not Granger cause Botswana	6.15*	0.00	Namibia does not Granger cause Morocco	2.56*	0.01
BRVM does not Granger cause Morocco	3.26*	0.04	Namibia does not Granger cause Nigeria	7.26*	0.00
BRVM does not Granger cause Uganda	3.19*	0.04	Namibia does not Granger cause Uganda	9.79*	0.00
Egypt does not Granger cause BRVM	3.43*	0.00	Nigeria does not Granger cause Botswana	3.49*	0.00
Egypt does not Granger cause Kenya	4.55*	0.00	Nigeria does not Granger cause BRVM	2.34*	0.02
Egypt does not Granger cause Mauritius	4.11*	0.00	Nigeria does not Granger cause Ghana	4.30*	0.01
Egypt does not Granger cause Nigeria	4.96*	0.00	Nigeria does not Granger cause Mauritius	3.75*	0.00
Egypt does not Granger cause Uganda	6.38*	0.00	South Africa does not Granger cause Egypt	10.48*	0.00
Ghana does not Granger cause Egypt	5.25*	0.00	South Africa does not Granger cause Kenya	6.58*	0.00
Ghana does not Granger cause Tunisia	42.96*	0.00	South Africa does not Granger cause Mauritius	5.56*	0.00
Kenya does not Granger cause Morocco	2.83*	0.00	South Africa does not Granger cause Morocco	2.39*	0.02
Kenya does not Granger cause Namibia	2.90*	0.01	South Africa does not Granger cause Nigeria	3.53*	0.00
Kenya does not Granger cause Nigeria	4.19*	0.01	South Africa does not Granger cause Uganda	11.53*	0.00
Kenya does not Granger cause South Africa	2.86*	0.01	Tunisia does not Granger cause Kenya	3.08*	0.02
Kenya does not Granger cause Uganda	20.88*	0.00	Tunisia does not Granger cause South Africa	3.63*	0.03
Mauritius does not Granger cause Kenya	4.58*	0.00	Tunisia does not Granger cause Uganda	4.17*	0.01
Mauritius does not Granger cause Nigeria	2.34*	0.03	Uganda does not Granger cause BRVM	4.96*	0.01
Mauritius does not Granger cause Uganda	2.64*	0.03	Uganda does not Granger cause Kenya	6.89*	0.00
Morocco does not Granger cause BRVM	5.64*	0.00	Uganda does not Granger cause Namibia	2.81*	0.03
Morocco does not Granger cause Namibia	5.29*	0.00	Uganda does not Granger cause South Africa	2.92*	0.02
Morocco does not Granger cause Nigeria	3.11*	0.05	Uganda does not Granger cause Morocco	3.02*	0.01
Morocco does not Granger cause South Africa	4.06*	0.00	Zambia does not Granger cause BRVM	4.56*	0.01
Namibia does not Granger cause Egypt	12.73*	0.00			

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 20: Granger causality test results between African stock markets during the pre-crisis/stable period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Botswana does not Granger cause Mauritius	9.07*	0.00	Nigeria does not Granger cause Ghana	3.98*	0.00
BRVM does not Granger cause Botswana	4.77*	0.00	South Africa does not Granger cause Egypt	5.08*	0.01
Ghana does not Granger cause Uganda	2.83*	0.02	South Africa does not Granger cause Morocco	4.04*	0.02
Kenya does not Granger cause Uganda	3.62*	0.03	Tunisia does not Granger cause Kenya	3.40*	0.01
Morocco does not Granger cause Tunisia	3.03*	0.01	Uganda does not Granger cause Kenya	4.52*	0.01
Namibia does not Granger cause Egypt	4.06*	0.02	Zambia does not Granger cause BRVM	3.64*	0.03
Namibia does not Granger cause Morocco	5.04*	0.01			

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 21: Granger causality test results between African stock markets during the global financial crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
BRVM does not Granger cause Ghana	6.49*	0.00	Morocco does not Granger cause Uganda	2.43*	0.01
BRVM does not Granger cause Morocco	3.62*	0.01	Morocco does not Granger cause Zambia	2.67*	0.02
Egypt does not Granger cause BRVM	3.80*	0.01	Namibia does not Granger cause Egypt	10.49*	0.00
Egypt does not Granger cause Mauritius	2.32*	0.04	Namibia does not Granger cause Kenya	3.02*	0.01
Egypt does not Granger cause Morocco	3.19*	0.00	Namibia does not Granger cause Nigeria	5.40*	0.01
Egypt does not Granger cause Namibia	3.79*	0.00	Namibia does not Granger cause Tunisia	3.60*	0.03
Egypt does not Granger cause Nigeria	2.98*	0.01	Namibia does not Granger cause Uganda	6.34*	0.00
Egypt does not Granger Cause South Africa	4.86*	0.01	Nigeria does not Granger cause South Africa	4.69*	0.00
Egypt does not Granger cause Uganda	4.33*	0.00	Nigeria does not Granger cause Zambia	3.05*	0.01
Ghana does not Granger cause Botswana	2.89*	0.02	South Africa does not Granger cause Egypt	12.08*	0.00
Kenya does not Granger cause Namibia	2.28*	0.04	South Africa does not Granger cause Mauritius	3.76*	0.01
Kenya does not Granger cause Nigeria	4.15*	0.01	South Africa does not Granger cause Uganda	7.30*	0.00
Kenya does not Granger cause Uganda	15.44*	0.00	Tunisia does not Granger cause Nigeria	3.09*	0.05
Mauritius does not Granger cause Kenya	3.35*	0.01	Uganda does not Granger cause Egypt	3.33*	0.01
Mauritius does not Granger cause Uganda	3.32*	0.01	Uganda does not Granger cause Kenya	4.13*	0.00
Morocco does not Granger cause BRVM	3.51*	0.02	Uganda does not Granger cause Namibia	2.66*	0.04
Morocco does not Granger cause Egypt	3.39*	0.00	Uganda does not Granger cause Nigeria	5.67*	0.00
Morocco does not Granger cause Namibia	4.64*	0.01	Uganda does not Granger cause South Africa	3.49*	0.01
Morocco does not Granger cause Nigeria	5.11*	0.01	Uganda does not Granger cause Morocco	3.89*	0.00
Morocco does not Granger cause South Africa	7.85*	0.00	Zambia does not Granger cause Botswana	2.38*	0.04

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 22: Granger causality test results between African stock markets during the Eurozone crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Botswana does not Granger cause BRVM	2.24*	0.04	Nigeria does not Granger cause Mauritius	3.25*	0.04
BRVM does not Granger cause Namibia	3.38*	0.04	Nigeria does not Granger cause Tunisia	2.83*	0.03
Egypt does not Granger cause Kenya	5.94*	0.00	South Africa does not Granger cause Egypt	4.83*	0.01
Egypt does not Granger cause Uganda	2.56*	0.04	South Africa does not Granger cause Kenya	3.73*	0.00
Ghana does not Granger cause Botswana	3.21*	0.04	South Africa does not Granger cause Mauritius	6.86*	0.00
Ghana does not Granger cause Tunisia	39.53*	0.00	South Africa does not Granger cause Nigeria	4.14*	0.02
Ghana does not Granger cause Egypt	5.10*	0.00	South Africa does not Granger cause Uganda	3.09*	0.01
Kenya does not Granger cause Botswana	4.84*	0.00	Tunisia does not Granger cause Uganda	3.14*	0.04
Kenya does not Granger cause Uganda	4.86*	0.01	Uganda does not Granger cause BRVM	4.15*	0.02
Mauritius does not Granger cause Tunisia	4.18*	0.00	Uganda does not Granger cause Egypt	2.95*	0.02
Namibia does not Granger cause Kenya	3.84*	0.01	Uganda does not Granger cause Namibia	3.68*	0.01
Namibia does not Granger cause Egypt	4.40*	0.01	Uganda does not Granger cause Tunisia	3.47*	0.03
Namibia does not Granger cause Mauritius	4.86*	0.01	Zambia does not Granger cause Ghana	4.56*	0.01
Namibia does not Granger cause Uganda	4.68*	0.00	Zambia does not Granger cause Uganda	3.82*	0.02
Nigeria does not Granger cause Kenya	5.48*	0.00			

Note: *denotes significance at 5%. Source: Author's computation

Table 6. 23: Granger causality test results between Africa and emerging stock markets during the full-sample period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets**: Null Hypothesis	F-Statistics	Probability
Botswana does not Granger cause China	4.18*	0.00	Namibia does not Granger cause China	4.39*	0.00
Botswana does not Granger cause Russia	2.43*	0.02	Namibia does not Granger cause India	4.85*	0.00
Egypt does not Granger cause Brazil	2.44*	0.05	Nigeria does not Granger cause Brazil	1.92*	0.05
Egypt does not Granger cause Russia	3.58*	0.00	Nigeria does not Granger cause Russia	2.51*	0.01
Mauritius does not Granger cause India	2.33*	0.02	South Africa does not Granger cause China	4.33*	0.00
Mauritius does not Granger cause Russia	4.99*	0.00	South Africa does not Granger cause India	1.70*	0.05
Morocco does not Granger cause Brazil	2.14*	0.03	Uganda does not Granger cause Brazil	3.39*	0.01
Morocco does not Granger cause Russia	3.63*	0.00	Uganda does not Granger cause Russia	2.70*	0.02
Emerging Markets					
Brazil does not Granger cause Egypt	12.48*	0.00	India does not Granger cause Nigeria	9.75*	0.00
Brazil does not Granger cause Kenya	6.43*	0.00	India does not Granger cause South Africa	2.61*	0.00
Brazil does not Granger cause Mauritius	6.20*	0.00	India does not Granger cause Tunisia	2.70*	0.04
Brazil does not Granger cause Morocco	2.68*	0.01	India does not Granger cause Uganda	9.29*	0.00
Brazil does not Granger cause Namibia	3.90*	0.01	Russia does not Granger cause Egypt	11.03*	0.00
Brazil does not Granger cause Nigeria	3.51*	0.00	Russia does not Granger cause Kenya	6.28*	0.00
Brazil does not Granger cause Uganda	10.34*	0.00	Russia does not Granger cause Mauritius	3.80*	0.00
China does not Granger cause Botswana	2.00*	0.04	Russia does not Granger cause Namibia	3.48*	0.00
India does not Granger cause Botswana	2.14*	0.05	Russia does not Granger cause Nigeria	4.51*	0.00
India does not Granger cause Egypt	11.48*	0.00	Russia does not Granger cause South Africa	2.01*	0.04
India does not Granger cause Kenya	5.73*	0.00	Russia does not Granger cause Tunisia	2.07*	0.03
India does not Granger cause Mauritius	5.05*	0.00	Russia does not Granger cause Uganda	7.06*	0.00
India does not Granger cause Namibia	2.00*	0.04			

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 24: Granger causality test results between Africa and emerging stock markets during the pre-crisis/stable period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Mauritius does not Granger cause China	3.84*	0.00	Morocco does not Granger cause Russia	3.25*	0.02
Morocco does not Granger cause China	3.09*	0.02	Nigeria does not Granger cause Russia	2.90*	0.02
Emerging Markets					
Brazil does not Granger cause Kenya	2.00*	0.04	India does not Granger cause Nigeria	2.67*	0.02
Brazil does not Granger cause Namibia	2.78*	0.03	Russia does not Granger cause Egypt	4.79*	0.01
China does not Granger cause Botswana	2.12*	0.03	Russia does not Granger cause Kenya	2.96*	0.01
China does not Granger cause Kenya	2.85*	0.02	Russia does not Granger cause Tunisia	3.04*	0.02
India does not Granger cause Kenya	3.36*	0.01			

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 25: Granger causality test results between Africa and emerging stock markets during the global financial crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets**: Null Hypothesis	F-Statistics	Probability
Botswana does not Granger cause Russia	3.33*	0.02	Namibia does not Granger cause China	5.62*	0.00
Egypt does not Granger cause Brazil	4.11*	0.02	Nigeria does not Granger cause Brazil	4.21*	0.02
Egypt does not Granger cause Russia	9.69*	0.00	South Africa does not Granger cause China	2.83*	0.01
Morocco does not Granger cause Brazil	3.69*	0.03	Uganda does not Granger cause India	2.60*	0.04
Morocco does not Granger cause Russia	4.81*	0.01			
Emerging Markets					
Brazil does not Granger cause Egypt	12.99*	0.00	India does not Granger cause Mauritius	7.88*	0.00
Brazil does not Granger cause Kenya	4.41*	0.00	India does not Granger cause Nigeria	9.76*	0.00
Brazil does not Granger cause Morocco	3.45*	0.03	India does not Granger cause Tunisia	6.08*	0.00
Brazil does not Granger cause Nigeria	4.73*	0.01	India does not Granger cause Uganda	4.56*	0.00
Brazil does not Granger cause Tunisia	3.90*	0.02	Russia does not Granger cause Egypt	20.34*	0.00
Brazil does not Granger cause Uganda	6.78*	0.00	Russia does not Granger cause Kenya	9.09*	0.00
China does not Granger cause Morocco	3.68*	0.03	Russia does not Granger cause Nigeria	3.46*	0.01
China does not Granger cause Ghana	3.13*	0.02	Russia does not Granger cause Tunisia	3.34*	0.04
India does not Granger cause Egypt	3.80*	0.00	Russia does not Granger cause Uganda	6.81*	0.00

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 26: Granger causality test results between Africa and emerging stock markets during the Eurozone crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**Emerging Markets:** Null Hypothesis	F-Statistics	Probability
BRVM does not Granger cause Brazil	3.66*	0.03	Nigeria does not Granger cause Brazil	6.96*	0.00
Kenya does not Granger cause Russia	4.26*	0.02	Uganda does not Granger cause Brazil	2.97*	0.03
Emerging Market					
Brazil does not Granger cause Egypt	6.12*	0.00	India does not Granger cause Kenya	3.66*	0.01
Brazil does not Granger cause Kenya	2.68*	0.03	India does not Granger cause Nigeria	2.82*	0.02
Brazil does not Granger cause Mauritius	3.87*	0.02	India does not Granger cause Uganda	5.31*	0.00
China does not Granger cause Egypt	3.62*	0.03	Russia does not Granger cause Botswana	3.78*	0.01
India does not Granger cause Egypt	8.15*	0.00	Russia does not Granger cause South Africa	3.19*	0.04

Note: *denotes significance at 5%.

Source: Author's computation

Table 6. 27: Granger causality test results between Africa and developed stock markets during the full-sample period

African Markets: Null Hypothesis	F-Statistic	Probability	**African Markets**: Null Hypothesis	F-Statistic	Probability
Botswana does not Granger cause Japan	2.64*	0.05	Morocco does not Granger cause Singapore	5.22*	0.00
Egypt does not Granger cause Australia	3.08*	0.00	Namibia does not Granger cause Australia	2.81*	0.04
Egypt does not Granger cause Canada	4.51*	0.00	Namibia does not Granger cause Canada	3.02*	0.00
Egypt does not Granger cause France	1.84*	0.02	Namibia does not Granger cause Hong Kong	4.15*	0.01
Egypt does not Granger cause Germany	5.16*	0.00	Namibia does not Granger cause Singapore	3.60*	0.00
Egypt does not Granger cause Switzerland	4.87*	0.00	Namibia does not Granger cause Japan	2.71*	0.03
Egypt does not Granger cause United Kingdom	1.73*	0.04	Namibia does not Granger cause Switzerland	4.05*	0.00
Egypt does not Granger cause United States	7.02*	0.00	Namibia does not Granger cause United Kingdom	2.49*	0.04
Kenya does not Granger cause Canada	2.80*	0.00	Namibia does not Granger cause United States	2.25*	0.02
Kenya does not Granger cause France	2.76*	0.01	Nigeria does not Granger cause United States	1.74*	0.05
Kenya does not Granger cause Germany	3.22*	0.00	South Africa does not Granger cause Canada	1.98*	0.01
Kenya does not Granger cause Hong Kong	2.39*	0.02	South Africa does not Granger cause France	1.96*	0.02
Kenya does not Granger cause Japan	3.30*	0.00	South Africa does not Granger cause Germany	1.78*	0.03
Kenya does not Granger cause Singapore	3.41*	0.00	South Africa does not Granger cause Switzerland	1.72*	0.04
Kenya does not Granger cause Switzerland	2.72*	0.01	South Africa does not Granger cause United Kingdom	2.30*	0.00
Kenya does not Granger cause United Kingdom	3.07*	0.00	South Africa does not Granger cause United States	2.04*	0.01
Kenya does not Granger cause United States	2.27*	0.05	Uganda does not Granger cause Canada	4.79*	0.00
Mauritius does not Granger cause Singapore	2.19*	0.03	Uganda does not Granger cause France	4.62*	0.00
Morocco does not Granger cause Canada	3.58*	0.00	Uganda does not Granger cause Germany	3.67*	0.00
Morocco does not Granger cause France	2.79*	0.00	Uganda does not Granger Cause Switzerland	4.99*	0.00
Morocco does not Granger cause Germany	3.17*	0.00	Uganda does not Granger Cause United Kingdom	4.17*	0.00
Morocco does not Granger cause Switzerland	2.24*	0.02	Uganda does not Granger Cause United States	3.65*	0.01
Morocco does not Granger cause Hong Kong	3.18*	0.02			
Developed Markets					
Australia does not Granger cause Botswana	2.35*	0.02	Hong Kong does not Granger cause Uganda	11.72*	0.05
Australia does not Granger cause Egypt	5.14*	0.00	Japan does not Granger cause BRVM	2.87*	0.01
Australia does not Granger cause Kenya	7.64*	0.00	Japan does not Granger cause Egypt	11.53*	0.00
Australia does not Granger cause Mauritius	3.85*	0.00	Japan does not Granger cause Kenya	6.30*	0.00
Australia does not Granger cause Namibia	3.06*	0.03	Japan does not Granger cause Namibia	2.93*	0.02
Australia does not Granger cause Nigeria	6.17*	0.00	Japan does not Granger cause Nigeria	5.12*	0.00
Australia does not Granger cause Uganda	9.16*	0.00	Japan does not Granger cause South Africa	3.31*	0.01
Canada does not Granger cause BRVM	3.18*	0.01	Japan does not Granger cause Uganda	14.19*	0.00
Canada does not Granger cause Egypt	5.41*	0.00	Singapore does not Granger cause Egypt	14.11*	0.00
Canada does not Granger cause Kenya	6.60*	0.00	Singapore does not Granger cause Kenya	7.64*	0.00
Canada does not Granger cause Mauritius	6.53*	0.00	Singapore does not Granger cause Mauritius	4.57*	0.00
Canada does not Granger cause Morocco	2.45*	0.01	Singapore does not Granger cause Nigeria	13.75*	0.00
Canada does not Granger cause Namibia	3.68*	0.00	Singapore does not Granger cause Uganda	14.17*	0.00
Canada does not Granger cause Nigeria	5.28*	0.00	Switzerland does not Granger cause Egypt	4.86*	0.00
Canada does not Granger cause South Africa	2.39*	0.00	Switzerland does not Granger cause Kenya	6.78*	0.00

Canada does not Granger cause Uganda	10.80*	0.00	Switzerland does not Granger cause Mauritius	3.67*	0.01
France does not Granger cause Botswana	2.35*	0.02	Switzerland does not Granger cause Morocco	2.98*	0.00
France does not Granger cause Egypt	3.44*	0.00	Switzerland does not Granger cause Namibia	5.12*	0.00
France does not Granger cause Kenya	6.00*	0.00	Switzerland does not Granger cause Nigeria	4.16*	0.00
France does not Granger cause Mauritius	3.01*	0.01	Switzerland does not Granger cause South Africa	5.38*	0.00
France does not Granger cause Namibia	4.25*	0.00	Switzerland does not Granger cause Uganda	13.28*	0.00
France does not Granger cause Nigeria	4.24*	0.00	United Kingdom does not Granger cause Botswana	1.82*	0.05
France does not Granger cause South Africa	3.94*	0.00	United Kingdom does not Granger cause Egypt	3.78*	0.00
France does not Granger cause Uganda	12.40*	0.00	United Kingdom does not Granger cause Kenya	6.70*	0.00
Germany does not Granger cause Botswana	2.34*	0.02	United Kingdom does not Granger cause Mauritius	2.64*	0.00
Germany does not Granger cause Egypt	8.28*	0.00	United Kingdom does not Granger cause Namibia	4.72*	0.00
Germany does not Granger cause Kenya	5.08*	0.00	United Kingdom does not Granger cause Nigeria	4.67*	0.00
Germany does not Granger cause Mauritius	5.02*	0.01	United Kingdom does not Granger cause South Africa	5.16*	0.00
Germany does not Granger cause Morocco	2.10*	0.03	United Kingdom does not Granger cause Uganda	12.46*	0.00
Germany does not Granger cause Namibia	3.14*	0.01	United States does not Granger cause BRVM	1.84*	0.03
Germany does not Granger cause Nigeria	4.42*	0.00	United States does not Granger cause Egypt	11.67*	0.00
Germany does not Granger cause South Africa	3.90*	0.00	United States does not Granger cause Kenya	11.91*	0.00
Germany does not Granger cause Uganda	11.70*	0.00	United States does not Granger cause Mauritius	4.85*	0.00
Hong Kong does not Granger cause Egypt	12.61*	0.00	United States does not Granger cause Namibia	6.26*	0.00
Hong Kong does not Granger cause Kenya	5.67*	0.00	United States does not Granger cause Nigeria	4.67*	0.00
Hong Kong does not Granger cause Mauritius	5.77*	0.00	United States does not Granger cause South Africa	4.38*	0.00
Hong Kong does not Granger cause Nigeria	12.91*	0.00	United States does not Granger cause Uganda	15.15*	0.00

Note: *denotes significance at 5%. Source: Author's computation

Table 6. 28: Granger causality test results between Africa and developed stock markets during the pre-crisis/stable period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Egypt does not Granger cause United States	3.28*	0.04	South Africa does not Granger cause Australia	3.95*	0.02
Namibia does not Granger cause Australia	4.10*	0.02	Tunisia does not Granger cause Japan	3.61*	0.01
Namibia does not Granger cause United Kingdom	2.29*	0.04			
Developed Markets					
Australia does not Granger cause Egypt	3.67*	0.03	Singapore does not Granger cause Kenya	6.52*	0.00
Canada does not Granger cause Egypt	2.39*	0.02	Singapore does not Granger cause Uganda	4.31*	0.00
Canada does not Granger cause Kenya	2.62*	0.04	Switzerland does not Granger cause Egypt	3.71*	0.03
Canada does not Granger cause Morocco	3.67*	0.03	Switzerland does not Granger cause Ghana	3.28*	0.00
France does not Granger cause Kenya	3.15*	0.02	Switzerland does not Granger cause Kenya	3.83*	0.00
Germany does not Granger cause Kenya	3.25*	0.01	United Kingdom does not Granger cause Egypt	2.68*	0.01
Hong Kong does not Granger cause Kenya	4.42*	0.01	United Kingdom does not Granger cause Kenya	3.02*	0.01
Hong Kong does not Granger cause Nigeria	2.32*	0.04	United States does not Granger cause Egypt	3.91*	0.02
Singapore does not Granger cause Botswana	3.83*	0.02			

Note: *denotes significance at 5%. Source: Author's computation

Table 6. 29: Granger causality test results between Africa and developed stock markets during the global financial crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Egypt does not Granger cause Canada	5.06*	0.00	Nigeria does not Granger cause Germany	4.99*	0.01
Egypt does not Granger cause France	3.34*	0.00	Nigeria does not Granger cause Switzerland	4.57*	0.01
Egypt does not Granger cause Germany	5.04*	0.00	Nigeria does not Granger cause United States	3.90*	0.02
Egypt does not Granger cause Japan	2.20*	0.05	Nigeria does not Granger cause United Kingdom	3.67*	0.01
Egypt does not Granger cause United Kingdom	3.88*	0.02	South Africa does not Granger cause Switzerland	4.09*	0.02
Egypt does not Granger cause United States	5.31*	0.01	Uganda does not Granger cause Canada	3.95*	0.00
Kenya does not Granger cause Switzerland	3.05*	0.01	Uganda does not Granger cause France	2.18*	0.04
Namibia does not Granger cause Switzerland	4.37*	0.01	Uganda does not Granger cause Germany	4.72*	0.00
Nigeria does not Granger cause Australia	4.22*	0.02	Uganda does not Granger cause Switzerland	4.87*	0.00
Nigeria does not Granger cause Canada	5.49*	0.01	Uganda does not Granger cause United Kingdom	3.36*	0.00
Nigeria does not Granger cause France	6.18*	0.00	Uganda does not Granger cause United States	2.74*	0.02
Developed Markets					
Australia does not Granger cause Egypt	5.64*	0.00	Hong Kong does not Granger cause Uganda	6.25*	0.00
Australia does not Granger cause Kenya	3.52*	0.02	Japan does not Granger cause Egypt	3.34*	0.00
Australia does not Granger cause Morocco	3.78*	0.03	Japan does not Granger cause Kenya	5.76*	0.00
Australia does not Granger cause Nigeria	3.61*	0.03	Japan does not Granger cause Nigeria	3.89*	0.02
Australia does not Granger cause Uganda	4.98*	0.00	Japan does not Granger cause Uganda	9.65*	0.00
Canada does not Granger cause Egypt	3.73*	0.00	Singapore does not Granger cause Egypt	10.90*	0.00
Canada does not Granger cause Kenya	4.21*	0.00	Singapore does not Granger cause Kenya	2.30*	0.03
Canada does not Granger cause Mauritius	3.87*	0.02	Singapore does not Granger cause Nigeria	6.79*	0.00
Canada does not Granger cause Morocco	4.19*	0.02	Singapore does not Granger cause Uganda	5.81*	0.00
Canada does not Granger cause Tunisia	4.56*	0.01	Switzerland does not Granger cause Kenya	5.08*	0.00
Canada does not Granger cause Uganda	5.75*	0.00	Switzerland does not Granger cause Morocco	5.93*	0.00
France does not Granger cause Egypt	3.82*	0.00	Switzerland does not Granger cause Namibia	5.81*	0.00
France does not Granger cause Kenya	5.96*	0.00	Switzerland does not Granger cause South Africa	5.24*	0.01
France does not Granger cause Morocco	5.32*	0.01	Switzerland does not Granger cause Uganda	10.43*	0.00
France does not Granger cause Nigeria	3.16*	0.05	United Kingdom does not Granger cause Egypt	6.67*	0.00
France does not Granger cause Tunisia	3.57*	0.03	United Kingdom does not Granger cause Kenya	5.19*	0.00
France does not Granger cause Uganda	8.67*	0.00	United Kingdom does not Granger cause Morocco	5.35*	0.01
Germany does not Granger cause Egypt	3.25*	0.01	United Kingdom does not Granger cause Nigeria	3.09*	0.02
Germany does not Granger cause Kenya	4.45*	0.00	United Kingdom does not Granger cause Uganda	9.85*	0.00
Germany does not Granger cause Morocco	5.06*	0.01	United States does not Granger cause Egypt	13.53*	0.00
Germany does not Granger cause Nigeria	4.65*	0.01	United States does not Granger cause Kenya	6.18*	0.00
Germany does not Granger cause Uganda	10.60*	0.00	United States does not Granger cause Mauritius	3.54*	0.03
Hong Kong does not Granger cause Egypt	12.90*	0.00	United States does not Granger cause Morocco	5.16*	0.01
Hong Kong does not Granger cause Kenya	3.08*	0.03	United States does not Granger cause Namibia	4.58*	0.01
Hong Kong does not Granger cause Nigeria	3.77*	0.00	United States does not Granger cause South Africa	3.46*	0.03
Hong Kong does not Granger cause Tunisia	3.16*	0.05	United States does not Granger cause Uganda	8.95*	0.00

Note: *denotes significance at 5%. Source: Author's computation

Table 6. 30: Granger causality test results between Africa and developed stock markets during the Eurozone crisis period

African Markets: Null Hypothesis	F-Statistics	Probability	**African Markets:** Null Hypothesis	F-Statistics	Probability
Morocco does not Granger cause Singapore	3.90*	0.02	Uganda does not Granger cause Switzerland	3.97*	0.00
Nigeria does not Granger cause Switzerland	3.19*	0.04	Uganda does not Granger cause United States	4.53*	0.00
Nigeria does not Granger cause United Kingdom	2.41*	0.04	Uganda does not Granger cause Singapore	2.80*	0.01
Uganda does not Granger cause France	4.18*	0.00	Uganda does not Granger cause United Kingdom	3.27*	0.00
Uganda does not Granger cause Germany	3.21*	0.02			
Developed Markets					
Australia does not Granger cause Egypt	6.90*	0.00	Japan does not Granger cause Egypt	6.54*	0.00
Australia does not Granger cause Kenya	8.39*	0.00	Japan does not Granger cause Kenya	3.79*	0.01
Australia does not Granger cause Mauritius	3.79*	0.01	Japan does not Granger cause Uganda	3.63*	0.01
Australia does not Granger cause Nigeria	3.29*	0.00	Singapore does not Granger cause Egypt	7.92*	0.00
Australia does not Granger cause South Africa	3.73*	0.03	Singapore does not Granger cause Kenya	5.82*	0.00
Australia does not Granger cause Uganda	5.63*	0.00	Singapore does not Granger cause Namibia	2.93*	0.01
Canada does not Granger cause Kenya	6.12*	0.00	Singapore does not Granger cause Uganda	6.25*	0.00
Canada does not Granger cause Nigeria	5.87*	0.00	Switzerland does not Granger cause Egypt	5.02*	0.01
Canada does not Granger cause Uganda	3.59*	0.00	Switzerland does not Granger cause Kenya	6.46*	0.00
France does not Granger cause Egypt	5.89*	0.00	Switzerland does not Granger cause Mauritius	3.48*	0.03
France does not Granger cause Kenya	6.65*	0.00	Switzerland does not Granger cause Uganda	3.53*	0.02
France does not Granger cause Mauritius	3.70*	0.03	United Kingdom does not Granger cause Egypt	8.39*	0.00
France does not Granger cause Uganda	2.72*	0.03	United Kingdom does not Granger cause Nigeria	4.27*	0.00
Germany does not Granger cause Botswana	3.19*	0.04	United Kingdom does not Granger cause Kenya	9.10*	0.00
Germany does not Granger cause Egypt	5.08*	0.00	United Kingdom does not Granger cause Mauritius	4.62*	0.01
Germany does not Granger cause Kenya	2.69*	0.02	United Kingdom does not Granger cause Uganda	3.28*	0.00
Germany does not Granger cause Nigeria	2.72*	0.02	United States does not Granger cause Botswana	5.28*	0.01
Germany does not Granger cause Uganda	2.69*	0.05	United States does not Granger cause Egypt	4.03*	0.02
Hong Kong does not Granger cause Egypt	4.77*	0.01	United States does not Granger cause Kenya	4.92*	0.00
Hong Kong does not Granger cause Kenya	7.38*	0.00	United States does not Granger cause Mauritius	3.58*	0.03
Hong Kong does not Granger cause Uganda	8.11*	0.00	United States does not Granger cause Uganda	3.82*	0.01

Note: *denotes significance at 5%.

Source: Author's computation

6.4.3 Generalised impulse response function (GIRF) results

After qualifying the direction of the causal linkages between African, emerging and developed stock markets, the impact dynamic response is analysed using the GIRF. The interest in understanding how each stock market in Africa responds to its own shocks and shocks from other markets is vital. Such an understanding provides useful information as to how a given market would react to shocks from other markets. Consequently, this section assesses the effects of own-shocks and shocks from other African, emerging and developed stock markets on the expected returns of a particular African market in the dynamic system.

Tables 6.31 – 6.34 report the response of individual African stock markets to own-shocks and shocks from other African markets for the first and fourth week. The reports in the tables reveal that the response of a particular African stock market to one generalised standard deviation impulse from other African markets is generally low. It appears that market own-shocks have more influence on stock market returns in Africa than external shocks from other African markets. The evidence during the full-sample reveals that changes in stock market returns in each African market is mainly attributable to its own shocks and most often, such shocks last for a week (Table 6.31). It appears that Namibia and South Africa are more responsive to shocks emanating from each other over the period. Similar evidence is found during the pre-crisis period, as shown in Table 6.32. This finding can be attributed to common institutional and macroeconomic ties between Namibia and South Africa (Piesse and Hearn, 2012).

However, during the global financial crisis period, the result reveals a slight increase in the response of each African market to own-shocks and shocks from other African markets. In particular, Egypt appears to respond to shocks from Kenya, Mauritius, Morocco, Namibia, Nigeria, South Africa, Tunisia and Uganda. There is also evidence of a reverse response of the above markets (except for Morocco and Tunisia) to shocks from Egypt. Again, the evidence over this period indicates that Namibia and South Africa share a mutual response to shocks emanating from either side (see Table 6.33). Further, analysis during the Eurozone crisis reveals a negative response of the Ghanaian stock market return to shocks from other African markets. Specifically, the Ghanaian stock market returns is shown to be sensitive to shocks from Botswana, BRVM, Kenya, Mauritius, Morocco, Nigeria, Tunisia and Uganda. Also, it appears that apart from Uganda, the Ghanaian stock market is more sensitive to shocks from other West African stock markets such as BRVM and Nigeria, indicating evidence of more regional influence (see Table 6.34).

The analysis between African and the major global markets reveals that the overall response of African markets to shocks from the global markets is generally low. However, it appears that stock market returns in Egypt, Namibia and South Africa are more responsive than any other African markets to shocks from the global markets shocks (Table 6.35). The results also show that Namibia and South African were more sensitive to shocks from the global markets prior to the global financial crisis compared to other African markets (Table 6.36). Again, it appears that there was a slight increase in response of African stock market returns to shocks from the global markets during the global financial crisis. The evidence in Table 6.37 indicates that African markets such as Egypt, Kenya, Mauritius, Namibia, South Africa and Uganda are more sensitive to shocks from the global markets over this period. However, the sensitivity of African markets during the Eurozone crisis period shows that only the Namibian and South African stock markets are more responsive to shocks from the global markets, as shown in Table 6.38.

In general, the GIRF results indicate the presence of both positive and negative responses of African stock market to own-shocks and external shocks. Although the response of African markets to one generalised standard deviation impulse from the global markets is generally low, they are more sensitive to own-shocks. This low response to external shocks suggests that developments in the global markets would have a limited impact on African markets and thus, signifies diversification potential. Besides, the response of African stock markets to external shocks to the generalised impulses tend to revert to zero within four weeks, indicating that shocks from the global markets have a transitory effect on African markets. Furthermore, the analysis during the global financial crisis period reveals that African markets' response to shocks from the global markets slightly increased. This result suggests that shocks from the global markets appear to have gained an increasing influence on the African stock market returns during the period of the global financial crisis.

The GIRF analysis has shown that own-shocks are more likely to induce changes in stock market returns in African markets than external shock. However, emphasising only the GIRF dynamic is not sufficient to quantify properly the proportion of each stock returns that is explained by its own shocks and shocks from other markets. To this purpose, the forecast error variance decomposition is used to quantify the impact of own-shocks and external shocks.

Table 6. 31: GIRF analysis between African markets during the full-sample period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	0.005	0.001	0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	-0.000	0.000
	4	0.000	-0.000	0.000	-0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
BRVM	1	0.001	0.011	0.000	-0.001	0.000	-0.000	0.001	-0.000	0.000	-0.000	-0.001	0.000	0.001
	4	0.001	-0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000
Egypt	1	0.000	0.000	0.019	0.000	0.004	0.004	0.004	0.004	0.003	0.004	0.002	0.002	0.001
	4	-0.001	-0.000	0.001	0.003	0.000	0.000	0.000	0.001	-0.000	0.001	-0.000	0.002	0.000
Ghana	1	-0.001	-0.003	0.000	0.038	0.002	-0.001	-0.002	-0.001	-0.002	0.000	-0.002	-0.004	-0.000
	4	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	0.000
Kenya	1	-0.001	0.000	0.003	-0.001	0.011	0.002	0.001	0.001	0.001	0.001	0.001	0.006	0.001
	4	-0.000	0.000	0.001	0.000	0.001	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000
Mauritius	1	-0.000	-0.000	0.002	-0.000	0.002	0.009	0.001	0.002	0.001	0.002	0.001	0.001	0.000
	4	-0.001	0.000	0.001	-0.000	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000
Morocco	1	-0.000	0.000	0.002	-0.000	0.001	0.001	0.009	0.001	0.001	0.001	0.001	0.000	0.001
	4	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Namibia	1	0.000	-0.000	0.003	-0.000	0.001	0.003	0.002	0.014	0.000	0.013	0.001	0.001	-0.000
	4	-0.000	-0.000	0.001	-0.000	0.001	-0.000	0.001	0.000	-0.001	0.000	-0.000	0.002	-0.000
Nigeria	1	0.001	0.000	0.002	-0.001	0.001	0.001	0.001	0.000	0.014	0.000	-0.001	0.001	0.001
	4	-0.000	0.001	0.001	0.000	-0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
South Africa	1	0.000	-0.000	0.003	-0.000	0.001	0.002	0.002	0.010	0.000	0.011	0.001	0.001	-0.000
	4	0.000	0.000	0.000	0.000	0.001	-0.001	0.000	0.000	-0.001	0.000	-0.000	0.001	0.000
Tunisia	1	-0.000	-0.000	0.001	-0.000	0.000	0.001	0.001	0.000	-0.000	0.000	0.007	-0.000	-0.000
	4	-0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	0.000
Uganda	1	-0.001	0.000	0.002	-0.002	0.008	0.002	0.000	0.001	0.002	0.001	-0.000	0.016	0.001
	4	-0.001	-0.000	0.001	0.000	0.002	0.002	0.002	0.002	-0.000	0.002	0.000	0.000	-0.000
Zambia	1	0.001	0.003	0.001	-0.000	0.001	0.001	0.002	-0.000	0.001	-0.000	-0.000	0.001	0.021
	4	0.000	0.000	0.000	-0.000	0.001	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 32: GIRF analysis between African markets during the pre-crisis/stable period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	0.005	0.001	0.000	0.001	-0.000	-0.000	-0.000	0.000	0.001	0.000	0.000	-0.001	-0.000
	4	-0.000	-0.001	-0.000	-0.000	0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.000	0.000
BRVM	1	0.002	0.014	0.000	0.002	-0.000	-0.001	0.001	0.001	-0.001	0.001	-0.001	-0.000	0.002
	4	0.001	0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
Egypt	1	0.001	0.000	0.017	-0.001	0.001	0.001	0.004	0.002	0.001	0.002	0.000	0.000	0.002
	4	-0.000	-0.000	0.001	0.001	0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.001	0.000	-0.000
Ghana	1	0.001	0.001	-0.000	0.006	-0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.000	-0.001	-0.000
	4	0.000	-0.000	-0.000	0.001	-0.000	0.001	0.001	0.000	0.002	-0.000	-0.001	-0.001	0.000
Kenya	1	-0.001	-0.000	0.001	-0.000	0.012	0.001	0.000	-0.001	-0.000	-0.001	-0.001	0.006	0.000
	4	0.000	-0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.002	0.002	0.000	0.000
Mauritius	1	-0.000	-0.001	0.000	-0.000	0.001	0.007	-0.000	0.000	0.000	0.000	0.000	0.001	0.000
	4	0.001	0.000	0.001	0.000	0.000	-0.001	-0.000	-0.000	0.002	-0.000	0.000	0.000	0.000
Morocco	1	-0.000	0.001	0.003	0.000	0.000	-0.000	0.010	0.002	0.001	0.002	0.001	-0.000	0.001
	4	0.000	0.000	-0.001	-0.000	0.000	0.002	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000
Namibia	1	0.000	0.001	0.001	-0.001	-0.000	0.001	0.002	0.012	0.000	0.011	-0.000	0.000	0.000
	4	0.001	-0.000	0.000	-0.002	0.001	0.000	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.000
Nigeria	1	0.001	-0.001	0.001	0.000	-0.000	0.000	0.001	0.000	0.013	-0.000	-0.000	-0.000	0.000
	4	-0.000	0.000	0.000	-0.000	-0.001	0.001	0.000	0.000	-0.000	0.000	-0.000	0.002	-0.000
South Africa	1	0.000	0.001	0.001	-0.001	-0.001	0.000	0.002	0.010	-0.000	0.010	-0.000	0.001	-0.000
	4	0.000	-0.000	0.000	-0.001	0.001	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000
Tunisia	1	0.000	-0.000	0.000	-0.000	-0.000	0.000	0.000	-0.000	-0.000	-0.000	0.005	-0.001	0.000
	4	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.001	-0.000	0.000	-0.000	0.001	0.001	0.000
Uganda	1	-0.002	-0.001	0.000	-0.003	0.008	0.002	-0.000	0.001	-0.000	0.001	-0.000	0.017	0.001
	4	-0.000	0.000	-0.000	0.003	-0.000	-0.000	0.000	0.002	-0.001	-0.000	0.000	0.000	-0.000
Zambia	1	-0.000	0.006	0.003	-0.002	0.001	0.001	0.003	0.000	0.001	-0.000	0.002	0.002	0.032
	4	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.002	0.000	-0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 33: GIRF analysis between African markets during the global financial crisis period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	0.006	0.000	-0.000	0.000	-0.000	-0.000	-0.001	0.000	0.000	0.000	-0.001	-0.000	0.001
	4	0.002	0.000	0.000	-0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001
BRVM	1	0.001	0.009	-0.001	-0.001	0.000	-0.000	-0.000	-0.002	-0.000	-0.002	-0.000	-0.001	-0.001
	4	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Egypt	1	-0.001	-0.003	0.023	0.001	0.010	0.011	0.007	0.007	0.006	0.007	0.008	0.007	0.001
	4	-0.001	-0.003	0.003	0.001	-0.000	0.000	0.001	-0.000	0.001	-0.000	0.000	0.001	0.000
Ghana	1	0.000	-0.001	0.000	0.012	0.000	-0.000	-0.001	0.001	0.000	0.000	0.001	0.001	0.000
	4	-0.001	0.002	-0.000	0.003	-0.001	-0.002	-0.000	-0.000	-0.001	-0.001	-0.000	0.000	-0.001
Kenya	1	-0.000	0.000	0.006	0.000	0.015	0.005	0.002	0.003	-0.000	0.003	0.003	0.008	0.002
	4	-0.003	0.000	0.001	-0.000	0.000	0.004	0.002	0.002	0.001	0.002	-0.000	0.001	0.002
Mauritius	1	-0.000	-0.000	0.006	-0.001	0.004	0.014	0.003	0.004	0.001	0.006	0.004	0.002	-0.000
	4	0.000	-0.000	0.004	0.001	0.002	0.000	-0.000	0.000	0.001	0.001	-0.000	0.002	-0.000
Morocco	1	-0.001	-0.000	0.003	-0.001	0.001	0.002	0.010	0.001	0.002	0.001	0.003	-0.001	0.001
	4	-0.000	0.001	-0.001	0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.001	0.001
Namibia	1	0.000	-0.004	0.007	0.001	0.005	0.006	0.001	0.021	-0.001	0.019	0.004	0.002	-0.002
	4	-0.001	0.000	-0.000	-0.001	0.004	0.000	0.000	0.000	-0.000	-0.000	-0.001	0.005	0.002
Nigeria	1	0.001	-0.001	0.005	0.001	-0.000	0.002	0.003	-0.001	0.020	0.000	0.000	0.003	0.004
	4	-0.001	0.001	0.001	0.003	-0.000	0.001	0.000	0.000	0.002	0.002	0.001	0.001	-0.000
South Africa	1	0.000	-0.003	0.006	0.000	0.003	0.005	0.002	0.015	0.000	0.017	0.003	-0.000	-0.001
	4	-0.001	0.000	-0.001	0.000	0.002	-0.001	-0.000	-0.000	-0.003	-0.000	-0.001	0.004	-0.000
Tunisia	1	-0.001	-0.000	0.002	0.001	0.001	0.002	0.002	0.001	0.000	0.001	0.007	-0.000	-0.000
	4	0.000	-0.000	-0.000	0.001	-0.001	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000
Uganda	1	-0.001	-0.001	0.006	0.001	0.009	0.003	-0.001	0.002	0.003	-0.000	-0.000	0.020	0.001
	4	-0.002	0.000	0.002	-0.000	0.006	0.006	0.004	0.003	-0.000	0.004	0.002	0.001	0.003
Zambia	1	0.002	-0.001	0.000	0.000	0.002	-0.000	0.001	-0.001	0.002	-0.001	-0.000	0.001	0.012
	4	-0.001	0.001	0.001	-0.002	0.002	0.002	0.003	0.000	0.003	0.002	0.001	-0.001	0.001

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 34: GIRF analysis between African markets during the Eurozone crisis period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	0.004	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	4	0.000	0.000	-0.000	-0.000	0.001	0.000	-0.000	-0.000	0.001	0.000	0.000	0.000	-0.000
BRVM	1	0.001	0.007	0.001	-0.002	0.001	0.001	0.001	0.000	0.001	0.001	-0.000	0.001	0.000
	4	-0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	-0.000
Egypt	1	-0.001	0.003	0.017	0.000	0.003	0.000	0.002	0.001	0.002	0.002	-0.000	-0.000	-0.002
	4	-0.000	-0.000	0.000	0.005	-0.000	-0.000	-0.000	0.000	-0.002	0.000	0.001	-0.003	-0.000
Ghana	1	-0.005	-0.016	0.000	0.064	-0.009	-0.006	-0.009	-0.002	-0.011	0.001	-0.005	-0.012	0.001
	4	0.001	0.000	0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.000	-0.001
Kenya	1	-0.001	0.001	0.001	-0.001	0.007	0.001	0.000	0.001	0.002	0.001	-0.000	0.004	-0.000
	4	0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000
Mauritius	1	-0.000	0.000	0.000	-0.000	0.001	0.005	0.000	0.000	0.001	0.000	-0.000	0.001	0.000
	4	0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	-0.000
Morocco	1	-0.000	0.001	0.001	-0.001	0.000	0.000	0.006	0.001	-0.000	0.000	-0.001	0.000	-0.000
	4	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000	-0.000	0.000
Namibia	1	-0.000	0.000	0.001	-0.000	0.001	0.001	0.001	0.010	0.000	0.009	-0.000	0.000	-0.000
	4	-0.001	-0.000	0.000	-0.000	-0.001	0.000	0.000	-0.000	0.000	-0.001	-0.001	0.000	0.000
Nigeria	1	0.001	0.002	0.001	-0.002	0.003	0.002	-0.000	0.000	0.010	0.001	-0.001	0.002	0.001
	4	-0.000	0.000	0.001	-0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	0.000
South Africa	1	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.007	0.000	0.008	-0.000	0.000	-0.000
	4	-0.000	-0.000	0.000	-0.000	-0.001	0.000	0.000	-0.001	0.000	-0.001	-0.000	0.001	0.000
Tunisia	1	-0.000	-0.000	-0.000	-0.001	-0.000	-0.001	-0.001	-0.000	-0.001	-0.000	0.008	-0.000	-0.001
	4	0.001	-0.000	0.000	-0.000	0.000	-0.001	0.000	-0.000	-0.000	-0.001	-0.000	0.000	0.000
Uganda	1	-0.000	0.002	-0.000	-0.003	0.006	0.002	0.000	0.000	0.002	0.000	-0.000	0.012	0.001
	4	-0.000	0.000	0.001	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000
Zambia	1	-0.000	0.000	-0.001	0.000	-0.000	0.001	-0.000	-0.000	0.000	0.000	-0.001	0.001	0.008
	4	-0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 35: GIRF analysis between African, emerging and developed markets during the full-sample period

		Emerging Markets				**Developed Markets**									
African Markets	Period (Week)	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000	0.000
	4	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000
BRVM	1	-0.001	-0.000	-0.000	-0.001	-0.001	-0.001	-0.000	-0.000	0.000	-0.000	-0.001	-0.000	-0.000	-0.000
	4	0.000	0.000	0.000	-0.000	-0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000
Egypt	1	0.004	0.003	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.004
	4	0.001	-0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.001
Ghana	1	0.000	-0.001	0.002	0.000	0.000	0.001	-0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.000	-0.000
	4	0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000
Kenya	1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.002
	4	0.002	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.002
Mauritius	1	0.002	0.001	0.002	0.001	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.003	0.002	0.002
	4	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000
Morocco	1	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	4	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000
Namibia	1	0.009	0.002	0.007	0.008	0.009	0.009	0.009	0.009	0.008	0.007	0.008	0.008	0.010	0.008
	4	-0.001	-0.001	-0.000	-0.001	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001	-0.002	-0.001
Nigeria	1	0.000	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
	4	0.000	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.000	0.002	0.001	0.001	0.002	0.002
South Africa	1	0.007	0.002	0.006	0.000	0.007	0.008	0.007	0.007	0.007	0.006	0.007	0.006	0.008	0.007
	4	-0.000	-0.001	0.000	-0.000	-0.000	-0.001	-0.002	-0.001	-0.000	-0.001	-0.000	-0.002	-0.002	-0.002
Tunisia	1	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	4	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000
Uganda	1	0.000	0.001	0.000	-0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000
	4	0.003	0.000	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.004	0.003	0.003	0.003	0.003
Zambia	1	0.001	0.001	0.000	-0.000	-0.000	0.001	0.000	0.000	-0.000	0.000	0.000	-0.000	0.000	0.000
	4	0.000	0.000	0.001	0.000	0.000	-0.000	-0.000	0.001	-0.000	-0.000	0.000	-0.000	0.000	-0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 36: GIRF analysis between African, emerging and developed markets during the pre-crisis/stable period

		Emerging Markets				**Developed Markets**									
African Markets	Period (Week)	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	-0.000	-0.000	0.000	-0.001	-0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
	4	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000
BRVM	1	-0.001	-0.001	0.000	-0.002	-0.001	0.000	-0.000	-0.000	-0.000	-0.000	-0.002	-0.000	-0.001	-0.000
	4	-0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000	-0.000
Egypt	1	0.002	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.004	0.003	0.002	0.002	0.002
	4	0.001	-0.000	0.000	-0.000	0.000	0.001	0.001	0.000	-0.000	0.002	0.002	-0.000	0.001	0.000
Ghana	1	0.001	-0.001	0.000	-0.000	-0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000
	4	0.000	0.000	0.000	0.001	-0.001	-0.000	0.000	0.000	0.000	0.000	0.000	0.001	-0.000	-0.000
Kenya	1	0.001	0.001	-0.001	-0.001	0.000	-0.001	0.000	0.000	0.001	-0.001	-0.000	-0.000	0.000	0.001
	4	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000	0.001	0.002	0.002	0.002	0.002
Mauritius	1	0.000	0.001	0.001	-0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	0.000
	4	-0.000	-0.000	0.000	0.000	0.001	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
Morocco	1	0.001	0.001	0.003	-0.002	0.002	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.001	0.001
	4	-0.000	0.001	0.000	-0.001	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Namibia	1	0.005	0.003	0.006	0.004	0.006	0.007	0.007	0.006	0.005	0.006	0.006	0.006	0.007	0.006
	4	-0.002	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000
Nigeria	1	0.000	-0.000	0.000	0.001	0.001	-0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000
	4	0.000	0.000	-0.000	-0.001	0.001	0.000	-0.000	0.000	0.001	0.000	-0.000	-0.000	-0.001	0.000
South Africa	1	0.005	0.002	0.005	0.004	0.006	0.007	0.006	0.006	0.005	0.005	0.005	0.006	0.007	0.006
	4	-0.001	-0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000
Tunisia	1	0.000	-0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.001
	4	-0.000	-0.000	-0.000	-0.001	0.000	-0.001	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000
Uganda	1	-0.001	0.001	0.000	-0.001	0.001	0.000	0.000	-0.001	0.000	0.000	-0.001	0.000	-0.000	-0.000
	4	0.000	-0.000	-0.000	-0.000	-0.000	0.001	-0.000	-0.000	-0.000	-0.000	0.004	0.004	0.000	0.000
Zambia	1	0.003	0.002	0.001	-0.001	-0.001	0.003	0.002	0.000	0.002	0.000	0.002	0.000	0.001	0.002
	4	0.000	0.000	0.000	0.001	0.000	-0.000	-0.000	-0.000	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 37: GIRF analysis between African, emerging and developed markets during the global financial crisis period

		Emerging Markets				**Developed Markets**									
African Markets	Period (Week)	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	0.000
	4	0.000	-0.001	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
BRVM	1	-0.002	0.000	-0.001	-0.001	-0.001	-0.002	-0.002	-0.001	-0.000	-0.001	-0.001	-0.000	-0.002	-0.001
	4	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Egypt	1	0.008	0.004	0.009	0.007	0.011	0.008	0.009	0.010	0.009	0.010	0.009	0.012	0.010	0.007
	4	0.001	0.001	-0.000	0.000	-0.001	0.000	0.000	0.001	0.000	0.001	0.001	-0.000	-0.000	0.001
Ghana	1	0.000	0.000	-0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.000
	4	-0.000	-0.003	-0.002	-0.001	0.000	-0.000	-0.000	-0.000	-0.001	-0.000	-0.001	0.000	0.000	-0.000
Kenya	1	0.004	0.001	0.004	0.003	0.004	0.004	0.003	0.004	0.004	0.005	0.005	0.004	0.003	0.003
	4	0.002	-0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.003	0.002	0.001	0.001	0.003
Mauritius	1	0.006	0.004	0.005	0.004	0.007	0.006	0.006	0.006	0.006	0.007	0.005	0.007	0.005	0.005
	4	0.000	-0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.001	-0.000	0.000	0.000
Morocco	1	0.002	0.000	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.000	0.001	0.001
	4	-0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.001	-0.000	0.000
Namibia	1	0.015	0.001	0.011	0.014	0.014	0.015	0.015	0.015	0.013	0.013	0.014	0.012	0.015	0.013
	4	-0.001	-0.000	0.000	0.000	0.000	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000	-0.002	-0.000	-0.001
Nigeria	1	-0.000	0.001	-0.001	-0.001	0.000	0.002	0.001	0.000	-0.001	0.001	-0.001	-0.001	0.001	-0.000
	4	0.001	0.000	0.002	0.002	0.000	0.000	0.000	0.001	-0.001	0.001	0.000	0.000	0.004	0.000
South Africa	1	0.014	0.001	0.009	0.012	0.012	0.013	0.013	0.013	0.011	0.011	0.011	0.010	0.013	0.012
	4	-0.001	-0.001	-0.001	-0.000	-0.000	-0.001	-0.000	-0.000	-0.000	-0.000	-0.001	-0.002	-0.000	-0.001
Tunisia	1	0.002	0.001	0.001	0.002	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.002	0.002
	4	0.001	-0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	0.000
Uganda	1	-0.001	0.003	-0.000	-0.002	0.000	0.000	-0.000	0.000	-0.000	0.000	0.001	0.001	-0.001	-0.001
	4	0.006	0.000	0.002	0.003	0.004	0.006	0.007	0.005	0.003	0.007	0.004	0.006	0.006	0.006
Zambia	1	-0.00	-0.000	-0.000	-0.000	-0.001	-0.000	-0.001	-0.000	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001
	4	0.002	-0.000	0.001	-0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 38: GIRF analysis between African, emerging and developed markets during the Eurozone crisis period

		Emerging Markets				**Developed Markets**									
African Markets	Period (Week)	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.000
	4	-0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	-0.000
BRVM	1	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Egypt	1	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.004	0.003	0.003	0.001	0.003	0.003
	4	0.000	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ghana	1	-0.002	-0.003	0.008	-0.000	0.001	0.003	-0.003	-0.000	-0.005	-0.005	-0.005	-0.002	-0.003	-0.002
	4	-0.000	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	0.001	0.001	0.000
Kenya	1	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.001
	4	-0.000	-0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.000
Mauritius	1	0.000	-0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001
	4	0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000
Morocco	1	0.001	-0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.000	0.000	0.001	0.001	0.000
	4	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
Namibia	1	0.006	0.003	0.004	0.006	0.007	0.007	0.007	0.007	0.006	0.004	0.005	0.006	0.007	0.006
	4	-0.001	-0.001	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001	-0.000	-0.001	-0.001
Nigeria	1	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.001
	4	0.000	-0.000	0.002	0.001	0.002	0.000	-0.000	0.002	0.001	0.000	0.000	0.000	0.002	0.000
South Africa	1	0.005	0.003	0.004	0.005	0.006	0.006	0.006	0.006	0.005	0.004	0.005	0.006	0.007	0.006
	4	-0.001	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	0.000
Tunisia	1	0.000	0.000	0.000	-0.000	-0.001	-0.001	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	4	0.000	0.000	0.000	-0.000	-0.000	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.001
Uganda	1	0.001	0.001	-0.000	-0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001
	4	0.001	0.001	0.002	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.002	0.000	0.001	0.001
Zambia	1	-0.000	0.000	-0.001	-0.000	0.000	-0.000	0.001	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000
	4	0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000

Note: Each entry denotes the impulse response of the market in the first column to a generalised one standard deviation impulse from the market in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

6.4.5 Generalised forecast error variance decomposition (GFEVD) results

In this section the study examines the relative importance of foreign shocks to stock returns in African markets. The GFEVD is used to investigate how much of the unanticipated change in stock returns in a given African stock market can be explained by own-shocks and shocks from other African markets, as well as shocks from the emerging and developed stock markets. Tables 6.39 – 6.46 report the results of the GFEVD between African, emerging and developed stock markets across different sample periods. The reports in the tables represent the total percentage of forecast-error variance of a given African stock explained by own-shocks and shocks from all other stock markets for the first and fourth week after the initial shock.

Evidence over the full-sample period, as shown in Table 6.39, indicates that African markets are generally explained by their own-shocks in the first period; while the influence of external shocks gradually emerge after the first period. Looking at the fourth period, shocks from South Africa and Namibia are more significant in explaining variations in Egypt, Kenya, Mauritius, Nigeria and Uganda. At the same time, variations in Kenya, Mauritius, Nigeria and Uganda stock returns are mostly influenced by shocks from other African markets. The evidence in Table 6.39 also shows that shocks from BRVM contributed approximately 4.6% variations in stock markets returns in Botswana in the fourth period. It also shows that about 13.0% change in Tunisian stock returns in the fourth period is explained by shocks from the Ghanaian stock market. While Kenya and Uganda are mutually responsive to each other's shocks, Kenya contributes 11.7% of shocks to Uganda and receives 4.3% from Uganda. The reports further show that Botswana, BRVM, Ghana, Morocco, Namibia, Tunisia, and Zambia are the least influenced markets as shocks from other markets tend to have a relatively small influence on them.

The analysis among the African markets during the pre-crisis period (Table 6.40) shows that Botswana, Egypt, Kenya, Mauritius, Morocco and Uganda are mostly influenced by the shock from other African markets over this period. At the same time, markets such as Ghana, Namibia, Nigeria, South Africa and Zambia appear to be the least influenced markets. Moreover, markets such as Botswana, Nigeria, Morocco, Tunisia and Uganda appear to be the most influential markets over this period. Again, the report in Table 6.40 shows that at the fourth period shocks from BRVM contributed about 8.9% variation to Botswana stock returns. The Egyptian stock market returns is most influenced by shocks from South Africa and Namibia, with 4.1% and 3.3% contribution respectively, at fourth period. The Ghanaian stock market is mostly influenced by the Nigerian market, which accounts for 6.8% of its variation at the fourth period. By the same taken, shocks from Ghana appear to have more influence on Namibia and Uganda, with 3.2% and 4.8% contributions respectively. The South African market is mostly influenced by shocks from Tunisia (3.2%) at the fourth period. The table also shows that shocks from Tunisia and Uganda jointly contributed to about 12.2% variation in Kenya. Likewise, shocks from Uganda appear to have more influence on Kenya (5.8%), Nigeria (3.8%) and Tunisia (3.3%).

Interestingly, the analysis among African markets during the global financial crisis period indicates that shock dynamics increased significantly in the fourth period (one month) after the initial shock, compared to other sample periods, as shown in Table 6.41. The most influential African markets during this period are Egypt, Kenya, Mauritius, Morocco, Namibia, South Africa and Uganda. Additionally, the most influenced African markets are Egypt, Kenya, Mauritius, Namibia, Nigeria, South Africa, Uganda and Zambia. The report in the table shows that 14.3% and 12.6% forecast-error variances in the Egyptian stock are attributed to shocks from South Africa and Namibia respectively. The Kenyan stock market is mostly influenced by shocks from Namibia (12.5%), South Africa (11.8%) and Mauritius (10.4%). African markets such as Kenya, South Africa and Namibia account for variation in Uganda at 26.4%, 14.6% and 12.9% respectively. The South African stock market appears mostly influenced by the shocks from Morocco (11.0%), Nigeria (10.5%) and Uganda (9.8%).

In contrast, the Eurozone crisis period indicates a decline in shocks among African markets (see Table 6.42). However, shocks from Ghana, Namibia, South Africa and Uganda appear to be more influential on other African markets. At the same time, markets such as Egypt, Kenya, Mauritius, Tunisia and Uganda appear to be the most influenced markets over this period. At the fourth-horizon, shocks from Ghana account for approximately 4.3%, 4.0%, 10.3% and 29.5% in forecast error variances of Botswana, BRVM, Egypt and Tunisia respectively. The forecast-error variance in Kenya is mainly influenced by the shocks from Egypt, Namibia, Nigeria and Ghana. African markets such as South Africa and Namibia contribute more shocks to Egypt, Kenya, Mauritius, Nigeria and Uganda, while, the combined shocks from Egypt, Kenya, Namibia, South Africa and Zambia account for a 21.8% variation in Ugandan stock markets returns (see Table 6.42).

On another front, the analysis between African and the major stock markets shows evidence of different degrees of interaction among these stock markets, across all the sample periods. The test results in Tables 6.43 – 6.46 reveal that the forecast-error variance in Africa, explained by shock from the emerging and developed stock markets, become more apparent four weeks after the initial shock. This implies that the responses of Africa markets to shocks from the major global stock markets are far from being immediate.

However, the result during the full-sample period shows that the major global markets are more influential on African markets four weeks after the initial shock. African markets such as Egypt, Kenya, Mauritius and Nigeria appear to be mostly influenced by the major global markets (see Table 6.43). At the same time, Botswana, BRVM, Ghana, Morocco, Tunisia, Uganda and Zambia are among the least influenced by shocks from either the emerging or developed markets. Among the emerging markets, Brazil appears to have more influence on Egypt, accounting for 7.6% of its forecast-error variance. India exerts more influence on Egypt, Kenya, Mauritius and Nigeria, accounting for 5.4%, 3.8%, 4.8% and 4.7% of their respective forecast-error variances. Also, Russia accounts for 7.9%, 4.2% and 3.6% forecast-error variances in Egypt, Kenya and Nigeria respectively, while, shocks from China appear less important in explaining variations in African stock market returns. As for the developed markets, the United States exerts more influence on Egypt, Kenya, Mauritius and Namibia, accounting for 6.9%, 7.7%, 4.1%, and 3.6% of their respective forecast error variances (see Table 6.43).

The analysis during the pre-crisis period shows that apart from Egypt and Kenya, African markets appear less sensitive to shocks from the emerging and developed market (see Table 6.44). However, the evidence among the emerging markets shows that shocks from Brazil and Russia appear to be more influential on African markets. For instance, shocks from Brazil account for 3.9%, 6.3% and 3.0% forecast-error variances in Egypt, Kenya and Namibia respectively. Russia accounts for 4.1%, 3.6% and 3.2% forecast-error variances in Egypt, Kenya and Tunisia respectively. However, China and India appear to exert more influence on Kenya only, accounting for 3.1% and 4.8% respectively. As for the developed markets, Singapore appears to have more influence on Botswana (3.2%), Kenya (8.4%) and Uganda (7.8%) compared to other developed markets. The shocks from the United Kingdom exert more influence on the Egyptian stock markets compared to other developed markets. Also, the contribution of the Canadian market shocks to Morocco is 3.2% (see Table 6.44).

Unlike the pre-crisis period, the forecast-error variances of African markets during the global financial crisis became increasingly attributable to shocks from the emerging and developed markets. According to the report in Table 6.45, at the fourth week, African markets such as Egypt, Kenya, Mauritius, Morocco, Nigeria, Tunisia and Uganda appear to be mostly influenced by shocks from the emerging and developed markets. On the other end, Botswana, BRVM, Ghana and Zambia are the least influenced markets over this period. Among the emerging markets, shocks from Brazil, India and Russia appear more important than those from China in explaining the forecast-error variances of African markets (Table 4.5). The contribution of Brazilian shocks is very high for Egypt, Kenya and Uganda, accounting for 15.9%, 7.4% and 21.9% respectively. The Chinese shocks appear more significant in accounting for forecast error variance in Botswana (5.0%), Ghana (8.3%) and Morocco (5.1%). The shocks from India appear to have more influence on Egypt (9.8%), Mauritius (11.8%), and Nigeria (12.3%). Likewise, the Russian innovations appear to have more influence on Egypt (21.8%), Kenya (11.8%) and Uganda (15.1%).

Furthermore, evidence in Table 6.45 shows that innovations from the United States exert more influence on the forecast-error variances of BRVM (3.9%), Egypt (16.1%) and Kenya (12.3%) than other developed markets. The table also shows that the Canadian shocks are more significant in explaining the forecast-error variances of Mauritius (5.5%), Tunisia (6.3%), and Zambia (3.3%) than those of other developed markets. Similarly, shocks from Switzerland are most influential on Namibia and South Africa, accounting for 7.8% and 7.5% of their respective forecast-error variances. The contribution of shocks from Singapore is more significant to the Nigerian market (12.8%) than other developed markets. Also, France contributes more shocks to Uganda, accounting for 20.6% of the market's forecast-error variance.

The analysis during the Eurozone crisis period, as shown in Table 6.46, reveals that the sensitivity of African markets to shocks from the emerging and developed market dramatically declined in the fourth period relative to the same period during the global financial crisis. As shown in the table, Africa markets such as BRVM, Ghana, Morocco, Tunisia and Zambia appear to be least influenced by the shocks from the emerging and developed markets. On the other end, markets such as Egypt, Kenya, Mauritius, Nigeria and Uganda are more sensitive to shocks from the emerging and developed markets. Among the emerging markets, shocks from Brazil and India appear more significant in explaining the forecast-error variances in African markets than shocks from China and Russia. As for the developed market, shocks from the United Kingdom exert more influence on Egypt and Kenya, accounting for 6.7% and 13.6% of their respective forecast-error variances than other developed markets. Likewise, the Australian shocks account for more forecast-error variances in Mauritius (4.2%) and Nigeria (7.5%) than other developed markets.

Overall, it is evident from the GFEVD analysis that stock market returns in Africa are largely influenced by the market's own shocks in the first week, while the influence of the foreign market shocks takes some weeks to emerge. This evidence is consistent across all the sample periods considered. It suggests that African stock market reactions to foreign stock market shocks are not immediate; rather there are some time lags in their response. In other word, it takes some time for the impact of foreign market shocks to filter through the African markets.

The results of the GFEVD analysis generally tend to support the hypothesis of interdependence among African and the major global stock markets. In addition, the analysis across different sample period provides a strong evidence of time varying sensitivity of African markets to shocks from foreign markets. While the sensitivity of African markets to shocks from foreign market appears to be low during the pre-crisis period, the sensitivity of African markets increased dramatically during the global financial crisis. This suggests that the dynamics in the sensitivity of African markets have changed from low a response during the pre-crisis to a noticeable increase during the global financial crisis period. A similar phenomenon was found using the Granger causality test and impulse response function. The increased influence of foreign market shocks indicates evidence that international volatility was amplified during the global financial crisis.

Furthermore, the analysis also shows that African markets such as Egypt, Kenya, Mauritius, Morocco, Nigeria, Tunisia and Uganda are highly influenced by shocks from emerging and developed markets, particularly during the global financial crisis. As for the emerging and developed markets, the analysis reveals that African markets are mostly influenced by shocks from Brazil, India, Russia, Canada, Singapore, United Kingdom and United States. This result is consistent with the existing studies that emphasised the consistent impact of the United States on other stock markets (see Saiti, Bacha, & Masih 2014; Yu & Hassan, 2008 and Bessler & Yang, 2003).

Table 6. 39: GFEVD analysis between African stock markets during the full-sample period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	95.358	4.642	0.499	0.813	1.321	1.592	0.652	0.112	2.141	0.085	0.569	0.498	0.708
BRVM	1	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.182	98.818	0.801	0.302	0.613	0.209	1.771	0.066	0.652	0.202	0.291	0.438	1.442
Egypt	1	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.712	0.216	99.784	3.678	0.334	0.097	0.099	6.012	1.119	6.354	0.200	0.850	0.559
Ghana	1	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.077	0.024	0.076	99.900	0.099	0.216	0.070	0.209	0.004	0.093	0.083	0.018	0.272
Kenya	1	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.010	0.310	2.471	0.120	97.529	3.145	0.533	5.655	1.356	5.220	1.634	4.345	0.194
Mauritius	1	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.399	0.086	3.398	0.041	0.895	99.551	0.449	3.871	2.555	4.818	0.587	1.179	0.640
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.342	0.946	0.913	0.185	0.155	0.507	98.409	1.591	0.083	1.221	0.043	0.0562	0.679
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000
	4	0.374	0.141	0.694	0.352	2.273	0.901	2.201	97.799	0.889	0.105	0.767	1.971	0.146
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000
	4	0.324	0.500	2.513	0.161	1.979	1.936	1.025	3.626	96.482	3.518	0.590	1.770	0.247
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000
	4	0.297	0.293	0.798	0.171	1.459	0.920	2.530	0.774	2.485	98.737	1.263	1.819	0.125
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.000	0.000	0.000
	4	0.035	0.161	0.310	13.029	0.333	0.198	0.071	0.387	0.432	0.410	99.590	0.319	0.029
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000
	4	0.115	0.448	3.733	0.140	11.728	1.764	1.643	5.866	0.437	6.482	1.561	99.709	0.291
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00
	4	0.106	0.355	0.238	0.131	0.239	0.579	0.441	0.709	0.504	0.564	0.076	0.291	99.924

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 40: GFEVD analysis between African stock markets during the pre-crisis/stable period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	91.148	8.852	0.761	0.583	1.425	1.296	1.502	0.553	1.012	0.301	2.240	0.627	0.321
BRVM	1	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.846	98.154	0.129	0.431	2.451	0.341	1.003	0.156	1.001	0.060	0.711	0.925	2.852
Egypt	1	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.052	0.432	99.532	2.207	0.468	0.016	1.621	3.256	1.615	4.077	1.969	0.232	0.928
Ghana	1	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.072	0.439	0.166	99.565	0.435	0.959	0.915	0.286	6.786	0.283	0.696	0.983	0.152
Kenya	1	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.796	0.137	0.972	0.271	99.960	0.040	0.825	2.322	0.889	2.256	6.412	5.823	0.077
Mauritius	1	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.545	1.154	2.356	0.268	2.422	96.592	3.408	0.385	4.391	0.868	0.504	1.937	0.209
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.690	1.685	1.090	0.096	0.259	3.550	95.653	4.347	0.105	3.679	0.641	0.194	1.122
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000
	4	1.691	0.024	0.118	3.204	0.267	0.109	0.545	99.032	0.968	0.327	2.460	0.515	0.042
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000
	4	1.847	0.231	0.209	0.378	0.436	0.103	0.274	0.395	99.961	0.039	0.951	3.836	0.021
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000
	4	0.742	0.031	0.073	1.955	0.561	0.521	0.654	0.141	0.463	96.800	3.200	0.142	0.177
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000
	4	0.778	0.265	0.160	0.733	0.070	1.357	2.470	0.319	2.100	0.340	99.326	3.267	0.674
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000
	4	0.827	0.015	2.052	4.831	4.106	0.780	0.194	2.648	0.210	0.231	3.237	99.381	0.619
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00
	4	0.095	0.376	0.315	0.357	0.103	0.262	0.238	0.746	0.017	0.801	0.028	0.619	99.972

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 41: GFEVD analysis between African stock markets during the global financial crisis period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	97.366	2.634	0.252	6.556	2.836	0.469	2.851	0.498	3.449	0.270	3.584	1.932	5.021
BRVM	1	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.876	96.845	3.154	0.211	1.812	0.390	7.738	1.727	2.317	2.089	1.222	3.062	2.652
Egypt	1	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.509	2.248	96.778	0.543	3.222	0.382	0.983	12.607	2.560	14.282	0.315	9.443	0.097
Ghana	1	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.307	11.679	1.507	98.498	1.502	3.040	0.047	2.059	2.797	1.744	0.690	0.360	2.299
Kenya	1	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.501	1.829	2.351	0.065	89.560	10.439	2.715	12.532	1.539	11.830	2.163	9.456	2.303
Mauritius	1	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.720	2.397	8.825	2.499	2.052	99.101	0.899	3.897	3.406	7.350	1.464	3.338	4.110
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.938	7.523	3.245	0.304	2.981	1.852	98.311	1.689	0.370	1.401	1.058	2.849	0.808
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000
	4	1.430	2.524	5.310	0.640	5.116	2.710	6.573	96.003	3.998	0.557	2.210	5.938	1.361
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000
	4	0.665	2.427	9.045	1.971	8.347	3.427	7.301	7.363	94.862	5.138	4.328	7.331	3.522
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000
	4	2.501	1.650	7.154	0.399	4.971	3.095	11.032	2.143	10.514	97.650	2.350	9.783	1.781
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000
	4	0.980	2.153	1.521	0.132	1.930	3.575	0.844	4.891	0.312	3.809	98.603	0.974	1.397
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000
	4	1.164	2.037	7.081	0.326	26.364	8.731	6.904	12.888	0.181	14.605	3.782	97.103	2.897
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00
	4	0.677	1.042	2.704	2.818	0.999	7.262	10.688	3.881	10.601	4.227	4.362	0.063	95.638

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 42: GFEVD analysis between African stock markets during the Eurozone crisis period

African Markets	Period (Week)	Botswana	BRVM	Egypt	Ghana	Kenya	Mauritius	Morocco	Namibia	Nigeria	South Africa	Tunisia	Uganda	Zambia
Botswana	1	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	98.235	1.765	0.336	4.314	7.738	1.956	0.614	1.468	2.421	1.355	0.442	2.143	0.345
BRVM	1	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.123	99.363	0.632	4.005	1.562	0.774	1.895	0.197	0.243	0.242	0.125	3.215	0.765
Egypt	1	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.621	1.546	99.927	10.314	0.073	0.895	0.727	3.687	2.656	3.896	0.655	3.911	0.196
Ghana	1	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.372	0.286	0.237	99.471	0.529	1.897	0.102	0.554	0.132	0.191	0.148	0.033	4.627
Kenya	1	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.052	0.392	4.942	1.113	97.681	2.319	0.120	4.542	7.415	5.746	1.188	0.795	0.921
Mauritius	1	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.230	0.811	1.295	0.555	1.466	99.961	0.039	4.183	3.162	5.730	0.897	0.845	1.222
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.832	0.500	2.141	1.157	0.315	0.144	99.911	0.089	1.511	0.227	0.353	0.243	0.676
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	0.000
	4	1.196	2.472	1.174	1.637	2.344	0.204	0.168	97.727	2.257	0.772	0.564	4.442	0.770
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.000	0.000	0.000	0.000	0.000
	4	1.329	2.082	1.282	1.384	2.801	1.153	0.457	1.432	96.546	3.454	0.397	1.223	0.779
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000
	4	0.293	1.680	1.121	0.919	2.411	0.246	0.134	0.459	1.143	98.627	1.373	4.254	1.564
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000	0.000
	4	1.158	1.727	0.273	29.469	1.216	5.219	0.884	0.769	4.975	1.443	98.453	2.786	1.517
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00	0.000
	4	0.146	0.257	3.952	0.863	3.860	0.374	0.734	4.864	1.965	6.051	2.521	96.882	3.118
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.00
	4	0.090	0.056	0.637	2.099	0.493	2.054	1.577	0.076	1.216	0.060	0.060	1.539	99.940

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 43: GFEVD analysis between African, emerging and developed stock markets during the full-sample period

African Markets	Period (Week)	Emerging Markets: Brazil	China	India	Russia	Developed Markets: Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.090	0.758	0.234	0.069	0.156	0.044	0.080	0.088	0.343	0.351	1.291	0.030	0.040	0.040
BRVM	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.263	0.754	0.236	0.355	0.088	0.711	0.194	0.146	0.100	1.079	0.057	0.640	0.870	0.547
Egypt	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	7.646	0.326	5.380	7.897	5.451	6.628	5.102	5.057	5.881	5.482	6.547	2.759	6.389	6.928
Ghana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.055	0.025	0.193	0.022	0.046	0.110	0.172	0.117	0.074	0.009	0.085	0.177	0.189	0.021
Kenya	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.916	0.696	3.812	4.173	5.496	6.470	6.216	5.626	4.847	4.129	5.537	6.849	6.496	7.749
Mauritius	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.211	0.206	4.833	2.492	3.090	3.397	2.592	1.787	3.039	0.629	3.147	2.454	3.457	4.113
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.785	0.773	0.981	0.234	0.617	0.619	0.566	0.758	0.856	0.324	0.843	1.650	0.957	0.460
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.805	0.249	0.767	0.811	1.603	2.205	2.075	1.922	1.079	1.996	0.787	3.478	2.982	3.560
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.672	0.635	4.734	3.623	4.009	3.369	3.766	4.111	4.175	3.337	6.495	3.117	4.860	3.885
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.713	0.258	0.739	0.665	0.446	1.886	2.460	2.143	0.579	2.211	0.658	3.652	4.160	3.458
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.183	1.018	1.387	0.528	0.519	0.800	0.179	0.214	0.032	0.171	0.479	0.543	0.297	0.244
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.188	0.208	0.400	0.365	0.644	0.431	0.261	0.273	0.231	0.680	0.315	0.140	0.281	0.331
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.006	0.247	0.345	0.136	0.440	0.349	0.180	0.298	0.118	0.581	0.349	0.169	0.309	0.077

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

Table 6. 44: GFEVD analysis between African, emerging and developed stock markets during the pre-crisis/stable period

African Markets	Period (Week)	**Emerging Markets** Brazil	China	India	Russia	**Developed Markets** Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.498	0.039	0.524	2.537	1.417	1.066	0.196	1.126	0.356	2.023	3.159	1.050	0.207	0.835
BRVM	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.157	0.542	0.006	0.719	0.942	0.491	0.124	0.041	0.435	0.150	0.142	0.055	0.052	0.011
Egypt	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.936	1.016	2.097	4.091	2.937	4.904	4.165	1.538	1.186	4.201	2.894	3.073	5.921	3.136
Ghana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.430	0.587	0.143	1.096	0.771	0.003	1.070	1.230	0.120	0.778	0.132	1.851	1.107	0.458
Kenya	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	6.303	3.177	4.843	3.631	2.396	4.106	5.064	6.114	3.719	2.217	8.429	6.989	5.907	5.577
Mauritius	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.131	0.996	0.597	0.295	2.425	0.272	0.734	0.900	1.802	0.466	1.780	1.325	0.959	0.622
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.607	0.562	2.342	0.666	0.601	3.249	1.662	2.235	0.865	2.268	1.279	1.278	0.773	1.948
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.026	0.542	1.321	1.886	0.477	0.812	0.043	0.091	2.324	0.078	1.244	0.231	0.676	1.880
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.176	0.388	1.438	0.958	0.662	0.154	0.095	0.375	1.139	0.453	1.288	0.591	0.480	0.100
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.610	0.473	2.512	0.839	0.739	1.017	0.021	0.219	1.821	0.033	2.043	0.355	0.077	1.253
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.004	2.079	1.134	3.227	1.292	1.377	1.018	1.556	2.700	1.282	0.580	2.720	1.102	0.246
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.449	0.047	2.092	0.395	0.306	1.555	1.745	0.768	0.484	0.131	7.773	5.589	1.299	2.437
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.023	0.616	0.218	0.169	0.846	0.288	0.612	0.213	0.275	1.651	0.267	0.183	0.460	0.270

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 45: GFEVD analysis between African, emerging and developed stock markets during the global financial crisis period

		Emerging Markets				Developed Markets									
African Markets	Period (Week)	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.622	4.989	0.941	0.306	0.350	0.139	0.515	0.508	2.028	0.146	0.342	0.225	0.357	0.511
BRVM	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.374	1.592	0.103	0.514	1.585	2.913	2.434	1.375	0.150	1.747	1.210	2.768	2.797	3.935
Egypt	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	15.890	0.333	9.867	21.831	7.233	9.054	8.113	7.616	15.542	8.388	13.315	1.463	8.531	16.113
Ghana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.340	8.290	1.143	2.716	2.492	2.565	0.635	1.040	3.591	1.465	2.892	0.286	0.774	0.322
Kenya	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	7.354	2.363	4.806	11.804	7.728	10.859	10.223	8.512	6.859	10.577	6.198	8.303	9.307	12.334
Mauritius	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.367	0.995	11.244	3.625	2.716	5.549	2.610	1.968	2.618	1.549	3.394	2.196	2.970	5.466
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	4.245	5.099	2.576	1.427	4.788	5.072	6.402	6.022	2.658	2.621	2.290	6.867	6.328	6.241
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.679	0.032	0.684	0.014	2.665	2.631	1.242	1.152	0.763	3.543	0.868	7.788	2.489	5.829
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	6.572	1.085	12.307	9.158	5.048	2.452	4.477	6.507	11.788	5.542	12.802	1.717	8.353	2.992
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.393	0.895	0.299	1.042	0.067	1.730	1.655	2.352	0.329	2.942	1.270	7.519	2.611	4.128
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	5.538	1.710	8.507	4.568	1.911	6.286	4.717	3.808	4.534	2.816	4.123	0.968	3.407	3.592
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	21.935	1.291	9.245	15.095	8.901	13.466	20.631	16.642	13.489	19.599	14.298	14.249	18.991	19.079
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.508	0.009	1.379	2.538	1.876	3.257	1.579	1.220	0.924	0.923	0.809	1.840	1.646	1.590

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author's computation

Table 6. 46: GFEVD analysis between African, emerging and developed stock markets during the Eurozone crisis period

African Markets	Period (Week)	Emerging Markets Brazil	China	India	Russia	Developed Markets Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.980	0.019	0.773	3.682	1.528	1.138	1.156	2.028	0.755	0.846	0.784	1.142	0.879	3.359
BRVM	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.440	0.921	0.516	0.532	0.058	1.683	0.081	0.358	0.425	0.686	0.566	0.529	0.762	0.378
Egypt	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	4.903	2.982	6.621	2.400	5.648	5.666	4.695	4.161	3.983	5.292	6.522	4.050	6.660	3.271
Ghana	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.183	0.335	0.459	0.064	0.065	0.227	0.443	0.431	0.055	0.041	0.420	0.858	0.684	0.072
Kenya	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	4.606	1.186	5.516	2.327	9.647	9.923	9.892	5.035	6.167	4.796	9.812	11.006	13.571	7.667
Mauritius	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	3.429	0.987	0.441	1.943	4.179	2.216	3.173	2.674	0.517	0.599	0.483	2.920	3.988	3.144
Morocco	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.221	0.786	0.010	1.146	0.510	0.882	0.394	0.352	0.084	0.397	0.265	0.310	0.266	0.618
Namibia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.390	0.369	0.748	0.750	1.433	0.958	0.377	0.197	0.098	0.314	3.594	0.025	1.576	0.489
Nigeria	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.502	0.070	5.058	1.375	7.460	4.578	0.671	3.672	2.500	0.860	1.775	1.106	7.246	1.396
South Africa	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.549	0.287	0.778	2.371	2.730	1.984	0.973	0.027	0.407	0.074	1.206	0.874	1.331	0.927
Tunisia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	1.126	0.576	0.479	0.020	0.436	0.741	1.324	1.471	0.824	1.162	0.247	0.347	0.512	0.586
Uganda	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	2.569	1.578	6.902	2.259	9.210	6.198	3.937	3.051	8.431	5.409	10.947	3.784	7.081	4.129
Zambia	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.370	0.149	0.492	1.300	0.136	0.061	0.097	0.627	0.021	0.854	0.766	0.128	0.244	0.314

Note: Each entry denotes the total percentage of forecast error variance of the stock markets returns in a particular African market in the first column explained by the error variance from the stock markets in the first row for the first and fourth week after the initial shock occurred.

Source: Author’s computation

6.5 Conclusion

This chapter empirically examined the dynamic relationships and contemporaneous interactions and linkages between African stock markets and the major global stock markets. The chapter began with the presentation of the preliminary results by analysing the descriptive statistical properties and unconditional correlation of the stock markets considered. This was followed by the analysis of the unit root/stationarity of the stock price series using the ADF, PP and KPSS tests. The last part of the chapter dealt with the empirical examination of stock market integration using the Johansen co-integration test, Granger causality test, GIRF and GFEVD.

The analysis of the preliminary results revealed that, while the stock market returns were positive prior to the global financial crisis, most markets recorded negative returns during the global financial crisis period than any other period. Also, stock market volatility, as measured by the standard deviation, revealed a dramatic increase in volatility during the global financial crisis period. On the other end, the stock market volatility appears to have declined significantly during the Eurozone crisis period. Further evidence shows that even though African markets have a relatively low correlation with other markets, their correlation increased during the global financial crisis period relative to other period. The increased correlation during the global financial crisis period can be considered as evidence of co-movement between the markets.

The evidence from the Johansen co-integration tests revealed the time-varying nature of the financial market integration process between African, emerging and developed stock markets. The results of the test support the existence of a high degree of financial integration among African stock markets and between them and the major emerging and developed markets, particularly before the 2007 global financial crisis (pre-crisis period). However, an overall reduction in the number of co-integrating relationship is clearly visible during the periods of the global financial crisis, suggesting a trend reversal towards disintegration. This evidence points to the impact of the global financial crisis on the integration of African markets with other major global markets. Notwithstanding this, African markets appear recoupled with other markets during the Eurozone crisis period.

Furthermore, the dynamic short-run interdependence based on the Granger causality test revealed a high degree of interactions among African, emerging and developed stock markets. The result further revealed there is a clear evidence of increased causal linkages during the crisis periods compared to the pre-crisis period. This result is mirrored across all the markets considered, suggesting the appearance of new causal linkages between the African markets and other markets during crisis periods, particularly the global financial crisis period.

Looking at the evidence from the GIRF analysis, it revealed existence of positive and negative responses of African stock market returns to own-shocks as well as shocks from foreign stock markets. The analysis also indicates that African markets are more sensitive to own-shocks than foreign shocks. That is, movements in stock prices in individual African markets are mainly explained by their own-shocks. Considering different sample periods, the analysis shows a visible increase in the response of African markets to shocks from the emerging and developed markets during the global financial crisis period.

Consistent with the evidence from GIRF, the results of the GFEVD analysis show that African stock markets are mainly influenced by the market's own-shocks during the first period while the influence of foreign market shocks take some weeks to emerge, particularly during the fourth week. This evidence is consistent across all the sample periods considered, suggesting that African stock markets' reactions to foreign stock market shocks are not immediate and there is a time lag in their responses. The analysis of GFEVD across different time periods reveals that the influence of foreign market shocks on African stock markets dramatically increased during the global financial crisis period compared to any other period.

To sum up, several important conclusions can be drawn from these findings concerning the stock markets integration between African, emerging and developed stock markets. First, there is the existence of long-run relationships between African markets and the major global markets before the 2007 global financial crisis. However, this relationship is time dependent, suggesting that the level of integration changes through time and the global financial crisis and Eurozone crisis had an impact on the degree of integration of these stock markets. Second, there is a high level of interdependence between African stock markets and the major global markets. Such a high level of interdependence is an indication that African markets may be sensitive to movements in stock returns elsewhere. Third, African stock markets are less responsive to foreign market shocks at the early stage but their responses increase with time. Hence, there are some time lags in their response to foreign market shocks. Fourth, there is evidence of increased sensitivity of African stock markets to foreign shocks during the global financial crisis relative to other periods. This suggests that the dependence of these markets on each other may have contributed to the transmission of financial turbulence from the developed markets to African stock markets. Moreover, the results from the Granger causality, GIRF and GFEVD have consistently shown the increased impact of the global financial crisis on interdependence between African markets and major global markets. Lastly, it appears that Eurozone crisis has a limited effect on the interdependence between African markets and other markets.

However, it is important to emphasise at this point that the interdependence between African stock markets and other markets is not sufficient to conclude evidence of contagion and volatility transmission. Although the interdependence between these markets may have provided a platform for the propagation of contagion and volatility, Chapter Seven will empirically investigative these two important issues.

CHAPTER SEVEN

ESTIMATION OF CONTAGION AND VOLATILITY TRANSMISSION

7.1 Introduction

While the previous chapter specifically focused on the evidence of financial integration and the direction of the linkages, this chapter empirically examines evidence of contagion and volatility transmission. The analyses in the previous chapter were conducted in a general framework that does not account for major features of international financial relationships, particularly, in the time of financial crisis. Given the main concern of this study is understanding how individual African markets were affected by the global financial crisis, this however, provides the need to reflect on contagion and volatility transmission between African markets and the major global stock markets considered in this study.

In order to empirically examine evidence of contagion and volatility transmission, the present chapter considers five aspects of international financial relationships. These five aspects are: (i) the level of volatility, (ii) dynamic conditional correlation, (iii) contagion, (iv) mean spillover effects, and (v) volatility spillover effects. Each of these quantities measures an aspect of international financial linkages between African, emerging and developed stock markets. The empirical models employed in this chapter permit the examination of these five aspects. The first three measures are analysed using the DCC-GJRGARCH model, while the last two measures are examined using the aggregate shock (AS) model. Like the pervious chapter, these five aspects are analysed across all four sample periods as identified in Chapter Five; namely, full-sample, pre-crisis, global financial crisis and Eurozone crisis periods. In addition, a bivariate testing technique is employed by pairing individual African stock markets with each of the emerging and developed stock markets.

However, the analysis in this chapter is presented in four sections. The first section deals with testing for the presence of volatility clustering in the data series, which provide a basis for modelling volatility by means of GARCH type of models. The second section provides the estimation and analysis of stock market volatility, the time-varying conditional correlation and contagion within the framework of the DCC-GJRGARCH. The third section provides the results and analysis of the mean and volatility spillover effects using the AS-EGARCH framework. Lastly, the fourth section provides the summary and conclusion of the chapter.

7.2 Testing for volatility clustering (ARCH effects)

An important condition before estimating the ARCH and GARCH type of models is to test the data series for the presence or otherwise of volatility clustering (ARCH) effects. As noted by Engle (1982), the absence of volatility clustering in the data series would lead to poor fit of the mean equation. Moreover, studies have shown that volatility clustering is a common feature of stock market return series (see Jin & An, 2016; Rejeb & Boughrara, 2015; Lean & Teng, 2013; Bekiros, 2013 and Min & Hwang, 2012). A visual inspection of Figure 6.1 of Appendix C suggests evidence of a volatility clustering effect. It is noticeable from the figures that there are periods when low volatility is followed by low volatility and high volatility is follow by high volatility. To formally examine evidence of volatility clustering or otherwise, the Engle (1982) Lagrange multiplier (LM) and Ljung and Box (1978) tests were employed to test the residual from the conditional mean equation (22) for the presence of ARCH effects. In this study, only 12 lags of the residual from the equation (22) were tested for ARCH effects.

The results of these tests are presented in Table 7.1 for all the stock markets across the four sample periods. Evidence from the table indicates that the null hypothesis of no ARCH effects in the stock market return series is rejected at 5% level of significance across all the markets, except for Ghana and Zambia over the full-sample period. The existence of ARCH effect implies rejecting the assumption of constant correlation and volatility for the alternative of dynamic correlation and volatility. In other words, correlation and volatility tend to follow a dynamic structure. This result is consistent with the above mentioned studies that stock market returns series are usually characterised by volatility clustering effects.

The Ljung-Box test on the standardised residuals and the squared standardised residuals produced mixed results. While the test on the standardised residuals shows little evidence of autocorrelation, the test on the squared standardised residuals shows existence of significant autocorrelation in the residuals. Considering the sub-samples, there is little evidence of ARCH effects and autocorrelation during the pre-crisis, global financial and Eurozone crisis periods. However, the presence of a significance ARCH effect obtained with the LM and Ljung-Box tests over the full-sample period was sufficient for a green light to use the DCC-GJRGARCH and EGARCH models in this study. Therefore, the following section will provide the estimation and discussion of the DCC-GJR-GARCH model.

Table 7. 1: Volatility clustering (ARCH effect) test results

African Markets	Full-sample period			Pre-crisis/stable period			Global financial crisis period			Eurozone crisis period		
	LM (12)	**LQ (12)**	**$LQ^2(12)$**	**LM (12)**	**LQ (12)**	**$LQ^2(12)$**	**LM (12)**	**LQ (12)**	**$LQ^2(12)$**	**LM (12)**	**LQ (12)**	**$LQ^2(12)$**
Botswana	11.180	80.654*	12.548	2.900	38.046*	2.986	2.716	15.502	2.268	2.420	14.230	2.963
BRVM	212.906*	11.464	224.280*	66.386*	3.356	79.582*	14.850	14.624	18.262	9.833	12.873	9.944
Egypt	68.960*	22.192*	95.254*	31.370*	14.203	38.563*	28.055*	17.370	42.917*	15.227	9.381	18.514
Ghana	0.023	1.876	0.023	26.426*	57.408*	32.445*	17.214	19.371	24.890*	0.069	0.437	0.068
Kenya	64.328*	12.987	94.472*	35.700*	8.842	31.641*	17.113	11.055	21.979*	16.623	16.950	18.020
Mauritius	95.004*	25.086*	191.030*	78.843*	9.619	130.920*	13.328	8.456	15.162	21.797*	10.511	30.561*
Morocco	87.054*	13.069	170.560*	26.553*	7.781	33.688*	30.436*	9.876	65.558*	10.217	10.921	11.574
Namibia	173.791*	8.269	554.250*	21.692*	9.621	19.695	42.435*	5.466	99.085*	11.985	11.721	4.418
Nigeria	104.498*	20.631	207.590*	24.826*	9.630	28.465*	20.249	9.251	34.827*	82.707*	17.519	67.876*
South Africa	173.134*	14.094	484.300*	26.546*	7.125	28.252*	41.420*	12.550	89.464*	12.716	22.125*	15.895
Tunisia	93.859*	22.406*	95.051*	5.163	15.742	5.506	8.063	16.747	8.283	44.891*	31.923*	47.323*
Uganda	69.838*	6.675	66.435*	13.089	12.373	14.406	26.709*	9.568	22.510*	13.393	12.530	13.315
Zambia	0.038	1.297	0.0381	0.065	0.464	0.066	28.047*	19.487	21.778*	30.670*	28.689*	39.727*
Emerging Markets												
Brazil	129.031*	14.916	255.340*	13.423	10.960	10.432	31.992*	8.436	56.632*	29.295*	12.098	29.698*
China	78.063*	28.368*	151.660*	24.636*	14.051	31.121*	11.869	12.988	13.571	19.263	12.258	14.095
India	107.392*	32.957*	199.460*	8.539	12.509	8.311	21.571*	21.386*	20.011	30.693*	11.337	56.487*
Russia	211.766*	27.629*	362.460*	24.246*	9.675	21.350*	53.329*	23.796*	71.657*	20.089	17.031	17.984
Developed Markets												
Australia	85.917*	11.581	157.320*	5.992	10.388	7.694	16.486	7.676	21.352	26.087*	22.652*	32.709*
Canada	170.360*	23.013*	393.170*	13.136	8.086	13.908	32.426*	13.402	64.299*	56.897*	27.022*	82.588*
France	62.997*	25.147*	100.810*	9.568	6.878	63.678*	12.128	19.814	16.370	39.563*	7.586	51.501*
Germany	90.508*	21.471*	147.090*	21.647*	10.571	80.994*	22.158*	20.087	29.400*	39.752*	13.359	64.841*
Hong Kong	104.157*	8.623	238.580*	8.927	5.110	9.838	20.356	5.393	18.053	45.530*	11.662	52.622*
Japan	33.730*	10.859	45.818*	15.350	6.316	17.802	5.558	6.543	6.647	6.479	12.674	4.792
Singapore	129.437*	8.755	221.820*	21.246*	9.978	33.354*	23.789*	6.917	27.021*	41.740*	12.393	63.510*
Switzerland	47.061*	19.389*	56.826*	7.671	11.101	54.151*	9.179	12.441	9.966	15.745	9.343	18.227
United Kingdom	78.904*	45.529*	117.92*	9.884	12.762	47.970*	16.479	22.980*	20.949*	18.391	24.133*	25.049*
United States	102.471*	19.538	183.010*	8.446	5.318	16.412	20.698	11.096	29.211*	55.586*	21.265*	109.070*

Note: * denotes significance at 5% level: The number in parenthesis is the lag length. The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author’s computation

7.3 Estimation results of the DCC-GJRGARCH model

One major advantage of the multivariate DCC-GARCH model is based on the fact that the model can jointly estimate the level of volatility for individual series in a group and the dynamic conditional correlation between them, so that their behaviours can be examined over time. Consequently, the analysis in this section is divided into three parts. The first part of the analysis will specifically focus on the level of volatility of individual markets across different periods. The second part will deal with the issue of dynamic conditional correlation between African stock markets and those of the emerging and developed markets. The third part will focus on testing for evidence of contagion.

7.3.1 Estimating the level of volatility level

Prior to the estimation of the conditional correlation and volatility, pre-whiten of stock market returns series is required before using the residuals for the conditional correlation and volatility analysis. However, to keep the models parsimonious, the stochastic evolution of the conditional mean and volatility equations are assumed to follow the univariate AR(1)-GJRGARCH(1,1) model as indicated by equations (22) and (24) in Chapter Five. To account for possible violations of normality assumption in the conditional error process of the volatility model, the test statistics are computed based on asymptotic robust standard errors proposed by Bollerslev and Wooldridge (1992). The results and diagnostic tests of the univariate AR(1)-GJRGARCH model estimated in the first step of the DCC are reported in Tables 7.2 – 7.5 over the four sample periods.

Table 7.2 reports the estimates of the conditional mean and variance equation over the full-sample period. The autoregressive term in the mean equation is positive and statistically significant for a number of African markets except for Ghana, Namibia, South Africa and Uganda. Similarly, the autoregressive term for the emerging markets is positive and insignificant for China and Russia but significant for India. The Brazilian market has a negative and insignificant coefficient value. For the developed markets, the autoregressive coefficient is negative except for Australia, Japan and Singapore. The autoregressive coefficient for the developed markets is only significant for Japan. This finding is consistent with the evidence in the literature in that the autoregressive term is usual positive for most developing and emerging markets, which indicates price friction or partial adjustment exists in these markets. Conversely, the existence of a negative autoregressive term in most developed markets indicates the presence of positive feedback trading in the developed markets (Mollah et al, 2016; Min & Hwang, 2012 and Chiang et al, 2007).

As for the variance equation in Table 7.2, ARCH coefficient (ψ), which captures the response of current markets volatility to movements in stock returns, is statistically significant in a number of African and emerging stock markets. For the developed markets, only Japan has a significant ARCH coefficient. However, the negative coefficient value violates the non-negativity assumption of the model. The GARCH coefficient (φ) which measures how long a shock in the condition variance will take to die out, is statistically significant in all the markets except for BRVM, Ghana and Zambia. The persistence of conditional volatility as captured by $\psi_i + \varphi_i + 0.5\gamma_i$ shows that apart from Botswana and Mauritius, the estimated individual GARCH processes are close to one, implying stationary and persistence in volatility behaviour.

Furthermore, there exist some asymmetric effects in the conditional volatility. The asymmetric coefficient (γ) is statistically significant for all developed markets except Singapore. In Africa and emerging markets, only Namibia, Uganda and Brazil are found to respond asymmetrically to volatility. For these markets, since the asymmetric coefficient is positive, larger negative shocks in the previous period would lead to more volatility in the current period. This phenomenon is well documented in the finance literature (see Park, Ryu & Song, 2017; Babalos & Stravroyiannis, 2017 and Bonga-Bonga, 2017). Moreover, an inspection of the standardised and the squared standardised residuals reported in Table 7.2 suggests that the estimated model is able to explain adequately the stock market returns changes since the residuals and their squared values are serially uncorrelated. Also, there are no ARCH effects in the residual series.

Table 7.3 reports the estimated results of the DCC-GJRGARCH model over the pre-crisis period. The estimated parameters from the mean equation show that the autoregressive coefficient is mostly positive among the African and emerging markets, while in the developed markets, the autoregressive coefficient is negative across all the markets except Australia. The ARCH coefficient from the variance equation is statistically significant in most African markets compared to the emerging and developed markets. This indicates that stock returns in most African markets react more to volatility in the short-run than the emerging and developed stock markets. On the other hand, the estimated GARCH coefficient is statistically significant across all the markets except BRVM, Zambia, Russia and Australia.

However, the GARCH coefficient for Japan is greater than 1, indicating that a shock to the conditional variance over the long-horizon does not die out and that volatility is persistent.

Further analysis shows that volatility is quite persistent with an explosive behaviour in Botswana, BRVM, Ghana and Japan. With the exception of these markets, the second moment and stationary conditions are satisfied. Table 7.3 also shows that there is a presence of asymmetric effects in Ghana, Nigeria, Tunisia, India, Australia, Canada, France, Switzerland and the United Kingdom. However, the asymmetric coefficient is negative for Nigeria and Tunisia, suggesting that larger negative shocks in the previous period contributes less to volatility in the current period. The residual diagnostic tests reveal an absence of ARCH effects as well as linear and non-linear serial correlation (except for Kenya and South Africa).

The estimated results during the global financial crisis period are presented in Table 7.4. As reported in the table, the autoregressive coefficients for Botswana, Egypt, Ghana, Mauritius and Zambia are significant at 5% level. For the emerging and developed markets, only Japan has a significant autoregressive coefficient. In contrast to the evidence during the pre-crisis period, the autoregressive coefficients are mainly positive and statistically insignificant for most markets during the global financial crisis period. The positive coefficient indicates that there could be some price friction or partial adjustment during the crisis period. This result is inconsistent with the existing literature and it may be attributed to the global financial crisis.

An analysis of the variance equation shows a number of negative and significant ARCH terms across the markets (see Table 7.4 below). The GARCH coefficient in all the markets (except for Germany and the United States) is statistically significant, which indicates a long memory in volatility. In addition, the GARCH coefficient is very high and exceeding one in some markets such as Botswana, Mauritius, Zambia and China. The analysis of the level of volatility shows the presence of volatility persistence in all the markets. However, the level of volatility during this period appears to be higher relative to the pre-crisis period. This observation is consistent with the evidence in the literature (Park et al., 2017; Gupta & Guidi, 2012; Dungey et al., 2005 and Forbes & Rigobon, 2002).

Further evidence from Table 7.4 shows there is overwhelming evidence of more asymmetric volatility during the global financial crisis period than any other periods. The positive asymmetric coefficient implies that large negative shocks in the previous period lead to more volatility in the current period. In addition, the results from the table show that the fitted

DCC-GJRGARCH model is adequately specified given the absence of ARCH effects in the residual. Also, the Ljung-Box Q-statistic in the standardised and the squared standardised residuals indicate that the residuals are serially uncorrelated.

Table 7.5 presents the estimated coefficients during the Eurozone crisis period. The estimated autoregressive coefficients for Botswana, BRVM, Egypt, Kenya, Mauritius, Nigeria and Tunisia are positive and statistically significant. For the emerging and developed markets, the autoregressive coefficients are insignificant. In the variance equation, evidence shows a negative and statistically significant ARCH coefficient for Morocco, Namibia, South Africa, Australia, Switzerland and the United Kingdom. The ARCH coefficient for Zambia is positive and statistically significant. Also, the GARCH coefficient is positive and statistically significant for all the markets except for Japan. The presence of statistically significant GARCH coefficients shows that volatility has a long memory and tends to be persistent.

Furthermore, the analysis in Table 7.5 below reveals clear evidence of asymmetric volatility since the estimated parameter is positive and statistically significant in most markets. For instance, stock market volatility in Egypt, Morocco, Namibia and South Africa is found to respond asymmetrically to negative shocks. Likewise, the volatility in the emerging and developed markets is asymmetric in nature except for Hong Kong. Also, the analysis in Table 7.5 shows that the fitted DCC-GJRGARCH model is adequately specified since there is no evidence of an ARCH effect in the residual. Moreover, the Ljung-Box test shows there is no evidence of serial correlation in the standardised and the squared standardised residuals.

In general, the estimated coefficients of the DCC-GJRGARCH model show that while there is limited evidence of significant ARCH effect, a GARCH effect exists in all the markets and periods. This result suggests that market volatility has a long memory and that volatility is more sensitive to its own past innovations than it is to current innovations in the markets. The magnitude of volatility as measured by $\psi_i + \varphi_i + 0.5\gamma_i$ shows that volatility is persistence and varies across markets and time. However, the magnitude of volatility across most markets appears to be more persistent during the global financial crisis period relative to other periods. Furthermore, there is overwhelming evidence of asymmetry in the volatility, particularly during the two crisis periods. Also, the evidence from the residual diagnostic tests shows that the fitted DCC-GJRGARCH model is adequately specified. Having examined the level of volatility across markets and time, the following section will investigate the structure of the pairwise time-varying conditional correlation.

Table 7. 2: DCC-GJRGARCH model results during the full-sample period

African Markets	Mean equation		Variance equation					Diagnostic tests		
	μ	ϕ	ω	ψ	φ	γ	Persistence	LQ(12)	$LQ^2(12)$	LM(12)
Botswana	0.001*	0.349*	0.000*	0.298*	0.420*	0.718	1.077	49.534*	3.374	3.384
BRVM	0.001*	0.243*	0.000*	0.870*	0.020	-0.528	0.626	16.106	1.518	1.437
Egypt	0.002*	0.121*	0.000*	0.053	0.715*	0.179	0.858	18.932	18.164	18.562
Ghana	-0.001	-0.002	0.001	0.051	0.567	-0.053	0.592	3.103	0.023	0.023
Kenya	0.001*	0.152*	0.000*	0.428*	0.462*	0.007	0.894	17.418	18.544	18.669
Mauritius	0.001*	0.226*	0.000*	0.123*	0.858*	0.041	1.002	18.318	10.403	10.795
Morocco	0.001	0.126*	0.000*	0.103*	0.830*	0.041	0.954	11.674	20.947	20.652
Namibia	0.001*	-0.081*	0.000*	-0.010	0.868*	0.171*	0.944	5.213	7.737	7.491
Nigeria	0.001*	0.145*	0.000*	0.254*	0.722*	-0.024	0.964	19.888	10.478	9.619
South Africa	0.001*	-0.048	0.000*	0.001	0.869*	0.136	0.938	7.237	10.632	11.671
Tunisia	0.001*	0.136*	0.000	0.062*	0.848*	0.059	0.940	13.177	6.542	6.747
Uganda	0.002*	-0.030	0.00*	0.082*	0.771*	0.116*	0.911	8.914	8.225	8.613
Zambia	0.002*	0.022*	0.000	-0.003	0.590	-0.006	0.584	2.327	0.034	0.033
Emerging Markets										
Brazil	0.001	-0.012	0.000*	-0.021	0.849*	0.160*	0.908	9.554	8.234	8.134
China	0.000	0.031	0.000	0.085*	0.899*	-0.014	0.977	27.122*	11.736	11.575
India	0.002*	0.094*	0.000	0.118*	0.782*	0.113	0.957	10.134	10.707	11.292
Russia	0.001	0.037	0.000*	0.109*	0.848*	0.037	0.976	7.374	6.200	6.185
Developed Markets										
Australia	0.001*	0.022	0.000*	0.036	0.787*	0.221*	0.934	11.989	4.039	3.884
Canada	0.001*	-0.051	0.000*	-0.009	0.845*	0.186*	0.929	11.944	3.610	3.771
France	0.000	-0.054	0.000*	-0.055	0.792*	0.387*	0.931	8.056	6.860	7.341
Germany	0.001*	-0.043	0.000*	0.024	0.598*	0.525*	0.885	9.415	6.704	6.699
Hong Kong	0.001	-0.027	0.000*	0.026	0.889*	0.112*	0.971	5.780	6.981	7.510
Japan	0.000	0.098*	0.000*	-0.102*	0.521*	0.472*	0.655	8.189	13.215	11.505
Singapore	0.001	0.064	0.000	0.067	0.858*	0.101	0.976	8.624	6.263	6.293
Switzerland	0.001*	-0.050	0.000*	-0.020	0.638*	0.630*	0.933	11.491	2.118	2.166
United Kingdom	0.000	-0.018	0.000*	-0.020	0.767*	0.400*	0.947	15.582	16.201	19.803
United States	0.001*	-0.073	0.000*	-0.021	0.781*	0.325*	0.923	6.060	10.888	10.007

Note: * denotes significance at 5% level: The persistence of volatility is given by $\psi_i + \varphi_i + 0.5\gamma_i$. The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 3: DCC-GJRGARCH model results during the pre-crisis/stable period

African Markets	Mean equation		Variance equation					Diagnostic tests		
	μ	ϕ	ω	ψ	φ	γ	Persistence	LQ(12)	$LQ^2(12)$	LM(12)
Botswana	0.001*	0.294*	0.000	0.353*	0.377*	1.104	1.282	28.550*	3.402	3.347
BRVM	0.001*	0.392*	0.000*	2.626*	-0.011	0.614	2.922	13.292	2.698	2.472
Egypt	0.005*	0.083	0.000	0.183*	0.772*	-0.059	0.926	7.580	5.749	5.239
Ghana	0.001	0.449*	0.000	0.320*	0.657*	0.561*	1.258	35.417*	4.742	4.489
Kenya	0.002*	0.234*	0.000	0.457	0.374*	0.037	0.850	17.274	23.922*	25.049*
Mauritius	0.002*	0.163*	0.000*	0.428*	0.646*	-0.299	0.925	6.753	14.300	16.384
Morocco	0.002*	0.125	0.000*	0.436*	0.470*	-0.225	0.794	8.706	10.154	12.294
Namibia	0.002*	-0.157*	0.000	0.001	0.811*	0.113	0.869	8.301	12.705	15.772
Nigeria	0.003*	0.257*	0.000*	0.695*	-0.123*	-0.574*	0.285	13.949	5.860	5.751
South Africa	0.003*	-0.095	0.000	0.019	0.964*	-0.024	0.971	8.440	26.875*	26.345*
Tunisia	0.001*	0.062	0.000*	0.483*	0.554*	-0.459*	0.808	14.473	2.187	2.360
Uganda	0.002	-0.021	0.000*	0.217*	0.675*	-0.089	0.848	6.698	5.828	5.765
Zambia	0.005*	0.013*	0.001	-0.007	0.588	-0.026	0.568	1.625	0.063	0.060
Emerging Markets										
Brazil	0.003*	-0.122*	0.000	-0.081	0.669*	0.127	0.652	10.029	10.493	12.109
China	0.001	0.026	0.000	0.123	0.794*	-0.122	0.856	18.838	10.034	9.150
India	0.003*	0.160	0.000*	-0.090	0.355*	0.701*	0.616	11.497	10.738	9.373
Russia	0.004*	0.035	0.000	0.178	0.443	0.087	0.665	8.250	13.337	15.009
Developed Markets										
Australia	0.001*	0.095*	0.000*	-0.124*	0.443	0.065*	0.352	13.923	7.251	5.583
Canada	0.001*	-0.128*	0.000*	-0.289*	0.703*	0.427*	0.628	8.234	8.861	8.269
France	0.001*	-0.205*	0.000*	-0.099	0.689*	0.366*	0.773	5.070	4.065	4.828
Germany	0.002*	-0.156*	0.000*	0.032	0.726*	0.226	0.871	6.579	4.085	2.302
Hong Kong	0.002*	-0.080	0.000	0.055	0.954*	-0.057	0.981	4.853	3.353	3.461
Japan	0.002*	-0.061	-0.000	0.062*	1.006*	-0.110	1.013	4.899	7.695	8.046
Singapore	0.002*	-0.053	0.000	0.093*	0.903*	-0.052	0.970	6.601	5.118	5.393
Switzerland	0.001*	-0.082	0.000*	-0.008	0.615*	0.376*	0.795	10.982	5.364	6.131
United Kingdom	0.001*	-0.092	0.000*	-0.082	0.783*	0.341*	0.872	13.484	7.127	5.843
United States	0.001	-0.102*	0.000*	-0.091*	0.990*	0.099*	0.949	5.164	7.831	9.242

Note: * denotes significance at 5% level: The persistence of volatility is given by $\psi_i + \varphi_i + 0.5\gamma_i$. The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 4: DCC-GJRGARCH model results during the global financial crisis period

African Markets	Mean equation		Variance equation					Diagnostic tests		
	μ	ϕ	ω	ψ	φ	γ	Persistence	LQ(12)	$LQ^2(12)$	LM(12)
Botswana	-0.001*	0.386*	0.000*	-0.084*	1.033*	0.027	0.963	10.867	6.303	4.865
BRVM	0.000	0.142	0.000	0.173	0.687*	0.202	0.961	15.834	8.097	9.074
Egypt	0.000	0.024*	0.000*	-0.087	0.487*	0.703*	0.752	12.149	16.464	14.883
Ghana	0.000	0.347*	0.000	0.003	0.919*	0.071	0.958	22.973*	4.440	3.776
Kenya	0.000	0.029	0.000	0.038	0.582*	0.309	0.775	10.347	4.526	4.377
Mauritius	0.001	0.194*	0.000*	-0.173*	1.004*	0.211*	0.937	5.820	5.139	5.391
Morocco	0.000	0.119	0.000*	-0.041	0.783*	0.265*	0.875	9.627	5.413	7.152
Namibia	-0.000	-0.056	0.000*	-0.133	0.888*	0.355*	0.933	4.915	10.462	8.023
Nigeria	0.001	0.026	0.000	0.223	0.708*	0.076	0.969	9.582	8.155	7.463
South Africa	0.000	-0.050	0.000*	-0.140*	0.969*	0.303*	0.981	10.872	9.767	10.511
Tunisia	0.002*	-0.030	0.000*	-0.034	0.519*	0.270	0.620	16.217	11.295	10.744
Uganda	0.000	-0.114	0.000*	-0.096*	0.931*	0.244*	0.957	8.857	11.706	13.372
Zambia	0.001	0.380*	-0.000	0.045	1.025*	-0.086*	1.027	18.053	11.563	9.927
Emerging Markets										
Brazil	0.001	0.028	0.000*	-0.161	0.998*	0.262*	0.968	7.052	7.824	8.829
China	-0.002*	0.090	0.000*	-0.120*	1.022*	0.138*	0.971	9.844	9.781	8.523
India	0.001	0.044	0.000	-0.013	0.670*	0.259	0.787	18.420	9.567	9.543
Russia	-0.000	0.002	0.000	0.028	0.841*	0.219*	0.979	14.749	17.331	12.395
Developed Markets										
Australia	-0.001	0.098	0.000	-0.100	0.968*	0.186*	0.961	3.304	5.179	5.031
Canada	-0.001	0.012	0.000*	-0.134*	0.928*	0.317*	0.953	4.590	7.358*	6.806
France	-0.001	0.010	0.000	-0.140	0.778*	0.505*	0.891	20.675*	2.571	2.406
Germany	-0.000	0.041	0.000*	0.065	0.072	1.839*	1.057	16.069	17.215	15.343
Hong Kong	0.000	0.047	0.000	-0.053	0.581*	0.434*	0.745	7.578	11.204	12.433
Japan	-0.001*	0.101*	0.000*	-0.120*	0.565*	0.537	0.714	2.714	5.495	5.377
Singapore	-0.000	0.072	-0.000*	-0.096	0.989*	0.201*	0.994	8.984	10.626	11.275
Switzerland	0.000	-0.120	0.000*	-0.207	0.915*	0.284	0.850	12.451	2.783	2.429
United Kingdom	0.000	0.024	0.000*	-0.116	0.788*	0.443	0.894	22.244*	8.629	8.173
United States	0.000	-0.045	0.000*	0.110	0.171	0.862*	0.712	7.019	9.440	7.036

Note: * denotes significance at 5% level: The persistence of volatility is given by $\psi_i + \varphi_i + 0.5\gamma_i$. The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 5: DCC-GJRGARCH model results during the Eurozone crisis period

African Markets	Mean equation		Variance equation					Diagnostic tests		
	μ	ϕ	ω	ψ	φ	γ	Persistence	LQ(12)	$LQ^2(12)$	LM(12)
Botswana	0.000*	0.293*	0.000*	0.161	0.631*	0.320	0.952	15.928	6.475	6.718
BRVM	0.001	0.202*	0.000*	0.145	0.556*	-0.225	0.589	10.601	9.336	9.402
Egypt	-0.000	0.228*	0.000*	-0.068	0.674*	0.447*	0.830	14.425	18.100	14.440
Ghana	-0.001	-0.017	0.003	0.055	0.594	-0.063	0.618	1.676	0.066	0.065
Kenya	0.001	0.166*	0.000*	0.243	0.625*	-0.078	0.829	16.413	10.696	11.441
Mauritius	0.000	0.202*	-0.000	-0.013	1.017*	-0.015	0.997	6.288	18.889	19.052
Morocco	-0.000	0.110	0.000	-0.060*	0.639*	0.311*	0.735	8.398	4.298	4.835
Namibia	0.001	-0.031	0.000*	-0.135*	0.892*	0.161*	0.838	8.839	11.868	11.816
Nigeria	0.000	0.197*	0.000	0.092	0.678*	0.179	0.860	15.684	6.191	7.121
South Africa	0.001	-0.066	0.000*	-0.108*	0.865*	0.316*	0.915	14.434	5.152	4.917
Tunisia	0.000	0.316*	0.000	0.720	0.566	-0.505	1.034	16.078	8.148	9.137
Uganda	0.002*	-0.082	0.000*	0.035	0.872*	0.079	0.947	13.097	6.014	5.286
Zambia	0.001*	0.047	0.000*	0.272*	0.721*	-0.239	0.874	21.733*	12.189	13.619
Emerging Markets										
Brazil	-0.001	0.025	0.000	-0.033	0.866*	0.189*	0.928	11.546	11.951	12.396
China	0.000	-0.043	0.000*	-0.019	0.778*	0.269*	0.894	15.740	12.489	12.932
India	0.001	0.047	0.000	0.033	0.713*	0.204*	0.848	15.870	9.021	14.675
Russia	-0.000	0.054	0.000*	-0.105	0.813*	0.321*	0.869	7.399	16.481	19.416
Developed Markets										
Australia	0.000	-0.007	0.000*	-0.090*	0.681*	0.418*	0.800	21.124*	9.241	9.328
Canada	0.000	-0.041	0.000*	-0.019	0.766*	0.282	0.888	15.259	12.675	12.921
France	-0.000	0.021	0.000*	-0.049	0.774*	0.343*	0.897	4.305	3.414	6.809
Germany	0.000	0.014	0.000*	-0.006	0.666*	0.398*	0.859	5.526	3.137	3.156
Hong Kong	-0.000	-0.037	0.000	-0.030	0.937*	0.115	0.965	6.119	6.604	10.309
Japan	0.001	0.103	0.000*	-0.046	0.240	0.317*	0.353	13.769	4.077	5.038
Singapore	0.000	0.103	0.000*	-0.015	0.822*	0.272*	0.943	6.639	11.284	10.659
Switzerland	0.000	0.058	0.000*	-0.107*	0.185*	0.917*	0.537	7.637	14.266	16.500
United Kingdom	-0.000	0.023	0.000*	-0.127*	0.659*	0.622*	0.843	10.815	5.462	10.585
United States	0.000	-0.089	0.000*	-0.059	0.699*	0.473*	0.877	14.901	5.461	5.897

Note: * denotes significance at 5% level: The persistence of volatility is given by $\psi_i + \varphi_i + 0.5\gamma_i$. The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

7.3.2 The dynamic conditional correlation results

In this section, the study examines the properties of the dynamic conditional correlation between individual African stock markets and each of the major developed and emerging stock markets. The key advantage of the DCC-GJRGARCH model is that it allows the conditional correlation and volatility to vary over time so that their behaviours can be examined (Marshall, Maulana and Tang, 2009). The analysis of such behaviour provides good insight into the dynamic relationship between individual African markets and each of the emerging and developed markets across different periods. Specifically, the analysis of the dynamic conditional correlation in this section focuses on providing insight as to whether there is evidence of contagion or otherwise.

In analysing the behaviour of the conditional correlation, this study follows the evidence in the literature. For instance, if the DCC of a given Africa market with any of the emerging or developed markets is consistently higher than those of other African markets over time, it can be said that such an African market is more integrated with the global markets. Similarly, an upward trend in the DCC of an African market over the period would indicate increasing integration with the global markets (Syllignakis & Kouretas, 2011; Park & Lee, 2011 and Johansson, 2008). Consequently, the analysis of the DCC in this section will not only focus on the sign of the correlation but also on the size and the evolution of the conditional correlation across time. However, before proceeding with the analysis of the DCC, the section first begins with the discussion of the DCC parameters and then the analysis of the conditional correlation.

The estimated DCC parameters (α and β) are reported in Tables 7.6 – 79 below for different sample periods. The evidence from the tables shows that the estimated DCC parameters are highly significant in a number of African markets (particularly the β), suggesting a good deal of persistence in the conditional correlation. Also, the DCC parameters satisfied the stability condition which requires that $\alpha + \beta > 1$. This implies that the DCC-GJRGARCH specification is valid for modelling stock market returns between African markets and the major global markets. However, it is important to highlight that the α parameter is negative in a number of cases, which violates the non-negativity constraint of the DCC model. Nonetheless, the estimated DCC processes for each pair of markets have a different degree of innovation and persistence. As a result, restricting the parameter α and β to be the same for all markets may lead to a different result. Therefore, this study focuses on pairing individual African markets with each of the major emerging and developed markets.

Table 7.10 reports the average DCC ($\rho_{ij,t}$) value for each pair of African markets with emerging and developed markets across the four sample periods. It is noticeable that the average value of the conditional correlation varies significantly across markets and periods. Panel A of Table 7.10 reports the average DCC over the full-sample period. Evidence from panel A shows that Egypt, Mauritius, Morocco, Namibia, South Africa and Tunisia are highly correlated with the emerging and developed markets. In particular, the conditional correlations of Namibia and South Africa are very high, with a range between 0.2 (or 20%) and 0.7 (or 70%). Their conditional correlations with the developed markets are strongest. The second strongest conditional correlation is found in Egypt, Mauritius, Morocco and Tunisia. For Botswana, BRVM, Ghana, Kenya, Nigeria, Uganda and Zambia, their conditional correlations are weak. Further evidence from Panel A shows that the conditional correlations are mostly positive except for BRVM, Ghana and Botswana. The positive cross-markets conditional correlation points to evidence of co-movement between African markets and the major global markets.

Evidence during the pre-crisis period as reported in panel B shows that the highest average conditional correlation is found in Namibia and South Africa, with the conditional correlation ranging from 0.2 to 0.6. This finding indicates that Namibia and South Africa are more integrated with the major global markets than other African markets. The second highest average value is found in Egypt, Morocco and Tunisia, with average conditional correlations ranging from 0.1 to 0.2. The analysis over this period also shows that Botswana, BRVM, Ghana, Kenya and Uganda are negatively correlated with the major global markets. This means that these do not move in same direction as the global markets.

However, the analysis during the global financial crisis period reveals that the average value of the dynamic condition correlation increased across all the markets (see Panel C of Table 7.10). Again, the highest average conditional correlation is found in Namibia and South Africa, with a range between 0.1 and 0.7. The second highest average dynamic conditional correlation is found in BRVM, Egypt, Ghana, Mauritius and Tunisia. The lowest average value is reported in Kenya, Morocco, Nigeria and Uganda. Furthermore, most African markets are positively correlated with major developed and emerging markets during this period, signifying evidence of co-movement. The result over this period is consistent with the evidence in the literature in that a period of financial crisis is usually characterised by high correlation between markets (Hemche et al., 2016; Jin & An, 2016; Kenourgios, 2014; Gupta & Guidi, 2012 and Chiang et al., 2007).

Panel D of Table 7.10 reports the estimated average conditional correlation during the Eurozone crisis period. The evidence over this period shows that the average dynamic conditional correlation value is highest in Namibia and South Africa, with average values ranging between 0.3 and 0.7. The second highest average conditional correlation is observed in Egypt, Mauritius and Nigeria, with a range between 0.1 and 0.2. Also, the evidence shows that the average conditional correlation is mainly positive except for Botswana, Ghana and Tunisia. In contrast to the global financial crisis period, the average conditional correlation value over this period appears to be relatively lower. This result suggests that the global financial crisis generated more co-movement than the Eurozone crisis. In other words, the conditional correlation seems to have been more affected by the global financial crisis than the Eurozone crisis.

Furthermore, a visual impression of the behaviour of the dynamic conditional correlation of individual African markets against each of the major developed and emerging markets is presented in Figures 7.1 – 14 of Appendix E. The figures illustrate that the conditional correlations for all the pairs exhibit different magnitudes across the two crises and pre-crisis periods. However, a more notable pattern from the figures centres on the seeming persistence in the behaviour of the conditional correlation across African markets around the global financial crisis period. The conditional correlations display relatively rising co-movement at the beginning of the global financial crisis, which gradually declined toward the end. Specifically, strong persistence behaviour can be seen around the days of the Lehman Brothers' collapse in September 2008. Additionally, the behaviour of the conditional correlation appears to be highly volatile as evident from the volatility spikes during the global financial crisis compared to Eurozone crisis period. This behaviour may be associated with an unprecedented rise in fundamental uncertainty and speculative activities in African stock markets during the crisis period.

Overall, the analysis of the average conditional correlation across different time periods as reported in Table 7.10 reveals several interesting patterns. First, it is noticeable that the average values of the conditional correlations vary significantly over time and across markets. Second, African markets such as Egypt, Mauritius, Morocco, Namibia, South Africa and Tunisia are more correlated with the major developed and emerging markets. More specifically, Namibia and South Africa are more integrated with the global markets than any other African markets. Third, the dynamic correlations between Africa and the developed markets appear to be generally higher compared to correlations between the African and emerging markets. Fourth, there is a presence of positive cross-market dynamic correlation, which points to evidence of co-movements between African markets and the global market. Fifth, with a few exceptions, the conditional correlation of African markets with the global market is generally low, which provides an opportunity for possible diversification. Sixth and interestingly, the conditional correlations appear to be higher during the global financial crisis period compared to the pre-crisis and Eurozone crisis periods. Also, the observed correlations during the Eurozone crisis appear relatively higher than those observed during the pre-crisis period.

The increase in correlation during the two crises periods is consistent with the evidence from the unconditional correlation as shown in Table 6.5 – 6.8. This result suggests that co-movement between African markets and the global markets increased during the crisis period. An important implication of the increased dynamic correlation during the crisis period, from an investor's perspective, is that the benefit from market-portfolio diversification diminishes as holding a portfolio with diverse country assets is subject to systematic risk. While the significant co-movement during crisis period highlights poor diversification benefits from portfolios including African financial assets, the lower dynamic correlation of most African markets with the major markets provides some support for diversification and investing in African financial assets. In addition, the lower conditional correlation of African markets with the global markets may suggest that African markets are receivers rather than transmitter of financial shock.

Although the conditional correlations between African markets and the global markets appear to have increased during crises periods relative to the pre-crisis, such increases may not be deemed as evidence of contagion, without considering the two conditions stipulated Chapter Four, as well as empirically testing whether there is evidence of significant increases in correlation. To this end, the next section examines whether the increase in conditional correlation is as a result of contagion or not.

Table 7. 6: DCC parameters during the full-sample period

African Markets	DCC	Emerging Markets				Developed Markets									
		Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singa-pore	Switzer-land	United Kingdom	United States
Botswana	α	-0.010	0.028	-0.023	0.021	0.049	0.017	0.050	-0.005*	0.048	0.040	-0.022*	-0.014*	0.071	0.029
	β	0.876*	0.469	0.920*	0.688*	0.317	0.587	0.481	1.003*	0.478	0.436	0.925*	0.982*	0.444	0.598
BRVM	α	0.041	0.067	0.088	0.038	0.017	0.017	-0.005	0.007	-0.012*	0.054	0.032	-0.010*	0.017	-0.004
	β	0.875*	-0.170	0.416	0.877*	0.845*	0.808*	1.002*	0.871*	0.377	0.508	0.873*	0.543	0.919*	0.959*
Egypt	α	-0.012	-0.032	0.010	-0.023	0.030	-0.032*	-0.020	0.006	0.013	0.013	0.018	0.019	0.002	-0.037*
	β	0.935*	0.103	0.900*	0.693	0.897*	0.459	0.481	0.975*	0.873*	0.969*	0.889*	0.946*	0.975*	0.762*
Ghana	α	-0.003*	0.374*	0.033	-0.002*	0.120*	0.329	-0.002*	-0.002*	-0.002*	-0.003	0.005	-0.002*	-0.003*	-0.004
	β	0.906	0.396	-0.090	0.750*	-0.019*	0.143	0.806*	0.794*	0.818*	0.994*	0.942	0.807	0.985*	0.985*
Kenya	α	-0.008	0.002	0.010	0.018	-0.009*	0.000	-0.020	-0.003	-0.003	-0.011	-0.009	-0.006	-0.027	-0.009
	β	0.781*	0.942*	0.880*	0.857*	0.989*	0.940	-0.279	0.641	0.751	0.584	0.757*	0.793*	-0.131	0.729*
Mauritius	α	0.036	0.004	-0.025	0.044*	0.034	-0.003	0.026	0.069*	0.053	0.119*	0.004	0.033	0.017	0.037
	β	0.193	0.981*	0.659	0.016	0.900*	0.734	0.908*	0.635*	0.506	0.544*	0.984*	0.916*	0.894*	0.758*
Morocco	α	0.025	0.005	0.023	0.014	0.063	0.021	0.019	0.022	0.065	0.028	0.019	0.021	0.008	0.030
	β	0.751*	0.959*	0.935*	0.928*	0.827*	0.899*	0.866*	0.866*	0.723*	0.854*	0.804*	0.907*	0.836*	0.820*
Namibia	α	0.047*	0.154*	0.136*	0.035*	0.029	-0.006	0.017	0.034	0.050	0.012	0.038	0.020	0.075	0.026
	β	0.917*	0.050	-0.123	0.936*	0.888*	0.739	0.924*	0.908*	0.658*	0.975*	0.863*	0.972*	0.216	0.904*
Nigeria	α	-0.018	-0.043*	-0.034	-0.011*	-0.036*	-0.007	-0.023*	-0.034*	0.010	-0.040*	-0.042*	0.013	-0.032	-0.042*
	β	0.539	0.454	0.744*	1.002*	0.730*	1.001*	0.808*	-0.667	0.954*	0.676*	0.581*	0.939*	0.787	0.782*
South Africa	α	0.052*	0.120*	0.043	0.028*	0.033	0.012	0.048*	0.061*	0.013	0.040	0.051*	0.033*	0.018*	0.031*
	β	0.933*	0.091	0.752*	0.967*	0.897*	0.879*	0.909*	0.904*	0.988*	0.880*	0.845*	0.956*	0.981*	0.936*
Tunisia	α	0.102*	0.039	0.031	0.058	0.030*	0.099*	0.017	0.120*	0.026	0.053*	0.013	0.025	0.011	0.033
	β	0.577*	0.461	0.877*	0.461	0.956*	-0.125	0.965*	-0.028	0.330	0.708*	0.978*	0.959*	0.968*	-0.383
Uganda	α	-0.008	0.028	-0.018	-0.014	-0.035*	-0.008*	0.071	0.075	-0.024	-0.039*	-0.038*	0.118	0.010	-0.014
	β	0.647	0.894*	0.972*	0.756*	-0.685*	1.002	-0.023	0.071	-0.814*	0.792*	0.516	0.083	0.925*	0.715*
Zambia	α	0.048	0.064	0.308	0.038	0.030	0.044	0.077	0.043	0.079	0.013	0.085	0.129	0.098	0.129
	β	0.699	0.633	0.127	-0.082	0.869*	0.787*	0.741*	0.826*	0.827*	0.778*	0.841*	0.776*	0.807*	0.678

Note: * denotes significance at 5% level: The model stability requires that $\alpha_i + \beta_i < 1$.

Source: Author's computation

Table 7. 7: DCC parameters during the pre-crisis/stable period

African Markets	DCC	Emerging Markets				Developed Markets									
		Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singa-pore	Switzer-land	United Kingdom	United States
Botswana	α	-0.031*	-0.017	0.030	-0.030	-0.025	-0.045*	-0.045*	-0.030*	0.046	-0.029*	-0.050*	-0.029*	-0.027*	-0.030*
	β	0.688	0.914*	0.671	-0.805	0.997*	1.007*	1.003*	0.542	0.614	0.728	0.995*	0.553	1.005*	0.976*
BRVM	α	0.040	0.024	0.133	-0.005	0.049	0.010	0.059	0.058	0.080	0.058	0.058	-0.014	0.029	-0.017*
	β	0.845*	0.097	0.190	0.677	0.912*	0.874*	0.856*	0.831*	0.761*	0.769*	0.836*	1.003*	0.901*	0.732
Egypt	α	-0.047*	-0.032*	-0.038*	-0.041*	-0.030	-0.052	-0.037	-0.044*	-0.048*	-0.011	-0.037*	-0.029	-0.037	-0.022*
	β	0.930*	0.999*	0.899*	0.983*	0.642	0.462	0.879*	0.951*	0.625	0.853*	0.691*	0.826*	0.831*	0.992*
Ghana	α	0.052	0.020	-0.010	-0.028	-0.031*	-0.021*	-0.025*	-0.022*	-0.030*	0.149*	0.279*	-0.023*	0.051	-0.020
	β	0.600	0.856*	0.776	1.000*	0.996*	0.996*	0.993*	0.993*	0.986*	-0.167*	-0.082	0.990*	-0.091	0.872*
Kenya	α	-0.040*	-0.047*	-0.022	-0.024*	-0.032*	-0.042	-0.040*	-0.036*	-0.037*	-0.037*	-0.028*	-0.026	-0.020*	-0.030*
	β	0.889*	0.654*	0.818*	0.999*	0.999*	0.839*	0.733*	0.729*	0.885*	0.969*	0.953*	0.854*	0.998*	1.001*
Mauritius	α	0.049	0.107	0.005	-0.084	0.008	-0.058*	0.088	-0.051*	0.041	0.066*	-0.007	-0.031	-0.028	-0.038*
	β	0.175	0.013	0.820	1.009*	0.448	0.847*	0.173	0.950*	0.501	-0.815*	1.002*	0.999*	0.951*	0.995*
Morocco	α	0.020	-0.019	-0.023	0.009	0.052	-0.048*	0.021	-0.053*	0.141	-0.013	0.034	0.008	-0.031	-0.052*
	β	0.664	0.863*	-0.199	0.943*	0.804*	0.543	0.856*	0.090	0.309	0.234	0.686*	0.804*	0.427	0.212
Namibia	α	0.021	0.195	-0.029	0.012	0.030	-0.006	0.006	0.032	-0.021*	0.007	-0.026	0.019	0.018	0.008
	β	0.974*	0.092	0.995*	0.901*	0.782*	0.938*	0.926*	0.918*	1.000*	0.855*	0.414	0.862*	0.965*	0.971*
Nigeria	α	-0.007	-0.035*	-0.033	0.072	0.061	-0.014	-0.015*	0.022	0.044	0.008	-0.038*	-0.007	-0.044	-0.029
	β	0.810	0.860*	0.924*	-0.222	-0.026	0.869	1.007*	0.954*	0.653*	0.919*	0.644	0.856	0.728	0.180
South Africa	α	0.016	0.234*	-0.030*	0.037	0.028	-0.027	0.055	0.076	-0.025	0.020	0.004	0.020	0.048	0.029
	β	0.979*	0.020	0.993*	0.730*	0.790*	0.918*	0.773*	0.836*	0.957*	0.843*	0.971*	0.844*	0.859*	0.859*
Tunisia	α	0.037	0.022	0.032	-0.065*	-0.020	-0.044*	-0.030*	-0.046	-0.022	-0.047*	-0.015	0.016	-0.030	-0.035*
	β	0.674*	0.505	0.737*	1.003*	1.006*	1.004*	0.417	0.987*	0.991*	0.998*	0.999*	0.907*	0.988*	0.991*
Uganda	α	-0.066*	0.025	0.139	-0.020	-0.072*	-0.052	-0.035	-0.039*	0.026	-0.036	-0.035	-0.028	-0.008	-0.012
	β	0.998*	0.906*	0.105	1.002*	1.001*	0.995*	0.999*	0.911*	0.323	0.960*	0.758*	0.950*	0.896*	1.004*
Zambia	α	0.148	0.178	-0.007	0.031	-0.064*	-0.011*	-0.035	0.198	0.485	-0.002	0.072	0.275	0.088	0.396
	β	0.672*	0.668	0.387	-0.229	0.999*	0.716	0.990*	-0.029	0.009	0.242	0.854*	0.536	0.663	-0.018

Note: * denotes significance at 5% level: The model stability requires that $\alpha_i + \beta_i < 1$.

Source: Author's computation

Table 7. 8: DCC parameters during the global financial crisis period

African Markets	DCC	Emerging Markets				Developed Markets									
		Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singa-pore	Switzer-land	United Kingdom	United States
Botswana	α	0.035	0.023	-0.001	0.101	0.048	0.061	0.070	0.055	-0.051*	-0.036*	-0.061*	0.036	0.081	0.049
	β	0.918*	0.891*	0.536	0.725*	0.859*	0.891*	0.828*	0.843*	0.949*	1.002*	0.514	0.783*	0.843*	0.812*
BRVM	α	0.020	-0.018	0102	0.080	-0.045*	-0.022	-0.008	0.009	0.011	0.015	0.039	-0.024*	0.026	0.034
	β	0.900*	0.684	0.628	0.830*	0.754*	0.393	0.808	0.409	0.884*	0.889*	0.848*	0.153	0.894*	0.906*
Egypt	α	0.036	0.015	0.006	0.170	0.028	-0.024	0.004	0.107	0.019	-0.020	0.025	0.035	0.038	0.071
	β	0.839*	0.796*	0.815	0.695*	0.859*	1.003*	0.843	0.175	0.914*	1.001*	0.879*	0.836*	0.750	0.076
Ghana	α	-0.038	0.087	-0.051*	0.071	-0.050*	-0.018	-0.027*	-0.012	-0.021	0.005	-0.045*	-0.023	-0.038	-0.054*
	β	0.980*	-0.791*	0.727*	0.909*	0.757*	0.883*	0.751	0.870*	0.625	0.888*	0.855*	0.702	0.790	0.872*
Kenya	α	0.180	0.007	0.119	0.040	0.033	0.031	0.022	0.123	0.041	0.024	0.057	0.037	0.035	0.037
	β	0.240	0.762	0.437	0.824*	0.888*	0.917*	0.864*	0.251	0.858*	0.604	0.863*	0.665	0.881*	0.799*
Mauritius	α	-0.035*	-0.035*	-0.030*	-0.051*	-0.016	0.077	-0.015	-0.086	-0.028	0.033	-0.042*	-0.013	-0.018	0.018
	β	1.001*	0.998*	0.976*	0.996*	0.381	-0.164	0.592	1.005*	0.432	0.254	0.387	0.490	0.665	0.953*
Morocco	α	0.111	0.039	0.069	0.081	0.101	0.097	0.147	0.074	0.075	0.108	0100	0.068	0.099	0.057
	β	0.615*	0.847*	0.844*	0.787*	0.740*	0.693*	0.163	0.752*	0.841*	0.675*	0.753*	0.617	0.665*	0.792*
Namibia	α	0.095	-0.040*	0.228*	0.059	0.055	0.233*	0.207	0.113	0.035	0.047	0.151	0.033	0.131	0.154*
	β	0.728*	0.947*	0.030	0.593	0.393	-0.273*	0.233	0.436	0.487	0.510	0.128	0.959*	0.080	0.446
Nigeria	α	-0.062*	-0.042	-0.035*	-0.008	-0.041*	-0.005	-0.030*	0.009	0.010	0.037	-0.038	-0.010	-0.028*	0.017
	β	0.506*	0.998*	1.002*	1.009*	0.722*	1.011*	0.660	0.958*	0.958*	0.945*	0.826*	1.006*	0.832*	0.947*
South Africa	α	0.084	-0.006	0.050	0.051	0.009	-0.033	0.046*	0.093	0.069	0.044	0.043	0.061*	-0.017	0.132
	β	0.841*	0.912*	0.736	0.706*	0.928*	0.936*	0.962*	0.729*	0.665	0.849*	0.770*	0.944*	0.870*	0.705*
Tunisia	α	0.161	0.118	0.291*	0.075	0.089	-0.040*	0.102	0.212*	0.133	0.132	0.116	-0.016	-0.028	0.183
	β	0.382	0.680*	0.044	0.245	0.461	1.008*	0.133	0.370	0.173	0.492*	0.351	1.023*	1.004*	0.070
Uganda	α	-0.043	-0.041*	-0.037	-0.031	0.017	-0.029	0.050	0.009	-0.027	-0.049	-0.048*	0.248*	0.047	0.005
	β	0.311	0.988*	0.758*	0.915*	0.862*	0.943*	0.699	0.625	0.510	0.389	0.831*	0.385*	0.487	0.704
Zambia	α	-0.060	0.083	0.070	0.033	0.050	0.012	0.016	0.049	0.038	0.083	0.063	0.029	0.067	0.026
	β	0.985*	0.719*	0.872*	0.801*	0.800*	0.845*	0.858*	0.871*	0.846*	0.738*	0.828*	0.833*	0.875*	0.854*

Note: * denotes significance at 5% level: The model stability requires that $\alpha_i + \beta_i < 1$.

Source: Author's computation

Table 7. 9: DCC parameters during the Eurozone crisis period

African Markets	DCC	Emerging Markets				Developed Markets									
		Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singa-pore	Switzer-land	United Kingdom	United States
Botswana	α	-0.018	-0.009	0.092	0.050	0.014	-0.018	-0.011	-0.030*	-0.027	0.183	0.054	0.014	-0.023*	-0.010
	β	0.699	0.849	0.452	0.554	0.926*	0.940*	1.001*	0.990*	0.941*	0.232	0.369	0.619	0.997*	1.001*
BRVM	α	0.028*	-0.064*	0.012	0.019	0.037	-0.022	-0.015	-0.040*	-0.033	-0.064*	-0.040	-0.037	-0.037*	-0.018
	β	0.957*	0.992*	0.640	0.969*	0.739*	0.962*	0.807*	0.946*	0.725*	0.773*	0.687	0.918*	0.869*	0.806*
Egypt	α	0.005	-0.028	0.074	-0.008	0.027	0.004	0.024	0.092	0.071	0.062	0.044	-0.026	0.032	-0.036
	β	0.976*	0.997*	0.713*	1.003*	0.587	0.824	0.282	0.304	0584	0.854*	0.837*	0.994*	0.653	0.984*
Ghana	α	0.223	0.315	0.271	0.113	0.221	0.629*	0.111	-0.003	0.277	0.364*	-0.008	-0.051	0.034	0.295*
	β	-0.003	0.388	0.539	0.269	0.711*	0.159	0.833*	0.670	0.575	0.603*	0.004	0.652	0.154	0.698*
Kenya	α	-0.037*	0.124	-0.061	0.016	-0.059*	-0.040*	-0.069*	0.024	-0.056*	-0.046	0.011	-0.051	-0.043*	0.024
	β	1.004*	0.407	0.397	0.883*	0.327	0.553	0.470	0.918*	0.771*	0.707*	0.635	0.977*	0.507	0.904*
Mauritius	α	0.010	0.133	-0.049*	0.049	-0.019*	-0.020*	0.019	0.039	0.063	-0.017	0.143	0.070	0.022	0.011
	β	0.887	0.185	0.853*	0.737*	1.005*	1.005*	0.865*	0.715*	0.364	0.952*	-0.318	0.796*	0.862*	0.685
Morocco	α	0.018	-0.023	0.025	-0.039	0.065	0.044	0.015	0.006	0.013	-0.066*	-0.043	0.038	0.027	-0.009
	β	0.947*	0.798*	0.906*	0.749*	0.746*	0.862*	0.874*	0.887*	0.854*	0.588*	0.556	0.879*	0.879*	0.668
Namibia	α	0.019	0.022	0.033	0.009*	0.012	0.022	0.120	0.059	-0.056*	-0.031	-0.016	-0.012	-0.004	-0.022
	β	0.956*	0.079	0.792*	0.969*	0.938*	0.900*	0.807*	0.643	0.876*	0.504	0.464	1.004*	1.003*	0.745*
Nigeria	α	-0.028	-0.045	-0.046	0.023	-0.023	-0.044	-0.042*	-0.041*	-0.026	-0.079*	-0.020	-0.057*	-0.032	-0.071*
	β	0.721	0.622	0.778*	0.867*	0.757*	0.673*	0.788*	1.003*	0.763*	0.999*	0.909*	0.826*	0.980*	0.891*
South Africa	α	0.057*	0.010	0.039	0.033	0.042	0.015	0.111*	0.149*	0.016	0.028	0.083	0.044	0.067	-0.012
	β	0.935*	0.974*	0.870*	0.951*	0.876*	0.909*	0.740*	0.742*	0.891*	0.942*	0.765*	-0.891*	0.767*	0.692*
Tunisia	α	0.041	0.023	0.010	0.012	0.038*	0.018	0.051	0.010	-0.022*	0.035	0.025	0.018	0.028	0.021
	β	0.922*	0.572	0.939*	0.974*	0.974*	0.973*	0.929*	0.961*	0.874*	0.926*	0.939*	0.958*	0.921*	0.916*
Uganda	α	0.028	0.100	-0.037*	0.012	0.029	-0.020*	-0.021*	-0.013	-0.040*	-0.042*	0.003	0.014	-0.019*	-0.043*
	β	0.821*	0.446	-0.489	0.913*	0.722*	1.005*	1.000*	0.629	0.454	0.016	0.847	0.890*	1.002*	0.533
Zambia	α	-0.009	-0.032	0.078	0.026*	0.054	-0.022*	-0.008	0.135	-0.034*	-0.012*	-0.021*	-0.013	-0.016	-0.019*
	β	1.006*	0.879*	0.060	1.002	-0.332*	0.999*	1.004*	0.081	0.981*	1.008*	1.000*	0.703	0.958*	1.004*

Note: * denotes significance at 5% level: The model stability requires that $\alpha_i + \beta_i < 1$.

Source: Author's computation

Table 7. 10: Average dynamic conditional correlation across all the sample periods

Panel A: Full-sample period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	-0.014	0.051	0.005	0.098	-0.023	0.016	0.010	0.004	0.027	-0.006	-0.002	0.001	0.009	-0.015
BRVM	-0.057	-0.021	-0.015	-0.088	-0.026	-0.034	-0.013	0.008	-0.011	-0.024	-0.053	-0.007	-0.035	-0.006
Egypt	0.162	0.134	0.196	0.192	0.191	0.169	0.193	0.172	0.216	0.195	0.196	0.193	0.170	0.115
Ghana	0.006	-0.021	0.062	0.014	0.036	0.053	-0.010	0.008	-0.039	-0.043	-0.049	-0.014	-0.014	-0.017
Kenya	0.091	0.081	0.041	0.041	0.033	0.030	0.047	0.032	0.117	0.059	0.075	0.044	0.036	0.068
Mauritius	0.113	0.107	0.209	0.085	0.206	0.107	0.148	0.137	0.220	0.177	0.203	0.198	0.116	0.135
Morocco	0.113	0.031	0.147	0.117	0.109	0.117	0.087	0.098	0.110	0.058	0.144	0.112	0.100	0.082
Namibia	0.557	0.217	0.443	0.471	0.584	0.635	0.604	0.587	0.497	0.473	0.514	0.550	0.656	0.563
Nigeria	0.028	0.059	0.039	0.073	0.025	0.037	0.074	0.075	0.082	0.047	0.083	0.069	0.072	0.051
South Africa	0.588	0.208	0.492	0.518	0.637	0.685	0.638	0.623	0.531	0.492	0.520	0.572	0.703	0.611
Tunisia	0.095	0.020	0.062	0.054	0.097	0.056	0.099	0.113	0.058	0.083	0.101	0.136	0.113	0.078
Uganda	0.005	0.087	0.021	-0.006	0.013	-0.020	0.033	0.018	0.025	0.095	0.012	0.083	0.042	0.036
Zambia	0.071	0.064	0.020	-0.009	-0.018	0.051	0.042	0.016	-0.011	0.000	0.040	0.007	0.009	0.018
Panel B: Pre-crisis/stable period														
Botswana	-0.083	0.029	-0.015	-0.114	-0.109	-0.100	-0.003	0.016	0.050	-0.026	0.006	0.017	0.075	-0.036
BRVM	-0.049	-0.120	-0.002	-0.146	0.008	0.021	-0.001	0.026	0.027	-0.025	-0.083	-0.053	0.010	-0.000
Egypt	0.111	0.121	0.138	0.165	0.106	0.122	0.127	0.104	0.137	0.153	0.143	0.154	0.085	0.136
Ghana	0.060	0.025	-0.063	-0.125	-0.068	-0.040	-0.011	0.024	0.011	-0.039	-0.022	-0.031	-0.058	0.002
Kenya	0.035	0.100	-0.055	-0.029	0.022	-0.014	0.034	-0.024	0.039	-0.095	-0.013	-0.008	0.092	-0.002
Mauritius	0.032	0.128	0.092	-0.048	0.041	-0.047	-0.014	-0.022	0.054	-0.038	0.130	0.048	-0.049	0.115
Morocco	0.096	0.057	0.258	0.147	0.175	0.105	0.140	0.177	0.153	0.132	0.213	0.213	0.160	0.167
Namibia	0.448	0.232	0.338	0.363	0.515	0.625	0.595	0.540	0.314	0.450	0.457	0.538	0.613	0.559
Nigeria	0.008	-0.005	0.015	0.051	0.023	0.021	0.068	-0.003	0.036	0.002	0.046	0.066	0.047	0.006
South Africa	0.470	0.230	0.499	0.407	0.583	0.633	0.605	0.542	0.456	0.495	0.482	0.564	0.634	0.581
Tunisia	0.039	-0.004	0.095	-0.093	0.116	0.062	0.131	0.168	0.113	0.061	0.276	0.200	0.157	0.157
Uganda	-0.140	0.050	0.103	-0.177	0.047	-0.033	-0.045	-0.052	0.015	0.010	-0.043	-0.002	0.022	-0.128
Zambia	0.081	0.090	0.031	-0.010	-0.028	0.033	0.059	0.035	0.069	0.003	0.082	0.040	0.056	0.087

Panel C: Global financial crisis period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	-0.033	0.108	-0.035	-0.094	-0.022	0.025	-0.010	-0.053	0.011	0.122	-0.029	0.007	-0.048	-0.034
BRVM	-0.163	0.036	-0.118	-0.097	-0.061	-0.118	-0.125	-0.111	-0.034	-0.143	-0.048	-0.040	-0.117	-0.155
Egypt	0.223	0.164	0.381	0.291	0.365	0.200	0.383	0.329	0.277	0.429	0.275	0.367	0.283	0.229
Ghana	0.116	-0.083	-0.023	0.100	0.164	0.160	0.156	0.167	0.061	0.070	0.140	0.136	0.175	0.045
Kenya	0.044	0.093	0.119	0.072	0.052	0.073	0.068	0.052	0.091	0.188	0.146	0.059	0.062	0.012
Mauritius	0.334	0.242	0.359	0.238	0.427	0.293	0.349	0.351	0.451	0.461	0.365	0.352	0.297	0.210
Morocco	0.086	0.026	0.062	0.056	0.031	0.061	0.006	0.008	0.052	0.019	0.081	-0.046	0.001	-0.026
Namibia	0.559	0.079	0.382	0.540	0.586	0.619	0.578	0.582	0.531	0.582	0.539	0.535	0.607	0.513
Nigeria	-0.010	0.055	0.139	0.055	-0.032	0.055	0.010	0.013	-0.056	0.007	-0.022	0.043	0.003	-0.042
South Africa	0.655	0.101	0.394	0.582	0.590	0.625	0.632	0.628	0.533	0.558	0.526	0.523	0.712	0.568
Tunisia	0.204	0.005	0.109	0.136	0.291	0.220	0.289	0.217	0.111	0.190	0.130	0.146	0.147	0.183
Uganda	-0.024	0.044	0.019	0.008	-0.012	0.022	0.020	0.052	-0.025	0.018	0.085	0.065	0.018	0.013
Zambia	-0.060	-0.027	-0.015	-0.004	-0.125	-0.057	-0.107	-0.055	-0.146	-0.128	-0.073	-0.115	-0.134	-0.090
Panel D: Eurozone crisis period														
Botswana	0.019	0.004	0.005	0.098	-0.087	-0.026	-0.126	-0.053	-0.046	-0.003	-0.063	-0.040	-0.119	-0.104
BRVM	0.007	0.081	0.044	0.026	-0.032	-0.017	0.065	0.044	0.030	0.073	0.037	0.052	0.081	0.081
Egypt	0.126	0.123	0.126	0.120	0.123	0.161	0.116	0.087	0.181	0.113	0.136	0.050	0.122	0.114
Ghana	-0.036	-0.041	0.099	0.002	0.015	0.053	-0.061	-0.013	-0.094	-0.056	-0.109	-0.034	-0.062	-0.068
Kenya	0.115	0.046	0.057	0.061	0.052	0.065	0.014	0.043	0.169	0.065	0.096	0.090	0.088	0.098
Mauritius	0.053	-0.029	0.156	0.071	0.291	0.192	0.157	0.143	0.148	0.214	0.193	0.181	0.121	0.180
Morocco	0.103	-0.042	0.046	0.088	0.078	0.137	0.077	0.083	0.084	0.028	0.093	0.082	0.105	0.089
Namibia	0.607	0.319	0.449	0.565	0.637	0.659	0.523	0.652	0.553	0.455	0.546	0.578	0.681	0.616
Nigeria	0.034	0.089	0.026	0.078	0.038	0.020	0.114	0.167	0.172	-0.029	0.143	0.152	0.169	0.146
South Africa	0.583	0.306	0.519	0.546	0.686	0.682	0.662	0.673	0.594	0.459	0.519	0.623	0.759	0.665
Tunisia	-0.052	0.049	-0.014	-0.028	-0.099	-0.130	-0.078	-0.031	-0.027	-0.021	-0.058	-0.027	-0.019	-0.045
Uganda	0.099	0.070	0.003	0.005	-0.004	0.078	0.126	0.047	0.093	0.108	0.021	0.129	0.164	0.101
Zambia	0.035	0.031	-0.019	-0.101	0.032	0.042	-0.009	0.042	-0.031	0.022	-0.060	0.024	0.076	0.017

Source: Author’s computation

7.3.3 Testing for evidence of contagion

An important consideration when analysing evidence of contagion is the increase in correlations during a particular crisis period relative to the pre-crisis period. The evidence from the above analysis of DCC reveals different magnitudes of conditional correlations across the two crises and pre-crisis periods. However, concluding that such an increase is because of contagion will not be robust without empirically investigating whether the observed increase in the conditional correlation during each crisis period is statistically different from the conditional correlation during the pre-crisis period. For this purpose, this study utilised the t-statistics test of equivalent correlation between crisis periods and the pre-crisis period as provided in equation (31) in Chapter Five. In order to analyse evidence of contagion, this study assumes that the major developed and emerging markets are the sources of contagion for both crises.

Table 7.11 presents the results of the t-statistics test for equivalent correlation during the two crises periods in panelA and B. The evidence presented in the table provides strong support for a significant increase in correlation during the two crises periods since the null hypothesis that the average conditional correlations are the same in crisis and pre-crisis periods is rejected for most African markets. Specifically, markets such as Egypt, Ghana, Kenya, Mauritius and Namibia experienced significant increase in correlation with global markets compared to any other African markets during the global financial crisis (see panel A).

Considering the fact that the 2007 global financial crisis originated from the United States, panel A shows evidence of a significant increase in correlation between the United States and African markets such as Egypt, Ghana, Mauritius, Tunisia, and Uganda. This finding is in line with the studies by Hemche et al., (2016). The authors found evidence of contagion between the United States and Egypt during the global financial crisis. A study by Celik (2012) found no evidence of contagion between the United States and South Africa. Similarly, evidence of increased correlation was document between the United Kingdom Egypt, Ghana, Mauritius and South Africa. The developed European and Asian markets have significant correlations with Egypt, Ghana, Kenya and Mauritius during the global financial crisis. In the emerging markets, the correlation between Russia and African markets exhibited significant increases (apart from BRVM, Morocco and Zambia) during the global financial crisis. These findings provide strong support for the contagion phenomenon during the global financial crisis period.

However, African markets such as Botswana, BRVM, Morocco, Nigeria and Zambia seem to have decoupled from the global markets with a significant negative decrease in correlation during the global financial crisis. For instance, the test result between the United States and African markets such as BRVM, Morocco, Namibia, Nigeria, South Africa and Zambia, shows that correlations declined significantly during the global financial crisis period. However, the majority of these African markets were affected by contagion through other developed and emerging markets as shown in panel A.

Furthermore, panel B reveals evidence of a significant increase in correlation between African markets (such as BRVM, Kenya, Mauritius, Namibia, Nigeria, South Africa and Uganda) and major global markets during the Eurozone crisis period. There is evidence of a significant increase in correlation between the United States and African market such as BRVM, Kenya, Mauritius, Namibia, Nigeria, South Africa and Uganda. The result also reveals increased correlations between European markets and African markets. For instance, correlations between the United Kingdom and African markets such as BRVM, Egypt, Mauritius, Namibia, Nigeria, South Africa, Uganda and Zambia, showed an increase. The French market has significant correlation with BRVM, Nigeria, South Africa and Uganda. Likewise, the German market is significantly correlated with BRVM, Ghana, Kenya, Mauritius, Namibia, Nigeria, South Africa and Uganda.

For the emerging markets, evidence in panel B reveals that most African markets experienced increased correlation with Brazil, India and Russia compared to China. For instance, African markets, with the exception of Ghana, Morocco and Tunisia, exhibited a significant increase in correlation with the Brazilian market. Similarly, the Russian market exhibits significant correlation with African markets except for Egypt, Morocco, Tunisia, and Zambia. Likewise, the Indian market has a similar correlation with African markets except for Uganda. The correlations between China and African markets are significant for BRVM, Namibia, Nigeria, South Africa, Tunisia, and Uganda.

In addition, the result in panel B indicates evidence of decoupling for Botswana, Egypt, Ghana, Morocco, Tunisia and Zambia with the global markets during the Eurozone crisis period. These African markets exhibited strong isolation characteristics since their correlations with the global markets appear to have declined during the Eurozone crisis. This result suggests that these markets had limited exposure to external shocks during the Eurozone crisis periods.

Overall, the analysis in the present section shows strong evidence in favour of contagion, given that there is a statistically significant increase in correlation between African markets and the major developed and emerging markets. This evidence is identified by the significant positive t-statistics during both crisis periods. This finding is in line with earlier studies that found evidence of contagion during crisis periods (Bonga-Bonga, 2017; Hemche et al., (2017; Mollah et al., 2016; Gupta & Guidi, 2012 and Celik, 2012). Moreover, the propagation of contagion during the global financial crisis period is found to be much stronger through the developed markets compared to the emerging markets. Also, there is evidence that contagion during both crises not only spread to African markets through the initial crisis country but also through other markets. This finding suggests that financial market integration, together with financial vulnerabilities, could to account for the differences in the contagious effect across different African markets. In other words, indirect linkages of individual African markets with the initial crisis country contributed to the contagion effect.

Generally, the significant increase in correlation indicates that contagion is a common phenomenon during a crisis period, which could give rise to business cycle synchronisation between African and the global markets. Based on this finding, evidence of decoupling hypothesis during the global financial crisis is not supported. This finding is in line with early studies by Trancoso (2014), Bekiro (2013), WäIti (2012), and Dooley and Hutchison (2009). Finally, having described the dynamic behaviour of conditional correlation across markets and time, it is thus interesting to investigate evidence of volatility spillover from the global markets to African markets. To this end, the following section will shed some light on the evidence of volatility transmission before, during and after each crisis period.

7.4 Estimation of the aggregate shock (AS) model

The main objective in this section is to investigate how shocks from the major global markets are transmitted to individual African markets. To achieve this objective, this study utilised the AS model within the framework of univariate EGARGH model. As noted in Chapter Five, the model provides a way to formally test the evidence of mean and variance spillover effects as well as analysing the volatility characteristics of each market. Therefore, the analysis of the AS-EGARCH model results in this section is divided into three parts. The first part deals with the analysis of the volatility characteristics from the AS-EGARCH model across all the markets and periods. The second part reports and analysed the mean spillover effects while the third part analysed the volatility spillover effects.

Table 7. 11: T-statistics test results

Panel A: Global financial crisis period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	5.99*	20.61*	-280.0*	1.73	10.75*	9.74*	-0.75	-9.19*	-2.73*	-9.93*	-4.09*	-2.49*	-9.05*	0.38
BRVM	-30.20*	75.51*	-11.44*	3.59*	-12.46*	-68.47*	-134.5*	-203.8*	-31.35*	-42.37*	5.34*	3.83*	-30.38*	-24.15*
Egypt	19.41*	19.33*	319.06*	7.46*	52.07*	14.02*	376.6*	30.43*	9.27*	49.25*	26.29*	40.35*	42.82*	19.59*
Ghana	6.61*	-10.52*	5.85*	16.07*	24.93*	57.46*	-36.95*	76.58*	20.01*	126.49*	20.25*	73.24*	32.55*	3.68*
Kenya	0.77	-6.98*	16.67*	13.80*	3.87*	11.73*	7.32*	7.38*	6.52*	104.45*	13.01*	13.82*	-3.79*	1.83
Mauritius	37.48*	1.26	45.54*	26.65*	199.04*	70.73*	137.84*	25.96*	82.33*	204.89*	39.62*	108.53*	88.34*	15.78*
Morocco	-0.91	-4.60*	-18.03*	-8.66*	-11.94*	-4.44*	14.54*	-16.52*	-7.87*	-8.64*	-10.68*	-40.57*	-16.72*	-21.94*
Namibia	12.50*	-16.93*	3.56*	45.29*	22.69*	-1.23	-1.36	6.70*	89.76*	39.37*	10.18*	10.88*	-0.95	-4.08*
Nigeria	-1.81	5.58*	11.24*	26.24*	-7.60*	42.96*	-8.15*	4.09*	-28.02*	0.41	-14.37*	-7.89*	-6.63*	-10.28*
South Africa	21.57*	-97.34*	-24.68*	55.03*	5.63*	-2.54*	2.77*	14.86*	14.95*	10.95*	9.29*	-3.24*	65.95*	-1.02
Tunisia	13.27*	0.74	0.48	37.64*	23.76*	13.40*	22.12*	1.91	-0.25	10.86*	-16.33*	-51.42*	-0.98	2.22*
Uganda	25.86*	-0.50	-16.54*	32.14*	-20.14*	9.40*	12.58*	106.32*	-11.99*	0.55	18.44*	4.00*	-0.90	210.33*
Zambia	-5.25*	-11.96*	-3.28*	1.26	-13.80*	-51.42*	-66.49*	-9.55*	-34.33*	-13.13*	-14.42*	-39.55*	-16.40*	-44.13*
Panel B: Eurozone crisis period														
Botswana	56.98*	-34.56*	3.13*	54.43*	7.79*	22.88*	-33.73*	-17.87*	-5.36*	2.33*	-17.07*	-46.08*	-24.86*	-29.06*
BRVM	6.63*	18.89*	44.90*	32.40*	-12.55*	-8.18*	47.42*	3.23*	1.14	12.30*	28.47*	18.88*	13.25*	40.77*
Egypt	11.39*	-10.97*	-1.66	-47.34*	8.65*	110.59*	-7.67*	-3.43*	9.27*	-4.51*	-1.21	-10.62*	15.22*	-2.39*
Ghana	-48.44*	-13.08*	25.32*	99.65*	16.58*	12.21*	-17.83*	792.20*	-12.48*	-1.57	-15.31	-36.83*	-7.42*	-6.58*
Kenya	12.65*	-7.24*	18.37*	38.08*	4.94*	18.59*	-4.41*	16.65*	16.48*	39.74*	119.97*	15.79*	-1.20	25.51*
Mauritius	17.32*	-21.58*	8.80*	27.68*	27.90*	34.24*	76.38*	49.00*	21.59*	83.64*	7.57*	17.41*	55.89*	76.39*
Morocco	1.61	-37.11*	-51.78*	-14.13*	-15.09*	5.45*	-35.25*	-119.3*	-38.69*	-18.32*	-36.60*	-26.35*	-15.42*	-104.41*
Namibia	49.95*	65.50*	35.43*	87.49*	68.51*	14.29*	-8.29*	37.08*	40.15*	2.35*	83.89*	9.02*	61.24*	35.02*
Nigeria	10.96*	22.47*	2.24*	8.28*	6.46*	-0.15	9.16*	21.61*	52.37*	-2.14*	33.34*	14.15*	23.48*	14.12*
South Africa	11.30*	28.44*	4.77*	20.38*	34.17*	36.98*	8.88*	15.55*	94.79*	-7.62*	5.37*	17.56*	35.59*	106.07*
Tunisia	-14.00*	30.98*	-51.26*	15.39*	-31.35*	-53.21*	-29.95*	-97.80*	-38.46*	-10.84*	-63.13*	-51.42*	-44.47*	-64.92*
Uganda	83.53*	3.38*	-19.41*	101.17*	-18.25*	10.54*	30.95*	107.79*	15.61*	23.03*	173.40*	63.45*	21.99*	49.13*
Zambia	6.20*	-14.20*	-12.13*	-10.65*	19.03*	-9.79*	-19.66*	1.05	-17.41*	2.77*	-167.05*	-14.30*	6.50*	-10.72*

Note: * denotes significance at 5% level. The value in each column represents the t-statistics for the average dynamic conditional correlation.

Source: Author’s computation

7.4.1 AS-EGARCH model results

This section reports the estimated coefficients from the AS-EGARCH model for individual markets over the four sample period. The results are presented in Tables 7.12 – 7.15. Table 7.12 reports the result of the EGARCH model for the full-sample period. As shown in this table, the ARCH coefficient or size effect coefficient (ψ) is highly significant across all the markets, except for Zambia and France, suggesting that current market volatility has a significant effect of conditional volatility. Similarly, an estimated GARCH coefficient (φ), which measures the degree of volatility persistence, is close to unity and significant for all the markets except for Ghana and Zambia. This supports the assumption of covariance stationarity of the GARCH process and the volatility persistence of all the markets. Also, it suggests that past stock market return volatility explains current market volatility. In addition, the leverage effect parameter (λ) is negative and statistically significant for most developed markets and few emerging and African markets, indicating the existence of a leverage effect. These findings are consistent with evidence from the DCC-GJRGARCH model presented in Table 7.2.

The results of the EGARCH model during the pre-crisis period as reported in Table 7.13 show that the current market volatility has more influence on African markets than the major developed and emerging markets. This is visible from the number significant ARCH coefficients across the markets. The persistent coefficients are highly significant across all the markets except for Zambia, Russia, Australia and Japan. Moreover, the persistent coefficient is less than one for all the markets suggesting that all the moments exist and the estimated values are consistent. Also, the existence of asymmetric volatility is found in Botswana, Tunisia, India, Canada, France and United Kingdom. Again, these findings are consistent with the evidence from the DCC-GJRGARCH model in Table 7.3.

Like the pre-crisis volatility condition, all the volatility persistence coefficients are statistically significant during the global financial crisis period, except for Tunisia and China (Table 7.14). However, it appears that market volatility is more persistent during the global financial crisis than during the pre-crisis period. In addition, the results in Table 7.14 show high evidence of negative and significant asymmetric coefficients for most markets, particularly in the major global markets. The presence of asymmetries in volatility indicates that market volatility tends to be higher during crisis periods than the pre-crisis period. Similar volatility patterns are found during the Eurozone crisis period, as shown in Table

7.15. The market volatility is found to be persistent and more asymmetric in the developed and emerging markets. These findings are also consistent with the evidence from the DCC-GJRGARCH model. Also, the finding supports evidence of contagion during both crisis periods.

Furthermore, the Ljung-Box statistics applied on the standardised and squared standardised residuals show that the EGARCH model successfully accounts for all linear and nonlinear dependencies present in the stock return series for all the periods. Also, the Lagrange multiplier test indicates evidence of no ARCH effects in the residuals. In sum, the result indicates that the EGARCH model specified for individual stock return series fits the data. Finally, having examined the volatility characteristics of individual stock markets, the following section considers evidence of the mean spillover effect.

7.4.2 Results of the mean spillover effects

This section focuses on the mean spillover effects from the major developed and emerging markets to Africa markets. In other words, it assumes that the spillover effects are unidirectional from the major global markets to African markets for all the sample periods. The mean spillover effects is captured by the parameter (σ) in equation (35), which reveals the effect of major global markets on the conditional mean of individual African markets. Hence, the emphasis in this section will focus mainly on the estimated coefficient of this parameter. The estimated coefficient of the parameter across all the markets and periods is reported in Table 7.16.

The results over the full-sample period as reported in panel A reveal that shocks from the global markets have positive and statistically significant effects on the conditional mean of African markets. Specifically, the global market shocks exert more influence on the conditional mean of Egypt, Mauritius, Namibia, South Africa and Tunisia compared to other African markets. The positive coefficients suggest that positive returns in the global markets affect the returns in African markets positively. In terms of markets groupings, shocks from the developed markets appear to have more influence on African stock market returns than shocks from emerging markets. It is also evident from the analysis over this period that stock returns from BRVM, Kenya, Nigeria and Uganda are not influenced by shocks from the global markets.

Table 7. 12: AS-EGARCH model results during the full-sample period

African Markets	Mean equation		Variance equation					Diagnostic tests			
	α	ρ	ω	ψ_1	φ_1	φ_2	λ	Q(12)	$Q^2(12)$	LM(12)	EGARCH
Botswana	0.001*	0.176*	-0.280	0.350*	0.063*	0.934*	0.028	70.509*	3.598	3.442	(1, 2)
BRVM	0.001*	0.279*	-6.578*	0.856*	0.371*		0.062	17.460	1.865	1.787	(1, 1)
Egypt	0.002*	0.106*	-1.389*	0.270*	0.853*		-0.124	19.231	19.916	20.467	(1, 1)
Ghana	-0.003	0.156*	-8.340*	1.968*	0.191		0.915*	46.894*	0.608	0.595	(1, 1)
Kenya	0.001*	0.155*	-1.961*	0.537*	0.829*		0.006	15.955	13.245	13.391	(1, 1)
Mauritius	0.001*	0.195*	-0.324*	0.279*	0.989*		-0.008	21.655*	9.132	9.544	(1, 1)
Morocco	0.000	0.144*	-0.978*	0.353*	0.312	0.614*	-0.037	11.403	20.065	20.845	(1, 2)
Namibia	0.001	-0.065	-0.423*	0.144*	0.965*		-0.110*	5.856	7.311	7.395	(1, 1)
Nigeria	0.001*	0.140*	-1.130*	0.436*	0.908*		0.016	19.335	11.799	10.885	(1, 1)
South Africa	0.001*	-0.038	-0.551*	0.151*	0.953*		-0.116*	7.777	12.634	14.450	(1, 1)
Tunisia	0.001*	0.097	-0.796	0.226*	0.937*		-0.041	13.816	12.039	12.494	(1, 1)
Uganda	0.002*	-0.048	-1.252	0.296*	0.878*		-0.057	8.651	8.370	9.159	(1, 1)
Zambia	-0.000	0.029*	-7.073	-0.497	0.010		0.041	11.503	0.194	0.186	(1, 1)
Emerging Markets											
Brazil	0.001	-0.022	-0.756*	0.171*	0.926*		-0.094*	9.386	13.015	12.868	(1, 1)
China	0.001	0.020	-0.312	0.167*	0.979*		0.018	29.505	13.713	14.010	(1, 1)
India	0.012*	0.098*	-0.675*	0.287*	0.949*		-0.068	11.456	10.508	11.625	(1, 1)
Russia	0.001	0.042	-0.407*	0.230*	0.971*		-0.038	7.098	7.992	8.260	(1, 1)
Developed Markets											
Australia	0.005	0.024	-0.444*	0.166*	0.967*		-0.091	12.069	3.989	3.933	(1, 1)
Canada	0.001*	-0.048	-0.603*	0.192*	0.953*		-0.128*	11.057	3.617	3.915	(1, 1)
France	0.000	-0.041	-0.497*	0.074	0.952*		-0.217*	9.272	4.691	4.811	(1, 1)
Germany	0.001	-0.037	-1.037*	0.184*	0.900*		-0.239*	8.911	4.708	4.442	(1, 1)
Hong Kong	0.000	-0.025	-0.377*	0.167*	0.973*		-0.073*	5.711	8.058	8.799	(1, 1)
Japan	0.000	0.058	-2.861*	0.312*	0.703*		-0.242*	7.633	8.088	8.161	(1, 1)
Singapore	0.001*	0.102*	-0.515	0.244*	0.965*		-0.074	8.693	6.910	6.776	(1, 1)
Switzerland	0.000	-0.021	-1.224*	0.194*	0.886*		-0.311*	13.010	1.498	1.581	(1, 1)
United Kingdom	0.000	0.004	-0.724*	0.157*	0.937*		-0.238*	19.008	7.809	10.178	(1, 1)
United States	0.001	-0.060	-0.686*	0.141*	0.940*		-0.220*	7.488	13.129	13.095	(1, 1)

Note: * denotes significance at 5% level: The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 13: AS-EGARCH model results during the pre-crisis/stable period

African Markets	Mean equation		Variance equation						Diagnostic tests			
	α	ρ	ω	ψ_1	ψ_2	φ_1	φ_2	λ	Q(12)	$Q^2(12)$	LM(12)	EGARCH
Botswana	0.001*	0.212*	-14.659*	1.111*		-0.314*		-0.380*	45.867*	18.942	16.819	(1, 1)
BRVM	0.001*	0.312*	-6.959*	1.434*		0.352*		-0.140	11.085	1.736	1.619	(1, 1)
Egypt	0.005*	0.092	-0.768*	0.258*		0.931*		0.040	8.220	7.865	7.140	(1, 1)
Ghana	0.000*	0.414	-1.236*	0.858*		0.938*		-0.206	50.808*	4.372	3.956	(1, 1)
Kenya	0.002*	0.235*	-3.478	0.634*		0.668*		-0.002	16.709	18.512	19.684	(1, 1)
Mauritius	0.002*	0.126	-1.195*	0.364*		0.910*		0.134	7.515	16.296	17.557	(1, 1)
Morocco	0.002*	0.146	-3.198*	0.466*		0.695*		0.084	7.368	8.997	10.457	(1, 1)
Namibia	0.002*	-0.132*	-1.544	0.047		0.227	0.604*	-0.183	10.054	16.474	21.097*	(1, 2)
Nigeria	0.003*	0.212*	-4.145*	0.678*		0.109	0.483*	0.166	14.529	5.881	5.558	(1, 2)
South Africa	0.002*	-0.090	-2.502	-0.312	0.414*	0.738*		-0.110	6.731	17.635	18.362	(2, 1)
Tunisia	0.001*	0.090	-2.403*	0.226*		0.790*		0.216*	14.797	2.411	2.550	(1, 1)
Uganda	0.003*	-0.054	-1.803	0.302		0.807*		0.075	6.759	5.747	6.455	(1, 1)
Zambia	0.003	0.020*	-6.899*	-0.764		0.012		-0.750	0.857	0.065	0.063	(1, 1)
Emerging Markets												
Brazil	0.003*	-0.130*	-3.469*	-0.279*	0.460*	0.611*		-0.118	10.926	11.922	12.459	(2, 1)
China	0.001*	0.020	-1.874*	-0.228	0.488*	0.808*		0.032	20.679	4.864	4.374	(2, 1)
India	0.002*	0.168	-3.156*	0.359*		0.679*		-0.290*	11.930	11.382	9.623	(1, 1)
Russia	0.004*	0.013	-3.187	0.372		0.639		-0.049	8.962	14.576	16.588	(1, 1)
Developed Markets												
Australia	0.001*	0.024	-14.776*	0.065		-0.419		0.183	9.305	9.091	6.480	(1, 1)
Canada	0.001*	-0.067	-4.670*	-0.528*	0.439*	0.533*		-0.286*	8.651	6.452	6.074	(2, 1)
France	0.001*	-0.217*	-0.867*	0.036		0.914*		-0.122*	8.307	3.995	3.982	(1, 1)
Germany	0.002*	-0.221*	-0.170	-0.088*		0.975*		-0.036	11.658	6.649	6.262	(1, 1)
Hong Kong	0.002*	-0.062	-0.484	-0.118	0.198	0.956*		0.011	5.195	4.810	4.509	(2, 1)
Japan	0.001*	-0.057	-10.658	0.069		-0.148		-0.075	6.531	18.987	17.285	(1, 1)
Singapore	0.002*	-0.060	-0.329	0.065		0.971*		0.036	5.843	6.018	6.020	(1, 1)
Switzerland	0.001*	-0.110	-0.490*	-0.007		0.951*		-0.082	18.130	6.113	6.078	(1, 1)
United Kingdom	0.001*	-0.107	-1.251	0.086		0.883*		-0.187*	15.757	6.095	5.384	(1, 1)
United States	0.001*	-0.161*	-0.699	-0.065		0.927*		-0.026	4.925	6.480	8.131	(1, 1)

Note: * denotes significance at 5% level: The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 14: AS-EGARCH model results during the global financial crisis period

African Markets	Mean equation		Variance equation						Diagnostic tests			
	α	ρ	ω	ψ_1	ψ_2	φ_1	φ_2	λ	Q(12)	$Q^2(12)$	LM(12)	EGARCH
Botswana	-0.000	0.497*	-1.041*	-0.123	-0.231	0.875*		0.131*	10.946	12.870	9.198	(2, 1)
BRVM	0.000*	0.070	-5.424*	0.685*	0.289	-0.209	0.730*	-0.071	26.160	6.671	8.554	(2, 2)
Egypt	0.005	0.246*	-2.458*	0.270*		0.711*		-0.410*	13.127	14.980	11.887	(1, 1)
Ghana	0.000	0.375*	-0.748	0.134		0.926*		-0.042	19.223	3.732	3.239	(1, 1)
Kenya	-0.000	0.084	-2.540	0.441*		0.740*		-0.113	9.383	4.653	4.325	(1, 1)
Mauritius	-0.000	0.150	-0.256	-0.161		0.955*		-0.081	6.321	7.229	6.889	(1, 1)
Morocco	0.000	0.102	-0.634*	0.047		0.938*		-0.173*	8.543	5.287	7.081	(1, 1)
Namibia	0.000	-0.026	-0.528*	-0.021		0.934*		-0.255*	4.705	10.239	7.897	(1, 1)
Nigeria	0.001	0.066	-1.104	0.447*		0.905*		-0.044	8.401	8.657	8.245	(1, 1)
South Africa	-0.000	-0.006	-0.649*	-0.080		0.917*		-0.320*	12.734	14.778	15.218	(1, 1)
Tunisia	0.002*	-0.015	-7.993*	-0.059		0.200		-0.479*	19.945	13.558	14.532	(1, 1)
Uganda	0.001	-0.017	-1.691*	0.083		0.801*		-0.261	12.596	14.469	15.554	(1, 1)
Zambia	0.001	0.473*	-4.250	0.322		0.546*		0.282	19.595	4.338	6.126	(1, 1)
Emerging Markets												
Brazil	0.001	-0.024	-0.232*	-0.084*		0.964*		-0.190*	6.236	8.563	9.996	(1, 1)
China	-0.001	0.070	-7.425*	-0.252		0.026		-0.449*	11.756	10.052	10.226	(1, 1)
India	0.000	0.005	-0.893	0.227*		0.909*		-0.087	15.860	8.246	9.528	(1, 1)
Russia	-0.003	0.046	-0.061	-0.132		0.976*		-0.223*	18.709	16.332	15.364	(1, 1)
Developed Markets												
Australia	-0.001*	0.131	-0.058	-0.051		0.989*		-0.166*	2.370	7.002	7.807	(1, 1)
Canada	-0.001	0.041	-0.291*	0.027		0.969*		-0.277*	4.174	6.622	6.960	(1, 1)
France	-0.001	0.053	-0.701*	0.078		0.923*		-0.281*	22.997*	2.337	2.198	(1, 1)
Germany	-0.000	0.005	-5.243*	0.661*		0.439*		-0.586*	14.347	13.392	11.026	(1, 1)
Hong Kong	-0.001	0.085	-0.245*	-0.124		0.956*		-0.125*	5.142	10.671	16.854	(1, 1)
Japan	-0.002	0.113	-3.305*	0.301		0.630*		-0.470*	2.677	6.431	5.829	(1, 1)
Singapore	-0.000	0.036	0.029	-0.082		0.997*		-0.141*	6.380	10.563	13.371	(1, 1)
Switzerland	-0.000	-0.109	-1.367*	0.150*		0.857*		-0.445*	10.269	1.001	0.941	(1, 1)
United Kingdom	-0.000	0.037	-0.817*	0.153		0.920*		-0.270	22.351*	8.700	8.722	(1, 1)
United States	0.000	-0.069	-4.193*	0.576*		0.618*		-0.392*	6.792	10.127	7.873	(1, 1)

Note: * denotes significance at 5% level: The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

Table 7. 15: AS-EGARCH model results during the Eurozone crisis period

African Markets	Mean equation		Variance equation						Diagnostic tests			
	α	ρ	ω	ψ_1	ψ_2	φ_1	φ_2	λ	Q(12)	$Q^2(12)$	LM(12)	EGARCH
Botswana	0.000*	0.184*	-2.107	0.654*		0.263*	0.596*	-0.067	19.511	2.666	3.199	(1, 2)
BRVM	0.003	0.112*	-0.951*	-0.263*		0.887*		0.176*	11.018	11.188	9.560	(1, 1)
Egypt	0.000	0.192*	-2.302	0.068		0.728*		-0.319*	13.670	14.980	12.681	(1, 1)
Ghana	-0.001*	-0.131*	-18.507*	1.345*	1.935*	-0.590*		0.312*	25.306*	20.150	16.119	(2, 1)
Kenya	0.000	0.149*	-2.033*	0.365*		0.821*		0.003	16.661	11.077	11.850	(1, 1)
Mauritius	0.000	0.188*	-0.012	-0.044		0.996*		0.023	6.455	18.309	17.966	(1, 1)
Morocco	-0.000	0.092	-4.907*	0.132		0.533*		-0.274*	9.602	3.866	4.663	(1, 1)
Namibia	0.000	-0.091	-0.593*	-0.061		0.932*		-0.130*	7.692	11.429	10.117	(1, 1)
Nigeria	0.000	0.181*	-1.284	0.308*		0.886*		-0.082	15.993	7.255	8.967	(1, 1)
South Africa	0.001	-0.058	-0.887*	0.030		0.912*		-0.224*	15.213	5.448	5.157	(1, 1)
Tunisia	0.001	0.220*	-9.054*	0.810*		0.734*	-0.576*	0.079	15.689	13.558	16.033	(1, 2)
Uganda	0.002*	-0.096	-0.803	0.181		0.925*		-0.070	13.234	5.588	4.856	(1, 1)
Zambia	0.001*	0.021	-0.960*	0.296*		0.924*		0.049	20.976	7.841	9.210	(1, 1)
Emerging Markets												
Brazil	-0.001	-0.000	-0.885	-0.184	0.317*	0.911*		-0.138*	9.407	9.718	9.935	(2, 1)
China	0.000	0.030	-0.294*	-0.020		0.966*		0.033	9.989	12.680	16.673	(1, 1)
India	0.001	0.053	-1.788	0.215*		0.826*		-.152*	15.930	13.110	18.846	(1, 1)
Russia	-0.000	0.023	-1.434*	-0.089	0.116	0.843*		-0.277*	8.010	20.909	22.461*	(2, 1)
Developed Markets												
Australia	0.000	-0.010	-3.180*	0.207*		0.691*		-0.372*	21.704*	12.997	11.402	(1, 1)
Canada	0.000	-0.028	-1.336*	0.195		0.882*		-0.239*	16.092	16.467	17.143	(1, 1)
France	-0.000	0.003	-0.560*	-0.029		0.935*		-0.281*	5.127	6.292	7.274	(1, 1)
Germany	0.001	-0.030	-0.897*	0.078		0.908*		-0.238*	4.944	2.466	2.396	(1, 1)
Hong Kong	0.000	-0.095	-15.954*	0.241	-0.071	-0.735*		-0.190*	9.244	6.604	16.648	(2, 1)
Japan	0.001	0.109	-3.146	0.192		0.663*		-0.160	13.594	3.442	3.847	(1, 1)
Singapore	0.000	0.150*	-0.923*	0.128		0.918*		-0.261*	5.315	15.467	14.375	(1, 1)
Switzerland	0.000	0.031	-5.308*	0.181		0.466*		-0.452*	8.899	14.035	16.265	(1, 1)
United Kingdom	0.000	-0.005	-0.972*	-0.016		0.898*		-0.304*	16.877	4.603	4.717	(1, 1)
United States	0.001*	-0.103	-0.980*	0.091		0.907*		-0.279*	15.350	6.289	7.311	(1, 1)

Note: * denotes significance at 5% level: The Lagrange Multiplier (LM) test for volatility clustering follows a Chi-square distribution and the test statistic is given by the number of observation (T) multiplied by the R-squared. The null hypothesis is that there is no ARCH effect. LQ and LQ^2 are Ljung-Box Q-statistic based on the standardised residuals and the squared standardised residuals respectively.

Source: Author's computation

The analysis of the results across different sub-samples provides varying evidence of mean spillover effects. In panel B, the results reveal that, except for Namibia, South Africa and Tunisia, stock returns in African markets are not influenced by the global market shocks. This means limited evidence of mean spillover effect from the global markets to African markets during the pre-crisis period. Conversely, the result during the global financial crisis period shows evidence of a positive and statistically significant effect of the global market on African stock market returns (see panel C). In particular, stock market returns in Egypt, Ghana, Mauritius, Namibia, South Africa, and Tunisia are positively and significantly influenced by the global markets. Conversely, the global markets influence on BRVM is negative and significant. Further evidence during the global financial crisis period indicates a strong isolation of Botswana, Kenya, Morocco, Nigeria, Uganda and Zambia stock market returns from the global markets. However, the mean spillover effect during the Eurozone crisis period, as shown in panel D, indicates that stock market returns in Egypt, Ghana, Mauritius, Namibia and South African are mostly influenced by the global market returns.

In sum, the analysis of the mean spillover effects across different time periods provides evidence of time varying returns spillover effect. The findings show evidence of limited influence from the major global markets to Africa markets prior to the global financial crisis. However, the returns of African markets appear to be significantly influenced by the movement in the global markets during the two crisis periods. This finding suggests that Africa markets were more sensitive movements in the major global markets during the time of crisis, which indicates structural shift due to external shocks during the crisis period. In addition, the finding supports evidence of contagion as identified in section 7.3. To further investigate the effect of the global markets on African markets, the next section considers the issue of volatility spillover effects.

7.4.3 Results of the volatility spillover effects

In this section, this study examines evidence of volatility spillover from the global markets to African markets for all the periods. The focus in this section is on the estimated coefficient of the parameter (η) in the variance equation (36) for individual African markets over the period. The parameter (η) measures the impact of conditional volatility from the major global markets on the conditional volatility of individual African markets. The result of the estimated coefficient is reported in Table 7.17 for different time periods.

Evidence in Table 7.17 shows that the estimated coefficient (η) is generally negative across all the periods. Specifically, evidence during the full-sample period as shown in panel A indicates a negative and significant volatility spillover effects from the global markets to African markets such as Egypt, Kenya, Namibia, South Africa and Uganda. The negative coefficient implies that unexpected volatility from the global markets would have a negative impact on volatility of these African markets. Further evidence in panel A indicates that the developed markets contribute more volatility to African markets than the emerging markets. Also, India and Russia appear to contribute more volatility to African markets than other emerging markets.

For the pre-crisis period, the result in panel B reveals that spillover effect from the global markets is more visible in Namibia, Nigeria and South Africa during period. Additionally, the result over this period indicates that global market volatility has a limited influence on a number of African markets. However, the result during the global financial crisis period, as shown in panel C reveals an increased contribution of global market volatility to African market volatility. Panel C also provides evidence of negative and statistically significant volatility spillover from the global markets to African markets except for Nigeria, Tunisia and Zambia. Within the emerging markets, the result shows that a spillover effect from the Chinese market has the least impact on African market volatility. Furthermore, the analysis during the Eurozone crisis, as shown in panel D, reveals that global markets have more influence on Egypt, Ghana, Kenya, South Africa compared to other African markets.

Generally, the analysis of volatility spillover effects shows that the magnitude of the spillover coefficient from the global markets to individual African markets varies considerably across markets and periods. As one would intuitively expect, volatility transmission ought to increase during the crisis period relative to the pre-crisis period. This is visible from the number of statistically significant occasions of volatility spillover from the global markets to African markets in different sub-samples. Clearly, there is more evidence of volatility transmission during the two crisis periods compared to the pre-crisis period, particularly during the global financial crisis period. This finding is consistent with an earlier study by Heymans and da Camara (2013). This finding indicates that volatility spillover is a common phenomenon during a period of crisis, suggesting evidence of structural shift in the volatility of African markets due to exogenous shocks during the two crises. However, the impacts of exogenous shocks across African markets over different time periods are largely negative.

Table 7. 16: Mean spillover effects across all the sample periods

Panel A: **Full-sample period**	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	-0.020	-0.001	0.035*	0.014	0.046	0.003	-0.006	-0.005	0.035*	0.026*	0.033	0.039*	0.019	-0.026
BRVM	-0.022	-0.027	-0.023	-0.009	-0.013	-0.001	-0.014	-0.005	-0.013	0.004	-0.048	-0.013	-0.017	-0.014
Egypt	0.216*	0.147*	0.311*	0.225	0.415*	0.418*	0.291*	0.250*	0.304*	0.300*	0.344*	0.356*	0.307*	0.272*
Ghana	-0.020	0.010	-0.013	-0.011	0.028	-0.049*	0.040*	0.037*	-0.007	0.030*	-0.027	0.057*	0.030	-0.007
Kenya	0.004	0.024	-0.036	-0.019	-0.073	-0.041	-0.029	-0.018	0.044	-0.024	-0.000	-0.026	-0.041	-0.004
Mauritius	0.022	0.017	0.076*	0.010	0.112*	0.052	0.045*	-0.097	0.080*	0.046*	0.099*	0.097*	0.048	0.059*
Morocco	0.003	-0.001	0.061*	0.023	0.061	0.119*	0.032	0.042	0.035	0.003	0.073*	0.050	0.048	0.035
Namibia	0.487*	0.187*	0.426*	0.356*	0.857*	0.910*	0.678*	0.635*	0.507*	0.441*	0.651*	0.757*	0.897*	0.790*
Nigeria	-0.018	0.054	-0.018	0.007	-0.017	0.007	0.031	0.061	0.046	0.003	0.039	0.022	0.004	-0.040
South Africa	0.418*	0.158*	0.381*	0.312*	0.747*	0.805*	0.586*	0.544*	0.438*	0.393*	0.546*	0.657*	0.782*	0.689*
Tunisia	0.022	0.003	0.035	0.017	0.081*	0.065*	0.043	0.055*	0.019	0.060*	0.050	0.083*	0.071*	0.080*
Uganda	-0.042*	0.100*	-0.050	-0.089	-0.048	-0.021	-0.030	-0.062	-0.024	0.058	-0.025	0.041	-0.026	-0.054
Zambia	0.102*	0.004	-0.050	0.013	0.004	0.092	0.119*	0.076*	-0.082	0.065*	0.110*	0.103*	0.093*	0.088
Panel B: Pre-crisis/stable period														
Botswana	-0.027*	0.024	-0.027*	-0.016	-0.101*	-0.030	0.059*	0.010	-0.007	-0.021	-0.044*	0.035	-0.006	-0.035
BRVM	-0.046	-0.038	-0.036	-0.011	0.024	0.061	0.028	0.065*	-0.088*	0.072	-0.085	-0.026	0.009	-0.109
Egypt	0.103	0.112	0.102	0.145*	0.182	0.130	0.059	0.074	0.169	0.131	0.140	0.117	0.198	0.064
Ghana	0.017	0.022	0.011	0.011	-0.031	0.041	0.002	-0.014	0.008	0.013	0.038	-0.007	0.004	-0.001
Kenya	0.001	0.055	-0.021	-0.031	0.100	-0.081	-0.028	-0.007	0.042	-0.124	0.013	-0.046	-0.052	0.082
Mauritius	0.000	0.035	0.019	-0.008	-0.011	-0.043	-0.046	-0.020	-0.067	-0.055	0.001	-0.039	-0.052	-0.012
Morocco	0.015	0.049	0.159*	0.040	0.188*	0.112	0.055	0.131	0.067	0.053	0.138	0.151	0.106	0.090
Namibia	0.395*	0.151*	0.442*	0.269*	1.110*	1.084*	0.879*	0.655*	0.467*	0.524*	0.587*	0.777*	1.112*	0.953*
Nigeria	-0.019	0.016	-0.037	0.029	-0.019	-0.030	0.060	0.048	0.071	-0.038	0.054	0.078	0.067	0.047
South Africa	0.361*	0.122*	0.441*	0.231*	1.007*	0.965*	0.769*	0.571*	0.408*	0.471*	0.461*	0.675*	1.004*	0.873*
Tunisia	0.016	0.010	0.041	0.012	0.161*	0.076	0.065	0.077*	0.031	0.075*	0.095*	0.110*	0.066	0.095*
Uganda	-0.164	0.161	0.049	-0.085	0.095	0.105	-0.107	-0.261	0.034	0.045	-0.255	0.054	-0.241	-0.255
Zambia	0.367*	-0.307	-0.002	0.076	0.125*	-0.052	-0.024	-0.335*	-0.173*	0.015	-0.138	0.038	-0.449*	-0.140

Panel C: Global financial crisis period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	0.008	0.009	0.021	0.016	-0.003	0.007	0.001	0.020	0.033*	0.020	0.004	0.022	0.023	0.027
BRVM	-0.128*	-0.041	-0.115*	-0.051*	-0.029	-0.097*	-0.099*	-0.080*	-0.006	-0.031	-0.066	-0.023	-0.109*	-0.102*
Egypt	0.400*	0.216*	0.396*	0.376*	0.597*	0.538*	0.605*	0.557*	0.363*	0.494*	0.400*	0.656*	0.584*	0.476*
Ghana	-0.028	-0.010	-0.005	0.003	0.058*	0.042*	0.057*	0.052*	0.018	0.054*	-0.001	0.047*	0.055*	0.065
Kenya	-0.010	0.100	0.102	-0.007	0.164	0.207*	-0.039	0.058	0.058	0.209*	0.061	0.045	0.186*	-0.025
Mauritius	0.197*	0.136*	0.195*	0.133*	0.358*	0.249*	0.240*	0.193*	0.220*	0.358*	0.277*	0.320*	0.236*	0.287*
Morocco	0.047	0.012	-0.007	-0.008	0.010	0.012	-0.010	-0.004	0.009	0.017	0.025	-0.014	0.007	-0.003
Namibia	0.726*	0.037	0.454*	0.413*	0.903*	0.887*	0.798*	0.745*	0.552*	0.687*	0.781*	0.943*	0.988*	0.810*
Nigeria	-0.084	0.061	-0.068	-0.054	-0.060	0.010	-0.140	-0.119	-0.145*	-0.062	-0.092	-0.170	-0.077	-0.176
South Africa	0.584*	0.089	0.333*	0.365*	0.707*	0.639*	0.668*	0.641*	0.446*	0.572*	0.534*	0.674*	0.796*	0.685*
Tunisia	0.065*	-0.035*	0.038*	0.029	0.180*	0.092*	0.124*	0.124*	0.082*	0.184*	0.092*	0.155*	0.132*	0.050
Uganda	-0.027	0.124*	-0.037	-0.080	-0.026	0.005	0.119*	-0.030	-0.044	0.107	0.101	0.145	0.087	-0.028
Zambia	0.041	0.002	-0.008	0.034	-0.049	0.046	-0.024	-0.034	-0.055	0.014	0.001	-0.105	-0.027	-0.032
Panel D: Eurozone crisis period														
Botswana	0.003	-0.014	-0.000	0.024	-0.003	0.045*	-0.015	-0.013	-0.027	0.009	-0.046	0.004	0.023	0.015
BRVM	0.017	0.045	0.019	0.042	-0.029	0.034	0.046*	0.025	0.017	0.007	0.066	0.011	0.044	0.031
Egypt	0.135	0.178*	0.196	0.253*	0.597*	0.331*	0.146*	0.051	0.243*	0.076	0.467*	-0.038	0.223*	0.302*
Ghana	-0.025	0.003	-0.067*	-0.031*	-0.011	-0.048	0.010	0.025*	-0.040	0.004	-0.107*	0.062*	0.022*	-0.243*
Kenya	0.076*	0.006	0.010	-0.012	0.164	-0.008	0.007	0.009	0.101	-0.005	0.168*	-0.008	0.001	0.013
Mauritius	0.018	-0.012	0.062*	0.029	0.358*	0.063	0.066*	0.060*	0.070*	0.063*	0.112*	0.109*	0.049	0.065*
Morocco	0.038	-0.016	0.030	0.041	0.010	0.107*	0.038	0.033	0.056	0.014	0.069	0.058	0.057	0.054
Namibia	0.442*	0.254*	0.403*	0.412*	0.903*	0.818*	0.526*	0.524*	0.494*	0.356*	0.678*	0.738*	0.814	0.749*
Nigeria	0.032	0.103	-0.024	0.068	-0.060	0.039	0.079	0.109*	0.145*	0.074	0.184*	0.126*	0.088	0.096
South Africa	0.345*	0.168*	0.370*	0.356*	0.707*	0.727*	0.457*	0.457*	0.394*	0.273*	0.553*	0.652*	0.731*	0.627*
Tunisia	0.055	0.017	-0.001	-0.005	0.180*	0.012	-0.009	-0.009	-0.023	0.033	-0.102	-0.128*	0.008	-0.019
Uganda	0.039	0.060	-0.036	-0.028	-0.090	-0.006	-0.016	0.001	0.068	0.077	0.035	0.169	0.054	0.149
Zambia	0.032	0.006	0.023	0.014	-0.049	0.003	0.033	0.037	0.011	-0.011	-0.023	-0.006	0.051	0.015

Note: * denotes significance at 5% level: Each column represents the coefficient of the parameter σ in the mean equation (35), which measures how much the idiosyncratic shock from a given foreign market affects the contemporaneous unexpected return of African markets (mean spillover effects).

Source: Author's computation

Table 7. 17: Volatility spillover effects across all the sample periods

Panel A: Full-sample period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	-0.042*	0.045	-0.041	-0.119	-0.037	-0.027	-0.046	-0.032	0.026	-0.052	-0.001	-0.029	0.003	-0.065
BRVM	-0.156	-0.123	-0.237*	0.377*	-0.025	-0.116	-0.181	-0.140	-0.237*	-0.158	-0.285*	-0.243	-0.243	-0.147
Egypt	-0.100	-0.032	-0.094	-0.048	-0.146*	-0.119	-0.100*	-0.131*	-0.136*	-0.108	-0.113*	-0.129*	-0.160*	-0.128*
Ghana	-0.012	-0.184*	-0.179	-0.182*	0.030	-0.258*	0.255	19.721*	0.043	0.099	-0.030	0.506*	0.288	0.066
Kenya	-0.124	0.037	-0.124*	-0.132*	-0.191*	-0.141*	-0.196*	-0.193*	-0.127	-0.147*	-0.125*	-0.191*	-0.193*	-0.168*
Mauritius	-0.067	-0.001	-0.009	-0.074	-0.132*	-0.069	-0.091	-0.081	-0.023	-0.109*	-0.054	-0.064	-0.100	-0.104*
Morocco	0.008	0.086*	-0.015	0.034	0.009	0.026	0.031	0.031	0.003	-0.027	0.014	0.008	0.011	0.005
Namibia	-0.034	-0.016	-0.073*	-0.034	-0.113	-0.095*	-0.137*	-0.156*	-0.076*	-0.102*	-0.100*	-0.089*	-0.074*	-0.117*
Nigeria	0.012	-0.045	-0.015	-0.021	-0.079	-0.014	-0.088	-0.094	-0.024	-0.037	-0.040	-0.077	-0.050	-0.012
South Africa	-0.077*	-0.021	-0.073*	-0.066*	-0.126*	-0.108*	-0.169*	-0.151*	-0.111*	-0.101*	-0.125*	-0.106*	-0.109*	-0.143*
Tunisia	-0.069	-0.003	-0.168*	0.043	0.010	-0.023	0.044	0.004	-0.027	0.042	0.025	-0.007	0.033	0.081
Uganda	-0.130*	-0.076	-0.109	-0.023	-0.078	-0.105	-0.119*	-0.183*	-0.117	-0.144*	-0.157*	-0.143	-0.104	-0.172*
Zambia	0.974	0.660	0.020	-0.176*	0.403	0.823	0.913	0.502	0.006	0.509	0.659	0.528	0.616	0.803
Panel B: Pre-crisis/stable period														
Botswana	-0.180*	0.100	-0.273*	-0.047	-0.115	0.030	0.006	0.039	0.109	0.010	-0.052	-0.037	-0.076	-0.120*
BRVM	-0.077	-0.119	-0.224	-0.478*	0.289	-0.006	-0.017	0.203	-0.467*	-0.024	-0.285	-0.214	-0.207	-0.156
Egypt	-0.114	0.005	-0.208*	0.285	-0.201	-0.191*	-0.166	-0.198*	-0.081	-0.242*	-0.172	-0.127	0.137	-0.151*
Ghana	-0.245*	0.053	-0.129	-0.290	-0.320*	-30.647	-0.189	-0.164	-0.121	-0.246	-0.209	-0.195	-0.172	-0.150
Kenya	-0.149	0.122	-0.094	-0.190*	-0.133	-0.052	-0.159	-0.102	-0.069	-0.183	0.014	-0.103	-0.234	-0.001
Mauritius	-0.088	0.170*	0.002	-0.131	-0.161*	-0.042	-0.054	-0.006	0.021	-0.170*	0.074	-0.023	-0.074	0.012
Morocco	0.094	0.266*	-0.108	-0.089	-0.012	0.122	0.055	0.002	0.017	0.016	0.016	-0.090	0.011	0.102
Namibia	-0.080	-0.287*	-0.057	-0.014	-0.226*	-0.162*	-0.210*	-0.142	-0.341*	-0.063	-0.260*	-0.116	-0.119	-0.124
Nigeria	0.383*	-0.261*	0.172	0.262*	0.304*	0.559*	0.371*	0.323*	0.064	0.200	0.201	0.306*	0.345*	-0.386*
South Africa	-0.083	-0.261*	-0.178*	-0.130	-0.229*	-0.156*	-0.255*	-0.124	-0.367*	-0.188*	-0.363*	-0.106	-0.144	-0.108*
Tunisia	-0.218	0.035	-0.280*	-0.090	-0.164*	-0.191*	-0.091	-0.053	-0.249*	-0.093	-0.018	-0.036	-0.119	-0.162*
Uganda	-0.045	0.011	0.156	-0.119	0.088	0.190	-0.281*	-0.295*	-0.127	-0.260*	-0.175	-0.222	-0.219	0.061
Zambia	0.346	0.707	0.497*	-0.948*	0.474*	1.012	1.108	0.834	0.266	0.394	0.733	0.198	0.193	0.124

Panel C: Global financial crisis period	Brazil	China	India	Russia	Australia	Canada	France	Germany	Hong Kong	Japan	Singapore	Switzer-land	United Kingdom	United States
Botswana	-0.047	-0.107	-0.116*	-0.132*	0.140	0.329	0.237	-0.250*	-0.083	-0.101*	0.041	-0.147	-0.123*	-0.161*
BRVM	-0.415*	-0.050	-0.134	-0.266*	-0.391*	-0.233*	-0.283*	-0.232*	-0.060	-0.264	-0.180*	-0.084	-0.287*	-0.206*
Egypt	-0.081	0.176	-0.117	-0.180	-0.268*	-0.073	-0.242*	-0.022	-0.201*	-0.075	-0.241*	-0.289*	-0.247*	-0.134*
Ghana	-0.238	-0.138	0.457*	0.257*	18.506*	0.358*	0.297*	0.118	0.245*	0.348*	0.341*	0.336*	0.240*	0.065
Kenya	-0.217*	0.007	-0.061	-0.159*	-0.342*	-0.158	-0.261*	-0.237*	-0.105	-0.170*	-0.181*	-0.167*	-0.231	-0.215*
Mauritius	0.064	-0.048	-0.005	-0.074	-0.188*	-0.143*	0.011	0.007	-0.056	-0.320*	-0.149*	-0.110*	-0.145*	0.133
Morocco	-0.144*	-0.015	-0.112*	-0.155	-0.175*	-0.166*	-0.165*	-0.156*	-0.151*	-0.132*	-0.101*	-0.130*	-0.125*	-0.114*
Namibia	-0.119*	-0.290	-0.123*	-0.175*	-0.171*	-0.255*	-0.277*	-0.263*	-0.186	-0.173*	-0.107*	-0.184*	-0.446*	-0.225*
Nigeria	0.031	-0.056	0.042	-0.087	-0.017	0.110	0.000	0.044	-0.175*	0.049	0.066	-0.014	0.046	0.084
South Africa	-0.100	-0.063*	-0.190*	-0.193*	0.042	0.001	-0.306*	-0.208*	-0.220*	0.136	-0.161*	-0.214*	-0.203*	-0.342*
Tunisia	0.115	-0.303*	-0.061*	-0.206	0.024	0.130	-0.017	-0.058	0.160	0.300	0.115	0.018	0.094	0.089
Uganda	-0.250*	-0.057	-0.190*	0.004	-0.247*	-17.00*	-0.274*	-0.200	-0.089	-0.292*	-0.279*	-0.223*	-0.255*	-0.282*
Zambia	0.229	-0.023	0.039	0.262	0.104	0.250	0.107	0.039	-0.035	0.239	0.177	-0.157	0.072	-0.021
Panel D: Eurozone crisis period														
Botswana	-0.236	-0.118	-0.186	-0.157	0.140	-0.108*	-0.133	-0.091	-0.143	-0.128	-0.066	-0.175	-0.107	-0.125
BRVM	-0.178	-0.028	-0.205*	-0.022	-0.391*	-0.041	0.061	0.021	-0.076	-0.002	-0.033	-0.010	0.017	-0.023
Egypt	-0.005	-0.065	0.182	0.166	-0.268*	0.276*	0.315*	0.293*	0.096	0.017	0.247*	-0.082	0.318*	0.364*
Ghana	0.395*	0.206*	-0.877*	-0.622*	0.102	-0.203	0.384*	0.580*	-0.057	-0.094	-0.197*	0.509*	0.840*	-0.272*
Kenya	-0.255*	0.014	-0.255*	-0.163	-0.342*	-0.217*	-0.278*	-0.219	-0.215*	-0.081	-0.209*	-0.168	-0.177	-0.162
Mauritius	-0.006	0.003	0.007	0.034	-0.188*	0.019	-0.014	-0.036	-0.006	-0.032	0.014	-0.033	-0.005	-0.052
Morocco	-0.242*	-0.220	-0.185*	-0.216*	-0.175*	-0.020	0.025	0.058	-0.136	-0.163	-0.130	0.073	-0.035	0.022
Namibia	-0.037	-0.021	-0.009	-0.148	-0.171*	0.049	-0.071	-0.079	-0.112*	-0.106*	-0.129*	0.046	0.044	-0.095*
Nigeria	-0.196*	0.092	-0.179*	-0.010	-0.017	-0.076	-0.058	-0.063	-0.067	-0.001	-0.062	-0.051	-0.078	0.037
South Africa	-0.127*	-0.029	-0.168*	-0.172*	-0.042	0.089	-0.116*	-0.095*	-0.151*	-0.011	-0.176*	-0.044*	-0.234*	-0.203*
Tunisia	0.079	0.174	0.192	0.178	0.024	-0.058	-0.154	-0.167	0.166	-0.161	-0.107	0.026	-0.187	0.243
Uganda	-0.101	-0.106	-0.184*	0.058	-0.161	-0.143	0.075	0.012	-0.084	0.118	-0.095	0.194	0.115	0.190
Zambia	-0.052	-0.105	-0.056	-0.110	0.104	-0.003	-0.040	-0.057	-0.061	-0.092	-0.046	-0.085	0.009	-0.058

Note: * denotes significance at 5% level: Each column represents the coefficient of the parameter η_i in the variance equation (36). It measures the effect of individual foreign market volatility on African market volatility (volatility spillover effects).

Source: Author's computation

7.5 Conclusion

This chapter set out to empirically examine the evidence of contagion and volatility transmission between African markets and the major developed and emerging markets. To achieve this, the chapter investigated five aspects of international financial relationships. These five aspects are: (i) the level of volatility, (ii) dynamic conditional correlation, (iii) contagion, (iv) mean spillover effects, and (v) volatility spillover effects. Each of these five aspects was empirically examined. The first three were analysed using the DCC-GJRGARCH model, while the AS-EGARCH model was used to examine the last two aspects. The main findings in this chapter can be summarised in the following points.

First, the analysis of volatility characteristics of individual stock markets using the DCC-GJRGARCH model shows that the magnitude of volatility varies considerably across markets and time. More interestingly, stock market volatility is found to be persistent with long memory, which is evident from the number of significant GARCH coefficients across periods. However, the magnitude of volatility across most markets appears to be highly persistent during the global financial crisis period relative to other periods. Also, volatility is found to be asymmetric, particularly during the two crisis periods. This finding suggests that negative shocks have more influence on the current stock market volatility than equivalent positive shocks during crisis periods. These results were corroborated by evidence from the AS-EGARCH model.

Second, the DCC results show evidence of time varying conditional correlation across markets and periods. African markets such as Egypt, Mauritius, Morocco, Namibia, South Africa and Tunisia are found to exhibit strong correlation with the global markets compared to other African markets. Also, the DCC result suggests that conditional correlation between African markets and global markets increased dramatically during the periods of the two crises, suggesting evidence of strong co-movements in the time of crisis relative to the stable period. In addition, it indicates that periods of extreme events do cause African markets to co-move with the major global markets.

Third, there is strong support in favour of contagion, since there is evidence of a statistically significant increase in correlation between African markets and the major global market during the two crisis periods relative to the pre-crisis period. This evidence of contagion is considered in the light of the two conditions stipulated in Chapter Four. First, if two markets are integrated before a crisis, any increase in correlation during the crisis period cannot be considered as contagion, unless the correlation between the markets increased significantly. Second, contagion exists if the markets are not integrated before the crisis and there is evidence of significant increase in correlation during the crisis period relative to the pre-crisis period.

Furthermore, based on the findings in this chapter, evidence of the decoupling hypothesis during the global financial crisis is not supported. This is because the significant increase in correlation indicates that contagion is a common phenomenon during a crisis period, which could give rise to synchronisation rather than decoupling.

In addition, there is evidence of mean and volatility spillover effects from the major global markets to African markets. As one would intuitively expect, both the mean and volatility transmission ought to increase during the crisis period relative to the pre-crisis period. This is visible from the number of statistically significant occasions of spillover effects. This finding shows that African markets are frequently affected by global market volatility during a crisis period. Moreover, volatility transmission is synonymous to contagion in times of financial crises.

Finally, these empirical findings elucidate how vulnerable African markets are to both emerging and developed market shocks; in addition, they display differences in crises dynamics that could be attributed to individual markets. Both crises affected African markets, regardless of their level of financial integration with the global market. Moreover, the cross-market correlation can be driven by shifting sentiment due to increased risk aversion among the investors during a crisis period, which could lead to co-movement across markets (Kenourgios & Padhi, 2012). Hence, the above findings have important implications for both the policymakers and international investors. On the one hand, the findings in this chapter provide some answers about the effect of growing financial integration between African markets and the global markets, especially regarding risk management and financial market stability. On the other hand, the findings provide information to the investors about the financial markets' stability in terms of contagion and volatility transmission risks, and thereby helping them to make better investment decisions. Consequently, the next chapter will provide the summary and conclusion of this study with possible recommendations.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This chapter summarises the general issues discussed throughout the study and provides the concluding remarks on the study. The chapter also highlighted the main findings of the study in relation to the research questions and objectives, as articulated in Chapter One. In addition, it provides possible recommendations based on the findings as well as highlighting the limitations of the study and making suggestions for future study. As a result, this chapter is organised in five sections. The first section provides a summary of the study. The second section highlights the main findings of the study. The third section provides the conclusion and implications of the findings. The fourth section provides possible recommendations based on the findings, while the last section discusses the limitations and makes suggestions for future study.

8.2 Research summary

Over the past decades, the process of financial integration has progressed in a number of countries, mainly motivated by the benefits associated with integration in terms of increased access to international capital, reduction in cost of capital, risk diversification and information efficiency (Rejeb & Boughrara, 2015; Gangadharan & Yoonus, 2012; and Buttner & Hayo, 2011). As part of this progress, policies promoting financial integration and liberalisation have become common practice and many countries have them as part of their economic policy strategies. Moreover, most developing countries, particularly those in Africa, have implemented several financial reforms in an attempt to strengthen their economic growth and deepen their financial markets in order to reap the benefits of financial integration.

Despite the benefits of financial integration, there are growing concerns over the downside risk of increased financial integration, particularly the vulnerability of markets to financial crises. As markets become increasingly integrated with the global markets, their sensitivity to volatility spillovers increases, the opportunity for portfolio diversification decreases and the markets become more vulnerable to external shocks (Alotaibi & Mishrs, 2015 and Buttner & Hayo, 2011). In the context of rapid financial integration and deep and complex interconnections across borders, a financial crisis can quickly spread across assets, markets, and economies.

Interestingly, in the wake of the 2007 global financial crisis, stock markets around the globe evolved in line with one another during the periods of both increase and decrease. The crisis revealed the complexity of the international transmission of financial shocks and the financial vulnerabilities, which may be associated with growing financial integration. More so, the crisis has exposed the major weaknesses in our knowledge of how the forces that drive global financial systems operate. This is compounded by failure to appreciate the scope of interdependencies that exist across markets and their potential to destabilise the global financial system in times of crises. At the heart of this weakness is the inability to accurately understand the various propagation mechanisms and channels through which a crisis in one market is transmitted to other markets.

The widespread impact of the 2007 global financial crisis spurred a renewed interest in public policy debate and economic research on how the crisis was transmitted across different markets, despite their widely differing levels of economic development. At the centre of this debate lies the issue of financial market integration, contagion and volatility transmission.

Although the debate on this issue has generated many empirical studies in the developed and developing countries, the bulk of the studies have concentrated mainly on the major developed and developing stock markets in other regions; namely, Europe, Asia and Latin America. However, there are fewer empirical studies which focused on why African stock markets were affected by the crisis (see Chapter Four for empirical literature). Moreover, many of the empirical studies on financial crises still consider the issue of integration, contagion and volatility transmission in isolation, and thereby, ignore or at least underestimate the importance of integration in the propagation of a crisis.

In this context, the 2007 global financial crisis and subsequent Eurozone sovereign debt crisis provided a unique opportunity for investigating the dynamic interrelationship among different stock markets, particularly between the African stock markets and the major global stock markets. In other words, there is a need to explore the role of financial integration of African stock markets, with the major global stock markets at the centre of the financial crisis, in the transmission of the crisis. This requires a good understanding of the fundamental relationship between African stock markets and the major global markets on one the hand and the contagion effects from the international financial market during the crisis periods on the other hand.

Against this background, this study set out to empirically investigate the financial integration, contagion and volatility transmission between the African stock markets and the globally developed and emerging markets using weekly data over the period 3 January 2003 to 26 December 2014. The study covers 27 stock markets, which are grouped into three different markets: Africa markets; developed markets; and emerging markets. Specifically, this study considered 13 African stock markets (namely Botswana, BRVM, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, Nigeria, South Africa, Tunisia, Uganda and Zambia), 10 major developed stock markets (namely Australia, Canada, France, Germany, Hong Kong, Japan, Singapore, Switzerland, United Kingdom and United States) and 4 major emerging stock markets (namely Brazil, Russia, India and China).

In order to conceptualise the theme of this study, the following research question were posed in the introductory chapter: Is the simultaneous decline in economic growth and stock market returns directly connected with the level of integration of African financial markets with the major global markets? Do the African stock markets share any common trend with the major global markets? Since economies and their financial markets are at different levels of development, does financial integration matter in the international transmission of volatility? What impact did the 2007 global financial crisis have on the relationship between African markets and the major global markets? Did it cause a permanent or temporal effect on their relationship? Is there any evidence of co-movement in stock market returns to suggest synchronisation of business cycle, or otherwise decoupling? Is it appropriate to talk about financial contagion or to simply refer to the interdependence between markets? How much of the volatility can be attributed to a specific markets and to what extent does a specific African market receive volatility from the global markets? What are the implications of stock market integration for the international portfolio diversification?

Ten specific objectives were formulated to address these research questions and these specific objectives were: to examine the performance of stock markets in Africa before, during and after the crisis; to examine the relationship between African and the major global stock markets; to examine the impact of the global financial crisis on the relationship between African and the major global stock markets; to examine the dynamic lead-lag relationship between stock markets in Africa and major global markets; to examine the nature of co-movements between African markets and the major global stock markets; to examine whether there is evidence of financial contagion or otherwise; to examine whether there is evidence of decoupling or synchronisation of African stock markets with the global markets; to examine the level of volatility before, during and after the crisis; to examine the behaviour of volatility spillover effects during the crisis; and to make policy recommendations based on these findings.

In the light of these specific objectives, this study adopted two empirical frameworks based on evidence in the literature. The first empirical framework focused on the short-run and long-run relationships between African stock markets and major global stock markets using the Johansen co-integration test, Granger causality test, GIRF and GFEVD. The second framework focused on testing evidence of contagion and volatility transmission using the DCC-GJRGARCH model and AS-EGARCH model.

The Johansen co-integration technique was used to examine the long-run relationship or financial integration between African markets and major global markets. The use of the Johansen co-integration technique in this study was supported by a number of reasons: first, the test is robust when the variables are integrated of order one or *I(1).* Second, unlike the Engle-Granger test, it does not assume one co-integrating relationship when there are more than two variable. Third, the restrictive assumption that designates one of the variables as exogenous is absent. Fourth, the test provides asymptotically efficient estimates of the co-integrating vector. Lastly, the estimator allows for testing restricted forms of the co-integrating vector (Park & Gaidai, 2005; Sjo, 2008; and Asteriou & Hall, 2011).

To analyse the causal relationship between African markets and the global markets, the Granger causality was used as opposed to VECM. Moreover, the GIRF and GFEVD were used to analysed the sensitivity and proportion of shock in given markets due to shocks from other markets.

The DCC-GJRGARCH model was used to test evidence of contagion during the crisis period as well as the level of volatility. The use of the DCC-GJRGARCH model is based on its advantages over other estimation methods. First, the model does not assume constant conditional correlation, which is unrealistic in many applications. Rather, it allows for possible changes in conditional correlations over time. Another advantage of the model is that it estimates the conditional correlation coefficients of the standardised residual from the

GRACH and thus accounts for heteroskedasticity directly (Celik, 2012; and Chiang et al., 2007).

Furthermore, in addressing the issue of contagion in this study, two conditions were stipulated in Chapter Three as benchmarks for analysing evidence of contagion. First, if two markets are integrated before a crisis, any increase in correlation during the crisis period cannot be considered as contagion unless the correlation between the markets increased significantly. Second, contagion exists if the markets are not integrated before the crisis and there is evidence of significant increase in correlation during the crisis period relative to the pre-crisis period.

In order to provide an economic interpretation for the behaviour of dynamic conditional correlation during a crisis and pre-crisis period given these conditions, the study utilised the t-statistic test of equivalent correlation to test evidence of significant increase in correlation during the crisis period compared to pre-crisis period.

To complement the DCC-GJRGARCH model, the AS model was employed in this study to analyse the volatility characteristic of individual markets as well as to investigate for evidence of mean and volatility spillover effects from the global markets to African markets. The AS model applied in this study is based on EGARCH model. The AS-EGARCH model provides a way of capturing asymmetric effects in volatility without imposing non-negativity restrictions on the values of the GARCH parameters.

Finally, the applications of all the above empirical frameworks were carried out over four sample periods: full-sample (3 January 2003 – 26 December 2014); pre-crisis/stable period (3 January 2003 – 6 July 2007); global financial crisis period (13 July 2007 – 16 April 2010); and Eurozone crisis (23 Aril 2010 – 26 December 2014). By doing so, the study was able to show and quantify the impact of different crises on the relationship between the African markets and the major global markets. In addition, a bivariate testing procedure was applied by pairing individual markets with the major markets. The main findings from these empirical frameworks are summarised below.

8.3 The main findings

Based on the evidence from the estimation results of the two empirical frameworks employed in this study, the highlights of the findings are summarised in two parts. The first part covers the summary of results from the Johansen co-integration technique, Granger causality test, GIRF and GFEVD. The second part summarises the main findings from the DCC-GJRGARCH and AS-EGARCH models.

8.3.1 The main findings from the Johansen, Granger causality, GIRF and GFEVD

This section provides a summary of results from Johansen co-integration technique, Granger causality test, GIRF and GFEVD.

a) Johansen co-integration test

The Johansen co-integration technique was used in this study to examine evidence of long-run relationships between African, emerging and developed stock markets over four sample periods. The key findings from this test are presented below:

The findings revealed evidence of a co-integrating relationship among African markets as well as between African markets and the major global markets during the full-sample period. Over this period, the analysis among African markets shows that Botswana, BRVM, Egypt, Kenya, Mauritius, South Africa, Tunisia and Zambia are more co-integrated with the rest of the African markets. The findings also show that Botswana, BRVM, Mauritius, Tunisia and Zambia are more co-integrated with the emerging markets than other African markets, while, African markets such as Botswana, BRVM, Egypt, Kenya, Morocco, Nigeria, South Africa and Zambia are more co-integrated with the developed markets.

The findings during the pre-crisis period revealed a high degree of co-integrating relationships both within the African markets and between them and global markets. This is evident from the number of significant co-integrating relationships over this period. They further revealed that, apart from Morocco and Zambia, most African markets are co-integrated with the major global markets. The above findings indicate that African markets were integrated with the global markets before the 2007 global financial crisis.

However, the findings during the global financial crisis period revealed a dramatic reduction in the number of co-integrating relationships, both within the African markets and between them and the major global stock markets, except Botswana, Egypt, Kenya and Mauritius. This finding indicates evidence of a disintegration of African markets from the global markets during the global financial crisis period. Also, it indicates that the 2007 global financial crisis had an impact on the relationship between Africa and the global markets.

Conversely, the findings during the Eurozone crisis periods revealed increased number of co-integrating relationships across African, emerging and developed stock markets compared to the global financial crisis period. This finding suggests that the relationship between African, emerging and developed stock markets recovered over this period except for Ghana, Morocco, Namibia, Nigeria, Uganda and Zambia. It also indicates that the global financial crisis had a temporal effect on the relationship between African markets and the major global markets. The findings further indicate evidence of time varying co-integrating relationships across different sample periods.

b) Granger causality test results

Generally, the results from the application of the Granger causality test revealed the existence of both bidirectional and unidirectional causality among the African markets and between them and major global markets across all period. In particular, the result over the full-sample revealed evidence of strong interdependence among African markets and between African markets and the major global markets. Such a high level of interdependence is an indication of the sensitivity of African stock market returns to the movements in global stock market returns. This finding is very interesting in that shocks originating from either the developed or emerging markets can be transmitted to the African markets and vice versa.

The application of the Granger causality test across the three sub-samples revealed some interesting patterns. The findings prior to the 2007 global financial crisis revealed a low level of causal relationships between African markets and the major global markets. Unlike the pre-crisis period, the findings during the global financial crisis and Eurozone crisis periods revealed a significant increase in the number of causal relationships among these stock markets. This important finding was consistently observed across all the markets considered, suggesting the new causal linkages emerged between these markets during both periods of crisis. In addition, it suggests that both crises may have been transmitted into African markets through a new path created during the crisis, instead of following the existing path. This finding is consistent with economic theory.

Overall, the evidence revealed by the Granger causality test results has a number of implications particularly in terms of return and volatility transmission. The above findings would indicate that a dynamic interaction exists between African markets and the major global markets, to the extent that each market reacts to other markets shocks. By and large, the causal linkages between these markets could help amplify the transmission of shocks across markets during crisis periods. Hence, formulation of domestic policy should take into account the interdependence that exists across borders.

c) GIRF and GFEVD

The analysis based on the GIRF revealed the existence of positive and negative responses of African stock market returns to own-shocks and external shocks. However, African markets are more sensitive to own-shocks than external shocks across all periods under review. In addition, the finding revealed that African stock market responses to one generalised standard deviation impulse from foreign markets, are generally very low.

The findings from the GIRF also revealed that the response of African markets to shocks from the major global markets increased during the global financial crisis period. This finding indicates that shocks from the emerging and developed markets appear to have gained increasing influence on the African stock market returns during the global financial crisis period. This finding is in line with the evidence from the Granger causality test.

Similarly, the results from the application of the GFEVD revealed that stock market returns in Africa are mostly influenced by the market's own-shocks during the first week of the initial shock, while the influence from the global market shocks took some weeks to manifest. This evidence is consistent across all the sample periods considered, suggesting that the response of African stock markets to global stock market shocks is not immediate; rather there are some time lags in their response.

In addition, the results across the three sub-samples revealed that, while the sensitivity of African markets to shocks from foreign markets was low during the pre-crisis period, it increased dramatically during the global financial crisis. This finding is also consistent with the evidence from the Granger causality and GIRF. The increased magnitude of shocks in African markets indicates evidence that the global financial crisis amplified stock market volatility.

8.3.2 The results from the DCC-GJRGARCH and AS-EGARCH models

This section provides the summary of results from the DCC-GJRGARCH and AS-EGARCH models.

a) DCC-GJRGARCH

For the analysis of volatility and the dynamic conditional correlation across different markets and time periods, this study applied the DCC-GJRGARCH model. The results from this model revealed evidence of significant GARCH effects across all the markets and periods. This finding indicates evidence of long memory in stock market volatility and that volatility takes a long time to die out. There is limited evidence of significant ARCH effects across the markets and periods.

Also, the results revealed evidence of persistence in the magnitude of volatility across all the markets and time. However, the magnitude of stock volatility is found to be more highly persistent during the global financial crisis period relative to other periods. Additionally, there is overwhelming evidence of asymmetry in the volatility, particularly during the two crisis periods. These findings suggest that stock market volatility was higher during the crisis period than during the pre-crisis period. It also indicates that negative shocks during the crisis period have greater effects on the stock market volatility than positive shocks. These findings are consistent with the generally observed behaviour of volatility during crisis periods, which is in line economic theory. Similar results were found using the EGARCH model.

In respect of dynamic conditional correlation behaviour between African and global markets, it was found that the conditional correlation is mainly positive and varies significantly over time and across markets. Moreover, the presence of positive cross-market dynamic correlation points to evidence of co-movements between African markets and the global markets. It also was found that the conditional correlations of African markets with the developed markets were generally higher compared to correlation between African and the emerging markets.

Interestingly, the conditional correlation was found to be higher during both crisis periods compared to the pre-crisis period. Consequently, the results provide strong evidence of a contagion effect during both crisis periods. Based on this finding, evidence of the decoupling hypothesis during both crises is not supported; rather the findings support evidence of synchronisation, given the strong co-movement during both crisis periods.

b) AS-EGARCH model

For the mean spillover effects, the findings revealed that shocks from the global markets have positive and statistically significant effects on the conditional mean of African markets. The results further revealed evidence of limited spillover effect from the global markets to African markets during the pre-crisis period. However, the returns of African markets appear to be significantly influenced by the movement in the global markets during the two crisis periods. This finding suggests that Africa markets respond more to movements in global markets during times of crises, which indicates structural shift due to external shocks during crisis periods.

In respect of volatility spillover effects, the findings revealed evidence of negative and statistically significant volatility spillover effect from the global markets to African markets. Importantly, it was found that volatility spillover effect was high during both crisis periods relative to the pre-crisis period. This is visible from the number of statistically significant occasions of volatility spillover from the global markets to African markets in different sub-samples. This finding indicates that volatility spillover is a common phenomenon during periods of crisis, hence the presence of contagion. The findings from AS-GEARCH model corroborated the evidence from the Granger causality, GIRF and GFEVD.

8.4 Conclusion

Based on the key findings of this study, several interesting conclusions can be drawn with respect to the analysis of the financial integration, contagion and volatility transmission between African stock markets and the globally developed and emerging stock markets. The conclusions emerging from the findings of this study are summarised below.

The analysis of long-run relationships has shown that the majority of African stock markets moved together in the long-run with the major global stock markets during the pre-crisis and Eurozone crisis periods. Notably, while the long-run relationship between African stock markets and the major global markets disappeared during the period of the global financial crisis, the relationship re-emerged during the Eurozone crisis period. This finding is in line with economic theory, suggesting that co-integrated markets move together through time and, despite following their individual paths after a given shock in the short-run, they will not drift apart in the long-run since they are linked to some common trends (Engle & Granger, 1987). Therefore, the presence of co-integrating relationship between these markets supports the existence of financial integration of African stock markets with the global markets.

From the analysis of the Granger causality test, it was shown that some differences exist in terms of the relative strength of the causal linkages across markets and periods. In view of this fact, it was shown that strong causal linkages emerged during both crisis periods relative to the pre-crisis period. Also, the leading role of the major developed markets, compared to the emerging markets, is demonstrated throughout the analysis of causality tests and in all times. Moreover, the strong causal linkages between African markets and major global markets during the period of crises are an indication of the interdependence that exists among these markets to the extent that each market reacts to other market's shocks. The magnitude and sensitivity of African markets to shocks from the global markets was clearly highlighted by the analysis of the GIRF and GFEVD during both crisis periods.

Also, the analysis leads to the conclusion that there is evidence of mean and volatility spillover effects from the major global markets to African markets. More specifically, the periods of both crises exhibited highly significant mean and volatility spillover effects from the global markets to African markets. Moreover, the level of volatility was found to be more persistent during both crisis periods compared to pre-crisis period. Furthermore, volatility was also found to be highly asymmetric during both crisis periods. These results appear quite consistent with expectations, since high volatility levels and volatility transmissions are synonymous to contagion in times of financial crises. They also show that shocks taking place in the major global markets can spillover to African markets and induce significant changes in their conditional mean and volatility during crisis periods.

Furthermore, evidence of contagion was substantiated through the analysis of the pattern of conditional correlation during both crisis periods. More importantly, the analysis of the behaviour of the conditional correlation emphasised evidence of heightened co-movement during crisis periods, which confirms that shocks were propagated from the major global markets to African markets through contagion during both crisis periods. Consequently, the decoupling phenomenon is rejected in favour of synchronisation of business cycles between African stock markets and the major global markets. This observation implies that downturns in the major global markets are more likely to cause a downturn in African markets due to synchronisation and interdependence between these markets.

Overall, the findings of this study appear to be entirely consistent with expectations. They allow the conclusion that financial integration played some role in amplifying contagion and volatility transmission between African markets and the major global markets. With the increasing financial integration, these markets have become more dependent on each other, which promoted the transmission of the crisis from one market to another.

In this regard, this study contributes not only to the understanding of the level of interdependence that exists between African markets and the major global markets but also to direction of contagion and volatility spillover effects. More importantly, it has contributed to the understanding of how financial crises can spread across markets in a rapidly growing financially integrated system. These contributions are important component for implementing a countercyclical policy for the future. In particular, the knowledge of the direction of interdependence and volatility spillover provides valuable information for the policymakers.

Therefore, the contributions of this study have a number of important implications for both the policymakers and investors in Africa and the world at large. First, from the policymakers' perspective, the study provide some answers about the effects of growing financial linkages that exist across markets, which is important for designing appropriate regulatory frameworks. In the face of growing financial linkages, financial contagion can have widespread harmful consequences in the global market in general and African stock markets in particular. In addition, the growing financial integration can weaken and make African markets vulnerable to external shock because of their interdependencies with the global markets.

Second, the findings of this study provide valuable information about the possible direction of influences so that measures can be taken to prevent contagion and a volatility spillover effect during future crises.

Third, the knowledge about the dynamic interrelationship in terms of contagion and volatility transmission between African markets and the major global markets can be utilised by investors, and thereby help them to make better investment decisions. Moreover, the presence of contagion during crisis periods suggests that the benefits of portfolio diversification will be limited and investors should be careful when investing in markets that exhibited contagion.

8.5 Recommendations

The 2007 global financial crisis and subsequent Eurozone crisis have shown the limits of the current regulatory and supervisory frameworks at both the domestic and the international levels. The challenge is, therefore, to design new rules that reduce systemic risks, without imposing unnecessary burdens and limiting countries from reaping the benefits of financial integration. Hence, the important question the policymakers and investors should answer is how to mitigate the risk associated with vulnerability of markets to a financial crisis due to contagion and volatility transmission that accompany growing financial integration. Based on the conclusions and their implications as discussed above, the following recommendations are suggested:

Despite the beneficial effects of financial integration on growth and welfare at large, short-term capital flows, especially speculative capital flows, imply significant risks for economies whenever they are combined with unsustainable domestic policies. Sustainable macroeconomic policies are necessary if African markets are to reap the benefits of financial integration. These policies will enable African markets to attract stable and long-term capital inflows, which are appropriate for achieving economic growth in the long-run. However, such macroeconomic policies should to be carefully designed and aligned with the objective of external sustainability, as the volatility that is inherent in the international markets can have a significant impact on the volatility of the domestic markets.

Policymakers should understand that financial instability through contagion can influence the growth and development markets and thus lead to systemic risk. Therefore, there is a need to closely monitor changes in financial development in other markets in order to reduce vulnerability of domestic markets to systemic risk. Therefore, policy frameworks need to fully recognise the linkages that exist across borders, as well as the impact that policies and developments in other economies can have on domestic financial systems. In this context, limiting systemic risk will require a broader perimeter of regulation than what is currently available. This requires the collection of information from a much broader set of institutions, including stock exchanges, banks, insurance companies, hedge funds, and off-balance-sheet engagements of different financial entities, in order to reduce the build-up of systemic risk.

To complement this measure, greater cross-border co-operation and co-ordination, with proper supervision of different financial markets should be encouraged. This can be achieved through strategic partnerships and mergers, foreign institutional investments, cross market listing of shares, corporatisation of exchanges and introduction of private ownership. This will ensure adoption of higher governance standards and international best practices by exchanges, together with prudent portfolio management. Potentially, such a strategy would help to minimise volatility in international portfolio.

Also, policymakers in Africa need to take into account the transmission channels through which the global market shocks impact African markets. The size and impact of future global shocks and their persistence in African markets will depend on the future policies which prevent transmission of shock to African markets. This may require not only the financial sector reforms but also countercyclical macro-prudential fiscal and monetary policies to better enable them to respond to the financial and economic challenges in the occurrence of similar crises in the future.

Within individual African markets, there is a need for country-specific factors to be given due consideration when promoting and framing financial integration policies. The implementation of such policies requires sound domestic financial infrastructure in terms of reviewing transparency, disclosure and reporting rules as well as educating the investors regarding the nature and risk of the instruments. Furthermore, these must be accompanied by pre-emptive measures that could reduce the vulnerability of the African markets, and thereby prevent the transmission of volatility.

Finally, the evidence of diverse patterns of contagion and volatility spillover effects to African markets across the two crises indicates that investors should be cautious about simultaneously investing in markets that exhibited contagion and spillover effects. In this respect, this study recommends that investors may focus on volatility trading and construct their portfolio using hedge ratios to minimise risk.

8.6 Suggestions for future research

Although the findings of this study are robust, its weaknesses need to be explicitly acknowledged so that future studies can be undertaken in that direction. This study is limited in two significant ways; namely in terms of approach (methodology) and scope. In terms of approach, the methodology used, particularly for the analysis of financial integration in this study can extended to other approaches such as the VECM model, and linear- and the non-autoregressive distributable lag model (ARDL) so that their findings can be compared. Also, the DCC-GARCH model used in this study should be generalised to other MGARCH models. On the other hand, the scope of this study is specifically limited to equity markets. Hence, it will be important to account for other aspects of financial markets such as the bond market, commodity market, foreign exchange market and money market. All of these extensions should be the object of future research.

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APPENDIX A

Figure 5.1: An overview of methodologies on contagion

Empirical Methodologies for Contagion

No identified linkage

Latent factor model

<u>Definition of contagion</u>
Restrictive:

a. The effect of unanticipated shocks across asset markets during the period of crisis.
b. Change in beliefs or expectations due to shock in other countries.

<u>Examples</u>
Unanticipated shock model and multiple equilibria model.

Comovement analysis

<u>Definition of contagion</u>
Very restrictive:
Correlation and comovement of equity returns during the turmoil period is larger than those at normal times.

<u>Examples</u>
Correlation test for contagion, Dynamic Conditional Correlation analysis and Principal components model.

Model of non-linearities

<u>Definition of contagion</u>
Restrictive, if controlled for fundamentals:
The probability of crisis in one economy increases the probability of crisis of another.

Identified linkage (s)

Model of non-linearities with identified channel(s) as explanatory variable(s)

<u>Definition of contagion</u>
Broad:
Spillover effects through the identified channels.

Examples:
Trade and financial channels, and economic similarities.

Source: Cheung et al., (2009)

APPENDIX B

STRUCTURAL BREAK TEST

B.1 Chow Test for Structural Break

A formal procedure for testing the presence of structure break in a data series was developed by Chow (1960). The test involves breaking the data sample into two or more structures, estimating the equation for each and then comparing the residual sum of squares (RSS) from different samples with that of the whole sample (Asteriou & Hall, 2011). To identify a common breakpoint for all the markets considered and given that the analysis in this study focuses on the global financial crisis as well as the Eurozone crisis, Chow test is carried out between the major markets. For instance, the appropriate breakpoint for global financial crisis is obtained by running Chow breakpoint test between the United States and United Kingdom stock returns. The breakpoint is estimated using the following steps:

1. Estimate a regression equation using the full sample (3 January 2003 – 26 December 2014), pre-crisis/stable period (3 January 2003 – 6 July 2007), and global financial crisis period (13 July 2007 – 16 April 2010) as:

$$Y_t^{UK} = \beta_1 + \beta_2 X_t^{US} + \varepsilon_t \qquad \text{B.1}$$

where Y_t^{UK} is the stock market return for the United Kingdom and X_t^{US} is the United States stock market return. The United State stock market return is used as the independent variable in model since the global financial crisis originated from the United States.

2. Obtain the RSS across the three samples
3. Calculate the F-statistic as:

$$F = \frac{RSS_n - (RSS_{n1} + RSS_{n2})/K}{(RSS_1 + RSS_2)/(n-2K)} \qquad \text{B.2}$$

where RSS is the residual sum of squares obtained from individual samples, n represents number of observations in each sample and K is the number of parameters in the model and it is equal to 2.

4. The final step is to compare the F-statistic obtained above with the critical $F(k, n-2k)$ for the specified level of significance. The null hypothesis (H_0) of no structural break is testes against the alternative hypothesis (H_1) that there is a structural break.

In the case of the breakpoint for Eurozone sovereign debt crisis, equation B.1 in step one is slightly modified. Here, the regression is estimated using Germany, United Kingdom and United States as the explanatory variables while France is assumed to the dependent variable. The inclusion of Germany, United Kingdom and United States as explanatory variables in the regression is motivated by both the global and regional influence of these markets. The regression is estimated using the following data samples: full sample (3 January 2003 – 26) December 2014), pre-crisis/stable period (3 January 2003 – 16 April 2010) and Eurozone crisis (23 April 2010 – 26 December 2014).

B.2 Chow Test Results

Before carrying out the Chow test for both crisis periods, a visual inspection of the stock price behaviour over the study period is necessary (see Figure B.1 – B.4 below). A cursory look at these figures suggests that all the four markets experienced a steady downward movement starting from 13th July 2007. This date suggests a turning point of the global financial crisis. For the Eurozone crisis, the movement of stock prices in France, Germany and United Kingdom suggests 23rd April 2010 as the turning point. Following this observation, the following subsamples are identified and tested for structural break: full sample (3 January 2003 – 26 December 2014), pre-crisis/stable period (3 January 2003 – 6 July 2007), global financial crisis period (13 July 2007 – 16 April 2010) and Eurozone crisis (23 April 2010 – 26 December 2014). Therefore, Chow test is estimated using these dates in order to determine robustness of these breakpoints and the test results are presented below.

Table B.1: Chow breakpoint test results

Global financial crisis	**Test value**	**Probability**
F-statistic	429.58*	0.00
Log-likelihood ratio	543.14*	0.00
Wald Statistic	859.15*	0.00
Eurozone crisis		
F-statistic	1473.37*	0.00
Log-likelihood ratio	1474.13*	0.00
Wald Statistic	5893.48*	0.00

Note: * denotes significance at 5%.

Source: Author’s computation

Based on the evidence presented in the Table B.1, the null hypothesis of no break at the specified breakpoint is rejected at 5% level of significance using the F-statistic. This result is collaborated by log-likelihood ratio and Wald statistic. Therefore, the result suggests evidence of structural break and that the identified samples have different structures.

B.2 Dummy Variable Test for Structural Break

Another approach employed in this study to ensure the robustness of the selected breakpoint is the use of dummy variables. This approach requires running a regression that includes both a dummy variable for the intercept and a multiplicative dummy for each of the explanatory variables. To carry out this test, the following equations are estimated for both crisis periods:

$$Y_t^{UK,} = \beta_1 + \beta_2 D_t + \beta_3 X_t^{US} + \beta_4 X_t^{US} * D_t + \varepsilon_t \qquad \text{B.3}$$

$$Y_t^F = \beta_1 + \beta_2 D_t + \beta_3 X_t^{US} + \beta_4 X_t^{UK} + \beta_5 X_t^G + \beta_6 X_t^{US} * D_t + \beta_7 X_t^{UK} * D_t + \beta_8 X_t^G * D_t + \varepsilon_t \qquad \text{B.4}$$

where $D_t = \begin{cases} 1 & crisis \\ 0 & otherwise \end{cases}$

Equation B.3 and B.4 represent regression model for global financial crisis and Eurozone crisis respectively. D_t is a dummy variable for both crises. For instance, in equation B.3, D_t corresponds to the period of the global financial crisis (13 July 2007 – 16 April 2010) and in equation B.4 it corresponds to the period of Eurozone crisis (23 April 2010 – 26 December 2014). β_2 represents the coefficient for the intercept dummy while $\beta_4, \beta_6, \beta_7, \beta_8$ are the coefficients for slope dummies in both equations. The tables below show the estimation results of test.

The evidence from Table B.2 indicates that the estimated intercept coefficient (β_2) is not significance at 5% level. This suggests there is no structural change in the mean stock market return due to the global financial crisis. However, there is a structural change in the relationship between the United States and United Kingdom following the global financial crisis as evident from the statistically significance slope dummy (β_4). On the other hand, Table B.3 shows the results for the Eurozone crisis. The results show evidence of structural change in mean stock market returns as well as the relationship between the French stock markets returns and other major markets during the Eurozone crisis. This is indicated by the significance slope dummies $(\beta_2, \beta_6, \beta_7, \beta_8)$. This result is consistent with the Chow breakpoint test for the global financial crisis and Eurozone crisis. Therefore, it shows that the breakpoints are adequately specified and the different samples can be used individually in carrying out different tests in this study.

Table B.2: Dummy variable test result for the global financial crisis

Variable	Coefficient	Standard error	t-Statistic	Probability
β_1	701.36*	44.85	15.64	0.00
β_2	-140.27	95.61	-1.48	0.14
β_3	1.62*	0.03	49.46	0.00
β_4	0.22*	0.08	2.76	0.01

Note: * denotes significance at 5%. R-squared = 0.84; Durban-Watson statistic = 0.03

Source: Author's computation

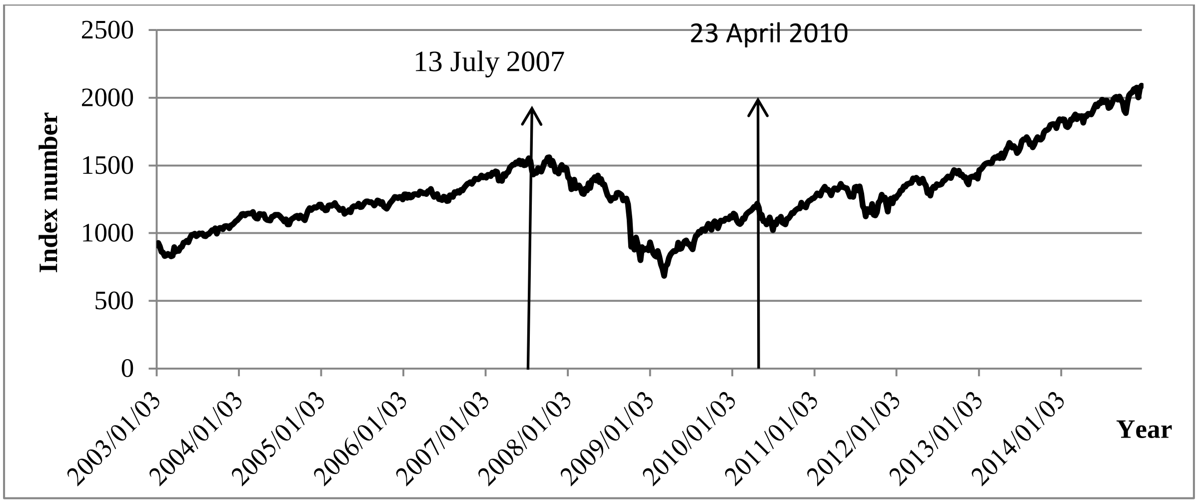
Table B.3: Dummy variable test result for the Eurozone crisis

Variable	Coefficient	Standard error	t-Statistic	Probability
β_1	-1303.02*	61.76	-21.10	0.00
β_2	2312.93*	208.44	11.10	0.00
β_3	2.16*	0.13	16.95	0.00
β_4	1.28*	0.09	14.78	0.00
β_5	-0.07*	0.02	-3.69	0.00
β_6	-3.93*	0.18	-21.28	0.00
β_7	-0.98*	0.16	-6.22	0.00
β_8	0.66*	0.04	15.32	0.00

Note: * denotes significance at 5%. R-squared = 0.96; Durban-Watson Statistic = 0.18

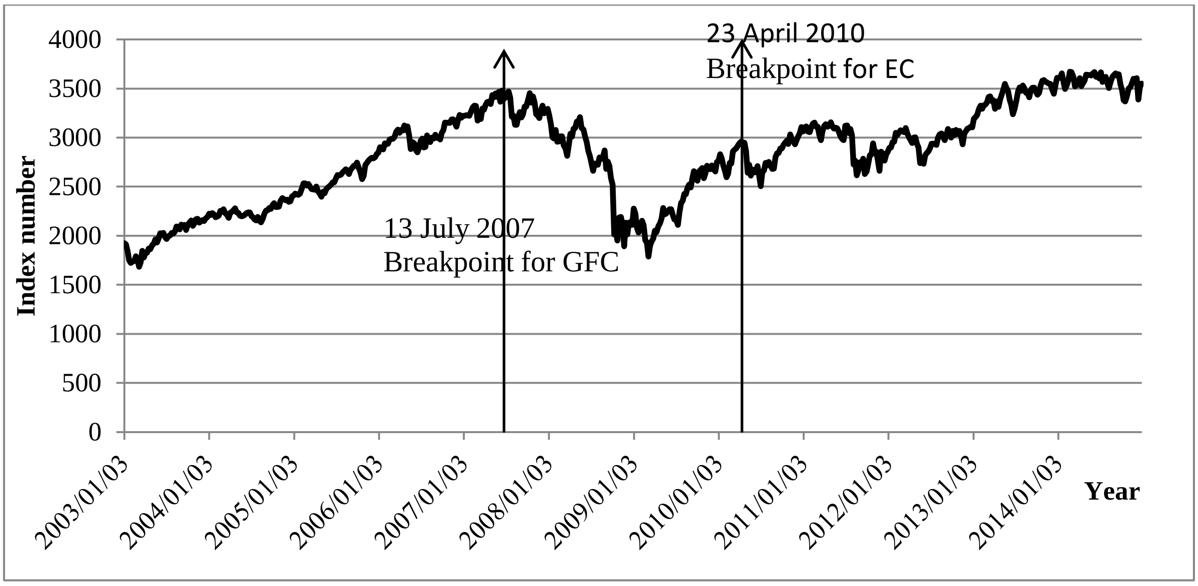
Source: Author's computation

Figure B.1: United States stock index (S&P 500), 2003 – 2014



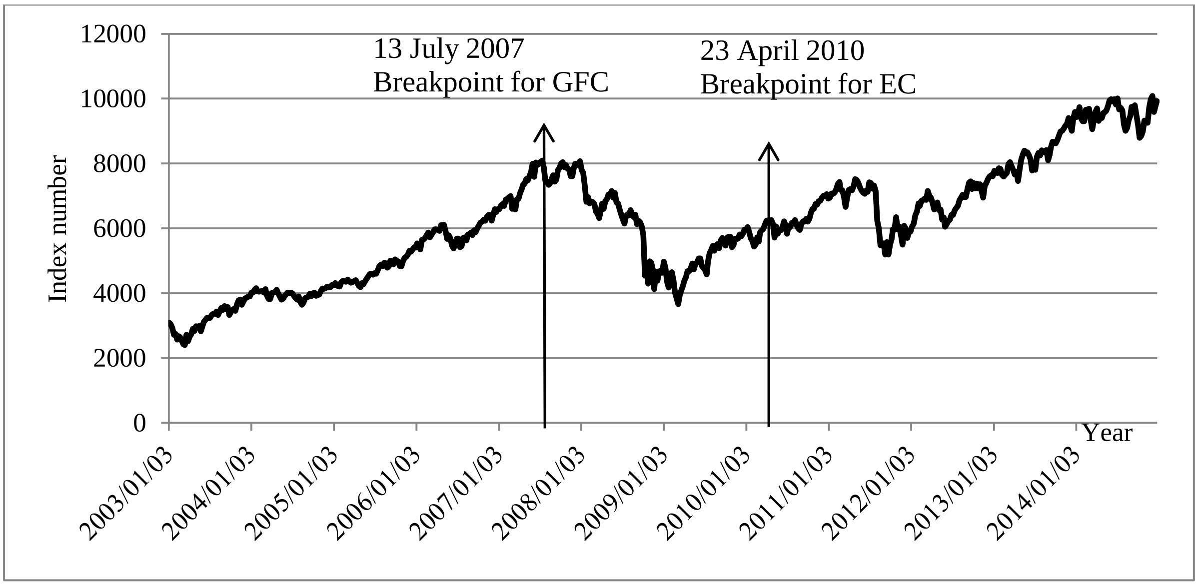
Data Source: Datastream and Bloomberg

Figure B.2: United Kingdom Stock index (FTSE100), 2003 – 2014



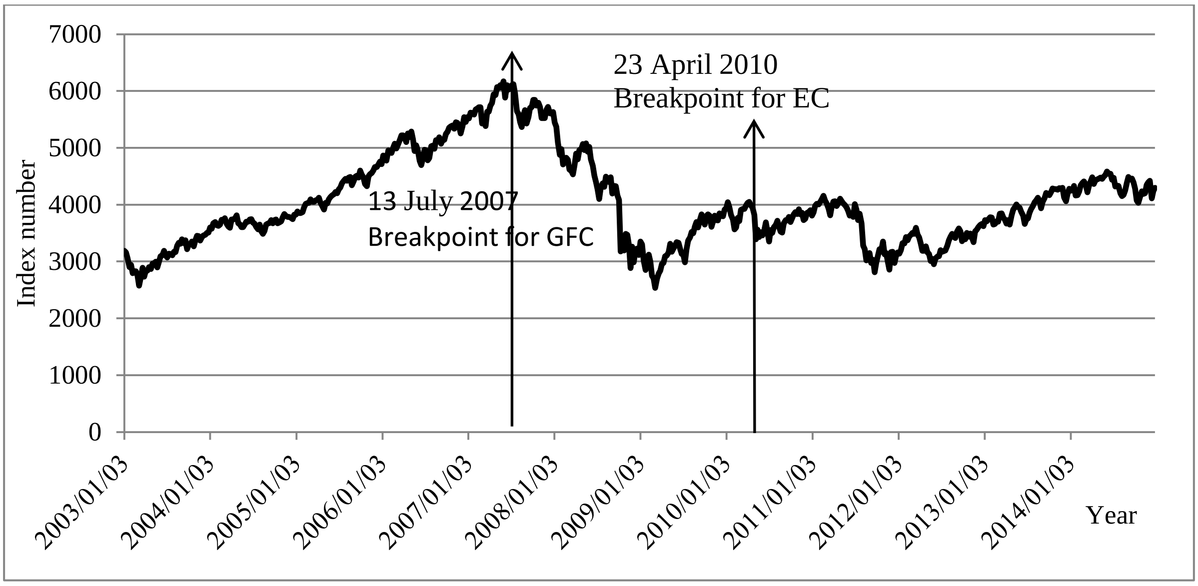
Data Source: Datastream and Bloomberg

Figure B.3: Germany stock index (DAX), 2003 – 2014



Data Source: Datastream and Bloomberg

Figure B.4: France stock index (CAC40), 2003 – 2014

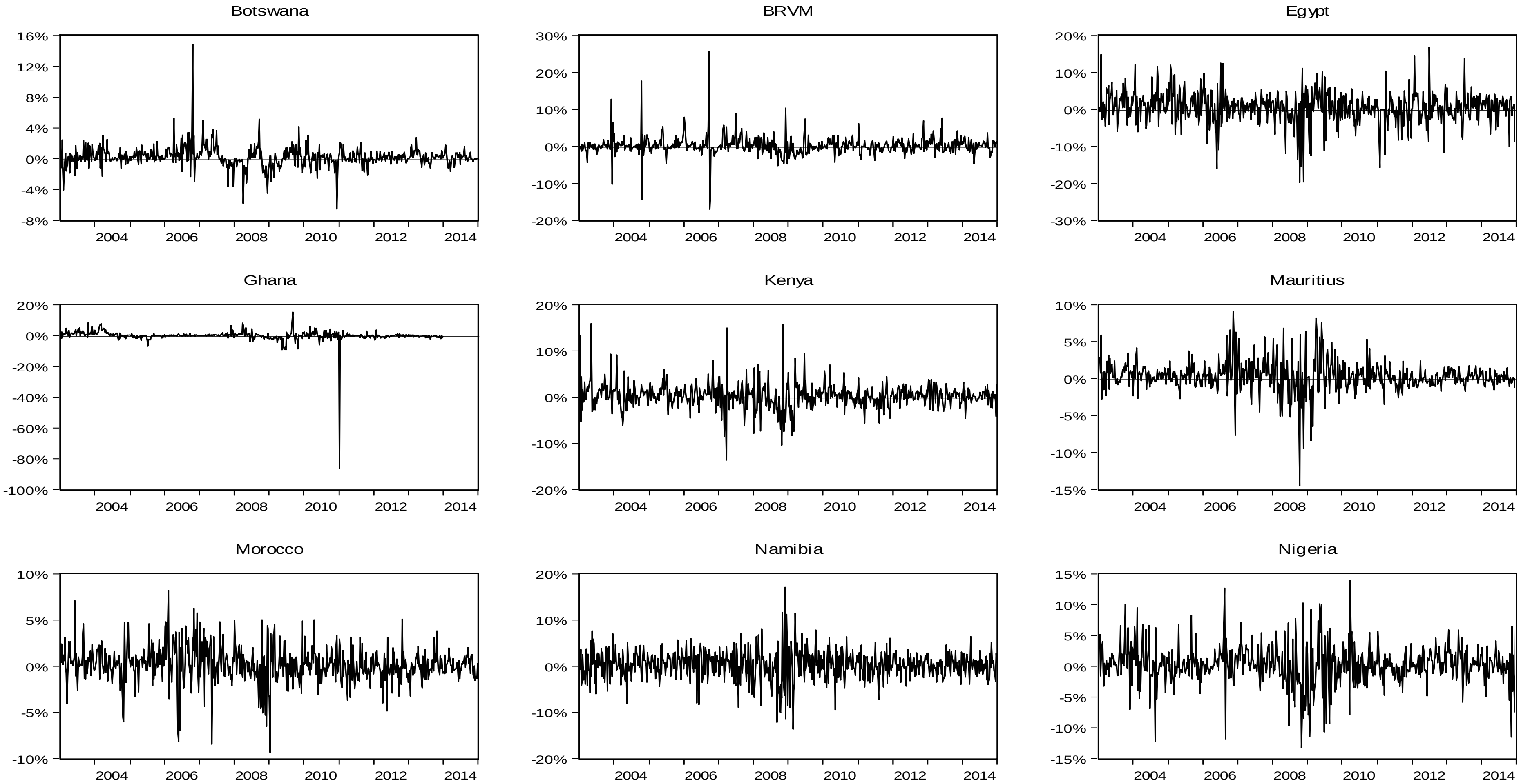


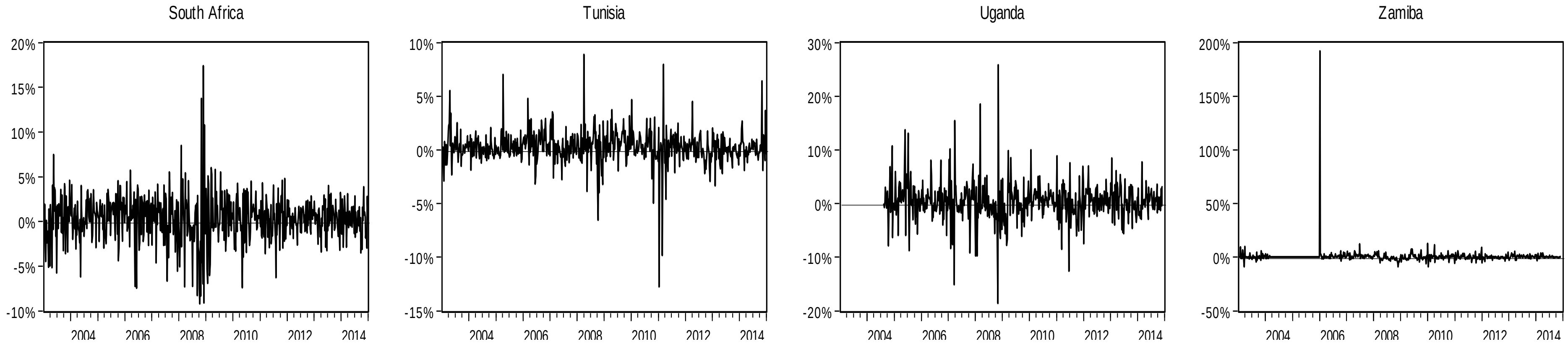
Data Source: Datastream and Bloomberg

APPENDIX C

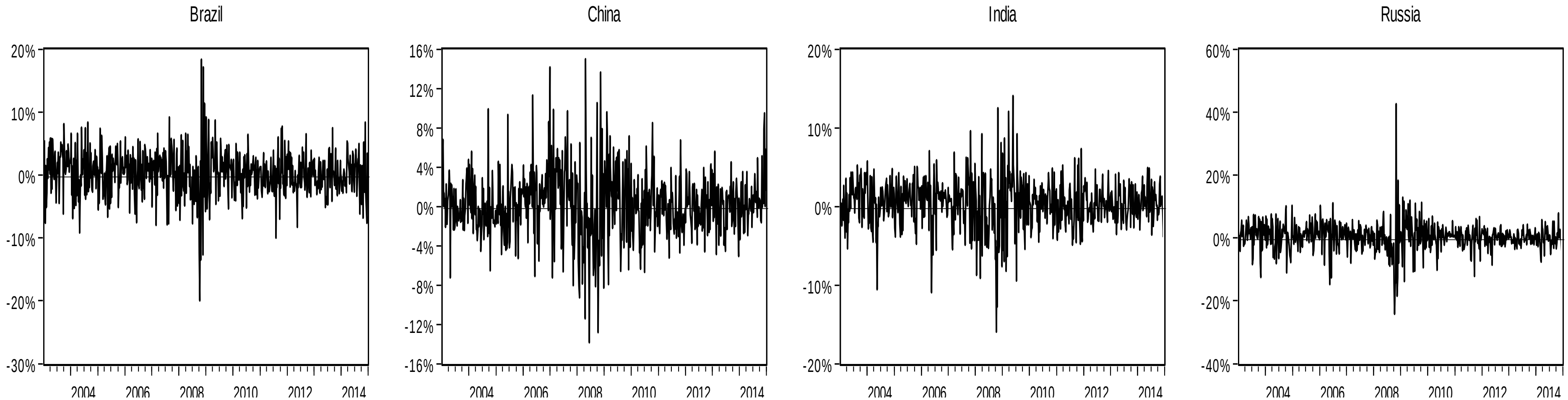
Figure 6.1: Weekly stock market returns

Panel A: Weekly stock returns for African markets (full-sample)

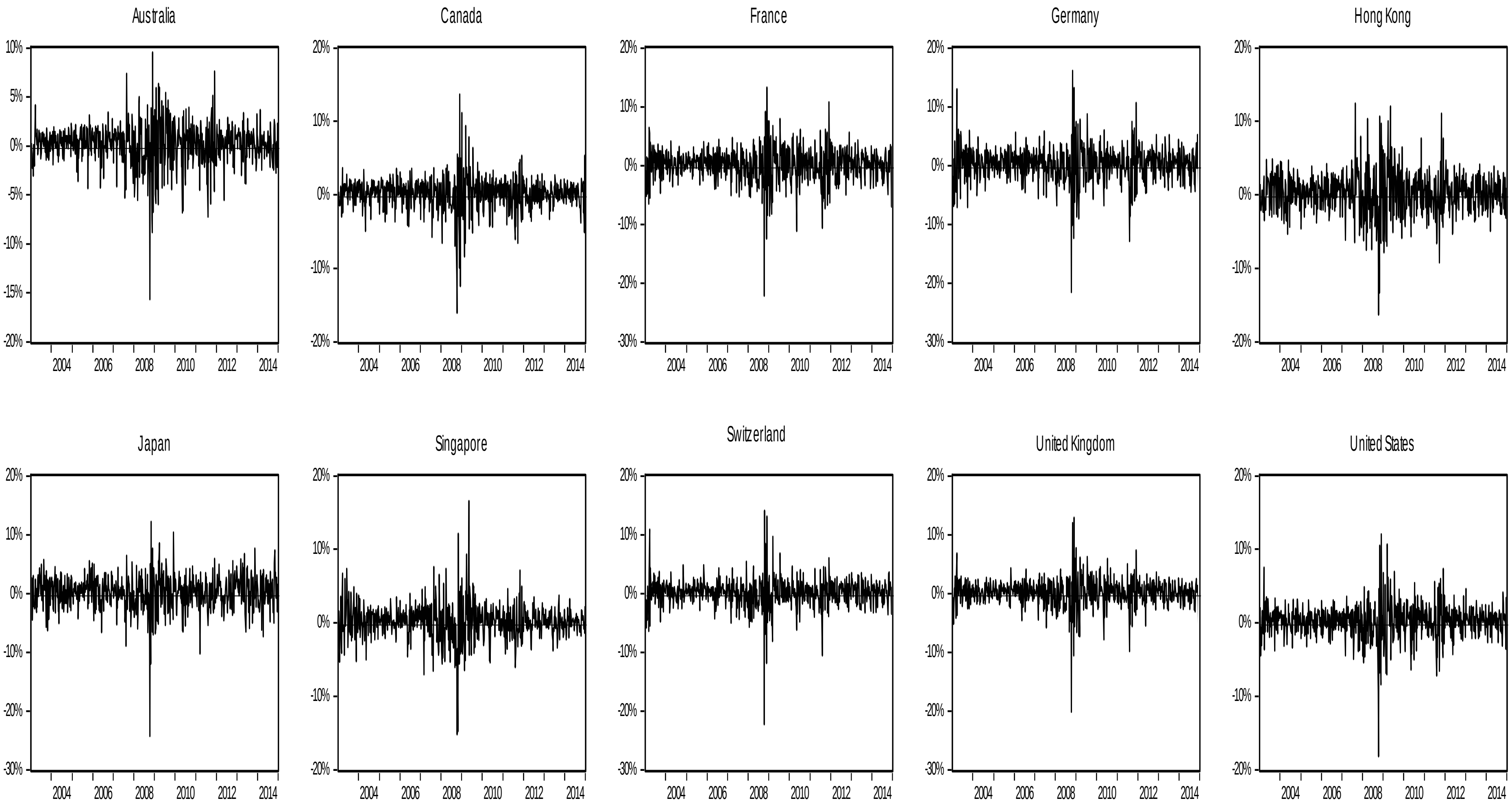




Panel B: Weekly stock returns for the emerging markets, (full-sample)



Panel C: Weekly stock returns for the developed markets, (full-sample)



Source: Author’s computation

APPENDIX D – BIVARIATE CO-INTEGRATION TEST RESULTS

Table D1: Bivariate co-integration test results for Botswana

Market: Botswana	**Full-sample period**							**Pre-crisis/stable period**						
	Trace test		**Eigenvalue test**		Lag	LM test	Model	**Trace test**		**Eigenvalue test**		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
BRVM	14.67	5.47	9.21	5.47	7	1.16	2	18.94*	3.04	15.90*	3.04	6	7.47	3
Egypt	25.94*	8.41	17.53*	8.41	6	2.52	2	30.26*	5.56	24.70*	5.56	2	3.24	3
Ghana	11.71	3.71	8.00	3.71	2	3.21	2	31.01*	6.44	25.56*	6.44	6	1.23	4
Kenya	20.36*	7.90*	12.46	7.90	6	7.83	3	29.61*	9.05	20.56*	9.05	6	3.77	4
Mauritius	19.36	5.73	13.63	5.73	10	1.95	2	24.34*	8.28*	16.05*	8.28*	9	4.00	3
Morocco	17.84	4.27	13.57	4.27	3	6.02	2	21.30*	1.56	19.74*	1.56	8	2.90	3
Namibia	31.51*	4.12	27.40*	4.12	3	1.46	4	15.78*	0.31	15.47*	0.31	7	4.12	3
Nigeria	12.45	4.83	7.62	4.83	9	1.31	2	30.00*	7.31	22.69*	7.31	9	2.78	2
South Africa	24.34*	5.25	19.09*	5.25	7	3.57	2	27.74*	3.63	24.11*	3.63	7	3.44	2
Tunisia	20.10	2.20	17.90	2.20	3	2.85	2	19.88*	0.23	19.64*	0.23	6	1.34	3
Uganda	22.98*	4.02	18.96*	4.02	3	6.13	2	35.11*	7.66	27.45*	7.66	2	3.89	2
Zambia	21.81*	7.72	14.10	7.72	3	1.60	2	31.58*	4.75	26.84*	4.75	2	3.51	4
Emerging Markets														
Brazil	22.22*	6.55*	15.66*	6.55*	8	4.86	3	24.82*	8.65*	16.17*	8.65*	6	3.23	3
China	15.38	6.28	9.10	6.28	9	0.83	2	18.49	2.92	15.56	2.92	9	2.99	2
India	15.81*	4.86*	10.95	4.86	6	2.52	3	27.39*	6.58	20.82*	6.58	6	1.42	4
Russia	23.74*	6.18*	17.56*	6.18*	7	5.05	3	20.13*	0.66	19.47*	0.66	6	1.63	3
Developed Markets														
Australia	19.54	7.84	11.70	7.85	8	1.64	2	21.22*	0.74	20.47*	0.74	2	4.12	3
Canada	28.17*	8.28	19.88*	8.28	6	0.42	2	32.62*	10.31	22.31*	10.31	2	2.73	4
France	19.85	8.21	11.64	8.21	8	3.25	2	29.12*	9.55	19.57*	9.55	6	0.12	4
Germany	21.62*	8.16	13.46	8.16	8	3.78	2	30.95*	6.72	24.23*	6.72	2	3.52	4
Hong Kong	26.18*	8.38	17.80*	8.38	8	3.32	2	36.10*	7.85	28.24*	7.85	6	2.81	2
Japan	29.70*	7.55	22.15*	7.55	3	6.49	4	18.82*	1.58	17.24*	1.58	6	3.09	3
Singapore	20.45*	5.69*	14.77*	5.69*	6	0.70	3	28.31*	5.57	22.73*	5.57	2	4.06	4
Switzerland	24.06*	6.74	17.32*	6.74	6	2.00	2	34.93*	8.20	26.72*	8.20	2	3.75	4
United Kingdom	17.86	5.90	11.96	5.90	11	0.43	2	17.72*	3.02	14.71*	3.02	6	7.64	3
United States	15.24	2.41	12.83	2.41	6	1.18	2	29.79*	6.45	23.34*	6.45	2	2.85	4

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation. Source: Author’s computation

Table D2: Bivariate co-integration test results for Botswana

Market: Botswana	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
BRVM	13.58	4.00	9.57	4.00	8	0.96	2	20.78*	3.28	17.50*	3.28	6	5.80	2
Egypt	29.48*	8.73	20.75*	8.73	2	1.86	4	27.92*	7.26	20.66*	7.26	2	6.36	4
Ghana	11.25	2.51	8.74	2.51	4	2.63	2	15.93	2.99	12.94	2.99	2	3.66	2
Kenya	18.30*	0.62	17.68*	0.62	7	6.64	3	35.80*	5.68	30.12*	5.68	3	6.92	4
Mauritius	27.28*	3.50	23.78*	3.50	2	1.50	4	16.94*	2.64	14.30*	2.64	8	3.20	3
Morocco	37.49*	4.05	33.44*	4.05	2	5.93	4	33.15*	5.56	19.39*	5.56	4	1.34	4
Namibia	20.03	4.38	15.65	4.38	4	4.28	2	37.63*	10.61	27.02*	10.61	3	8.05	4
Nigeria	21.42*	4.84	16.58*	4.84	2	4.22	2	30.76*	4.21	26.55*	4.21	3	8.10	4
South Africa	15.43	3.84	11.59	3.84	4	3.12	2	17.43*	0.17	17.26*	0.17	2	7.03	3
Tunisia	35.17*	10.95	24.21*	10.95	2	3.46	4	34.11*	3.37	30.73*	3.37	4	0.22	4
Uganda	12.97	2.23	10.75	2.23	4	3.61	2	9.48	3.36	6.12	3.36	2	3.52	2
Zambia	15.09	6.81	8.29	6.81	5	6.55	2	26.19*	4.78	21.39*	4.78	2	6.26	4
Emerging Markets														
Brazil	24.35*	8.27	16.08*	8.27	7	1.37	2	32.44*	7.99	24.44*	7.99	3	6.74	4
China	16.97	3.53	13.44	3.53	2	1.98	2	29.26*	0.00	29.26*	0.00	2	6.35	3
India	38.11*	8.66	29.44*	8.66	2	4.48	4	28.99*	6.16	22.83*	6.16	4	1.72	4
Russia	46.77*	5.87	40.90*	5.87	3	2.14	4	32.36*	3.49	28.87*	3.49	3	8.01	4
Developed Markets														
Australia	19.01	3.64	15.37	3.64	2	1.29	2	15.54*	0.23	15.31*	0.23	2	5.42	3
Canada	36.71*	12.03	24.68*	12.03	2	1.42	4	29.58*	11.09	18.49*	11.09	2	4.69	4
France	30.48*	0.01	30.47*	0.01	2	5.28	3	29.54*	7.33	22.22*	7.33	6	0.11	2
Germany	26.34*	0.08	26.26*	0.08	2	4.49	3	27.07*	7.09	19.99*	7.09	2	6.24	4
Hong Kong	33.46*	9.74	23.72*	9.74	2	1.29	4	19.27*	3.23	16.04*	3.23	2	5.65	3
Japan	33.79*	6.57	27.22	6.57	2	7.00	4	26.43*	5.89	20.54*	5.89	2	5.52	4
Singapore	26.90*	0.87	26.04*	0.87	2	4.83	3	19.14*	1.47	17.68*	1.47	2	5.93	3
Switzerland	31.58*	0.00	31.58*	0.00	2	6.82	3	33.78*	8.46	25.32*	8.46	2	5.00	4
United Kingdom	26.20*	0.04	26.16*	0.04	2	4.07	3	34.48*	9.86*	24.62*	9.86*	6	0.34	2
United States	24.63*	0.81	23.83*	0.81	2	3.54	3	20.07*	0.87	19.20*	0.87	2	4.98	3

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D3: Bivariate co-integration test results for BRVM

Market: BRVM	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	14.67	5.47	9.21	5.47	7	1.16	2	18.94*	3.04	15.90*	3.04	6	7.47	3
Egypt	22.08*	7.27*	14.81*	7.27*	9	6.13	3	32.12*	7.99	24.13*	7.99	2	2.35	2
Ghana	7.58	2.75	4.83	2.75	2	2.16	2	16.38	4.93	11.45	4.93	3	0.58	2
Kenya	35.45*	11.86	23.59*	11.86	2	2.14	4	19.24	6.80	12.44	6.80	2	3.69	2
Mauritius	22.29*	5.99	16.30*	5.99	2	1.25	2	31.20*	5.41	25.79*	5.41	2	2.81	2
Morocco	13.33	2.05	11.28	2.05	2	5.13	2	15.74	5.06	10.68	5.06	2	5.96	2
Namibia	35.40*	7.35	28.05*	7.35	2	1.29	4	24.16*	6.93	17.23*	6.93	2	3.32	2
Nigeria	15.55	5.05	10.50	5.05	7	2.28	2	14.99	3.87	11.07	3.87	2	4.95	2
South Africa	36.09*	5.77	30.32*	5.77	2	0.45	4	24.15*	6.47	17.68*	6.47	2	1.24	2
Tunisia	18.91	1.84	17.06*	1.84	2	2.64	2	18.07	4.32	13.75	4.32	2	2.89	2
Uganda	19.92	5.82	14.10	5.82	2	0.40	2	15.62	3.41	12.21	3.41	2	3.37	2
Zambia	13.48	4.25	9.23	4.25	2	2.19	2	10.26	2.22	8.04	2.22	2	2.37	2
Emerging Markets														
Brazil	22.83*	8.86	13.98	8.86	2	3.91	2	22.37*	8.02	14.34	8.02	2	4.39	2
China	9.09	2.27	6.82	2.27	2	4.38	2	17.58	1.91	15.68	1.91	2	3.64	2
India	25.40*	7.49	17.91*	7.49	3	1.07	2	18.87	7.87	11.00	7.87	2	2.63	2
Russia	23.79*	7.49	16.30*	7.49	2	1.27	3	21.86*	9.25*	12.61	9.25	2	4.92	2
Developed Markets														
Australia	39.70*	8.01	31.69*	8.01	2	0.52	4	23.60*	6.68	16.92*	6.68	2	1.98	2
Canada	28.64*	8.46	20.18*	8.46	5	5.04	2	26.93*	7.35	19.58*	7.35	2	1.07	2
France	38.46*	7.94	30.51*	7.94	2	0.61	4	22.44*	6.92	15.52	6.92	2	3.47	2
Germany	43.01*	7.48	35.53*	7.48	2	4.20	4	22.25*	6.78	15.47	6.78	2	1.08	2
Hong Kong	30.92*	6.55	24.37*	6.55	2	4.33	4	18.54	6.03	12.50	6.03	2	4.09	2
Japan	19.34	4.46	14.88	4.46	6	3.37	2	18.30	5.73	12.57	5.73	2	0.66	2
Singapore	40.59*	10.92	29.67*	10.92	2	3.23	4	25.01*	6.10	18.91*	6.10	2	3.29	2
Switzerland	39.70*	9.21	30.50*	9.21	3	3.43	4	20.11	5.76	14.35	5.76	2	2.42	2
United Kingdom	36.73*	16.06*	20.67*	16.06*	13	4.23	4	23.43*	9.30*	14.13	9.30	2	2.61	2
United States	30.20*	9.59	20.61*	9.59	2	1.82	4	17.63	7.12	10.51	7.12	2	0.95	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D4: Bivariate co-integration test results for BRVM

Market: BRVM	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	13.58	4.00	9.57	4.00	8	0.96	2	20.78*	3.28	17.50*	3.28	6	5.80	2
Egypt	28.81*	8.85	19.96*	8.85	4	6.73	2	31.50*	7.60	23.90*	7.60	2	2.64	2
Ghana	20.24*	1.61	18.63*	1.61	2	2.99	3	9.23	2.21	7.01	2.21	3	3.57	2
Kenya	16.39	5.33	11.06	5.33	2	3.78	2	21.05*	7.21	13.84	7.21	2	3.83	2
Mauritius	23.28*	8.93	14.36	8.93	2	1.80	2	33.94*	5.80	28.14*	5.80	2	3.22	2
Morocco	13.00	3.61	9.40	3.61	3	3.54	2	19.12	5.35	13.78	5.35	2	6.37	2
Namibia	11.55	3.69	7.87	3.69	2	1.62	2	20.18	4.05	16.13*	4.05	2	4.59	2
Nigeria	9.45	4.64	4.81	4.64	2	1.89	2	18.19	4.48	13.71	4.48	2	4.37	2
South Africa	11.04	3.71	7.33	3.71	2	5.10	2	20.99*	3.69	17.30*	3.69	2	2.30	2
Tunisia	12.08	4.06	8.03	4.06	2	1.25	2	18.21	3.63	14.59	3.63	2	3.06	2
Uganda	16.16	1.75	14.41	1.75	2	8.82	2	10.96	3.30	7.67	3.30	2	3.64	2
Zambia	10.62	3.29	7.32	3.29	6	6.68	2	11.56	3.09	8.47	3.09	2	1.89	2
Emerging Markets														
Brazil	15.02	5.54	9.48	5.54	2	3.37	2	22.53*	7.67	14.86	7.67	2	3.17	2
China	5.59	1.56	4.04	1.56	2	2.81	2	25.97*	5.75	20.21*	5.75	2	3.70	4
India	13.39	4.50	8.89	4.50	2	1.75	2	19.31	6.77	12.54	6.77	2	2.04	2
Russia	12.83	4.44	8.40	4.44	2	4.30	2	20.06	7.75	12.31	7.75	2	4.84	2
Developed Markets														
Australia	13.78	5.02	8.76	5.02	2	2.43	2	20.80*	5.13	15.67	5.13	2	1.17	2
Canada	15.45	5.82	9.63	5.82	2	0.50	2	23.93*	5.78	18.16*	5.78	2	0.80	2
France	13.53	3.91	9.62	3.91	2	2.69	2	17.72	3.82	13.90	3.82	2	3.79	2
Germany	12.18	4.07	8.11	4.07	2	0.80	2	20.93*	5.59	15.34	5.59	2	1.05	2
Hong Kong	14.78	3.79	10.98	3.79	2	2.50	2	20.90*	6.28	14.62	6.28	2	3.66	2
Japan	9.20	4.00	5.19	4.00	2	1.92	2	15.53	4.25	11.28	4.25	2	0.87	2
Singapore	17.74	5.89	11.85	5.89	3	2.62	2	24.54*	5.96	18.58*	5.96	2	3.29	2
Switzerland	11.95	3.53	8.42	3.53	2	2.27	2	16.94	3.61	13.33	3.61	2	2.34	2
United Kingdom	14.16	5.92	8.24	5.92	2	2.26	2	18.62	5.99	12.63	5.99	2	2.06	2
United States	11.67	4.39	7.28	4.39	2	0.55	2	17.45	6.51	10.95	6.51	2	0.84	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D5: Bivariate co-integration test results for Egypt

Market: Egypt	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	25.94*	8.41	17.53*	8.41	6	2.52	2	30.26*	5.56	24.70*	5.56	2	3.24	3
BRVM	25.88*	10.95	14.93	10.95	9	6.13	4	32.12*	7.99	24.13*	7.99	2	2.35	2
Ghana	16.04	2.24	13.80	2.24	4	0.79	2	18.43*	3.46	14.98*	3.46	3	1.22	3
Kenya	24.95*	6.63	18.32*	6.63	3	5.26	2	19.90	5.62	14.28	5.62	5	4.89	2
Mauritius	19.54	5.56	13.98	5.56	5	4.17	2	18.86	2.51	16.35*	2.51	7	2.93	2
Morocco	30.89*	10.82	20.08*	10.82	2	5.49	4	25.54*	4.46	21.08*	4.46	3	4.35	2
Namibia	19.21*	4.21*	15.00*	4.21*	3	6.13	3	32.51*	8.95	23.56*	8.95	2	2.78	2
Nigeria	15.75*	3.08	12.67	3.08	3	3.33	3	23.55*	1.46	22.10*	1.46	2	5.25	2
South Africa	21.09*	6.45	14.64	6.45	4	3.07	2	35.93*	12.07*	23.86*	12.07*	2	1.54	2
Tunisia	21.59*	6.94*	14.65*	6.94*	2	3.60	3	36.58*	5.23	31.35*	5.23	2	4.01	2
Uganda	20.08	5.69	14.39	5.69	4	6.86	2	30.51*	7.28	23.23*	7.28	2	2.97	2
Zambia	29.56*	10.61	18.95*	10.61	2	0.84	4	27.55*	4.49	23.05*	4.49	2	1.65	2
Emerging Markets														
Brazil	18.63	2.37	16.26*	2.37	4	0.68	2	20.73*	1.24	19.49*	1.24	7	0.42	2
China	18.42	4.18	14.25	4.18	4	1.31	2	31.05*	9.53*	21.52*	9.53*	2	1.93	2
India	15.72*	2.27	13.45	2.27	3	2.75	3	27.30*	4.02	23.28*	4.02	2	5.15	2
Russia	18.24	3.72	14.52	3.72	5	5.03	2	26.59*	2.53	24.05*	2.53	2	3.08	2
Developed Markets														
Australia	22.84*	4.80	18.03	4.80	7	6.27	2	31.93*	7.27	24.66*	7.27	2	5.28	2
Canada	19.30*	4.61*	14.69*	4.61*	9	1.62	3	22.87*	2.92	19.95*	2.92	7	2.76	2
France	17.28	5.66	11.62	5.66	16	2.36	2	21.05*	2.63	18.41*	2.63	7	1.16	2
Germany	16.07	2.11	13.96	2.11	4	3.68	2	27.68*	3.83	23.86*	3.83	2	0.80	2
Hong Kong	24.26*	5.95	18.32*	5.95	3	3.89	2	25.04*	2.82	22.22*	2.82	2	4.03	2
Japan	17.73*	1.97	15.76*	1.97	3	7.17	3	22.77*	3.37*	19.40*	3.37	6	4.77	2
Singapore	22.07*	4.10	17.98*	4.10	3	1.28	2	18.47	1.42	17.05*	1.42	7	1.91	2
Switzerland	18.04	2.69	15.35	2.69	4	4.30	2	29.11*	5.94	23.16*	5.94	2	0.48	2
United Kingdom	15.02	2.83	12.19	2.83	16	1.99	2	18.90	1.63	17.27*	1.63	7	0.47	2
United States	15.25	0.61	14.64	0.61	4	7.06	2	26.38*	3.68	22.70*	3.68	2	1.82	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D6: Bivariate co-integration test results for Egypt

Market: Egypt	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
Botswana	29.48*	8.73	20.75*	8.73	2	1.86	4	27.92*	7.26	20.66*	7.26	2	6.36	4
BRVM	28.81*	8.85	19.96*	8.85	4	6.73	2	31.50*	7.60	23.90*	7.60	2	2.64	2
Ghana	16.02	7.32	8.70	7.32	3	5.07	2	9.26	2.76	6.50	2.76	4	0.62	2
Kenya	20.60*	7.03	13.58	7.03	5	2.13	2	28.93*	4.59	24.34*	4.59	2	0.85	2
Mauritius	17.72	3.51	14.22	3.51	6	0.62	2	29.91*	3.51	26.40*	3.51	2	5.07	2
Morocco	18.54	2.38	16.16*	2.38	8	6.29	2	27.97*	5.79	22.18*	5.79	3	4.66	2
Namibia	16.18*	0.00	16.18*	0.00	2	2.03	3	31.01*	8.34	22.67*	8.34	2	3.20	2
Nigeria	20.25	2.58	17.67*	2.58	5	6.92	2	26.09*	1.92	24.17*	1.92	7	2.88	2
South Africa	26.07*	6.48	19.59*	6.48	2	5.16	4	35.45*	12.06*	23.39*	12.06*	2	1.93	2
Tunisia	31.28*	7.35	23.93*	7.35	2	2.58	2	23.37*	2.68	20.69*	2.68	4	2.27	2
Uganda	15.97	3.16	12.81	3.16	5	4.45	2	7.87	1.62	6.26	1.62	4	2.52	2
Zambia	17.34	3.73	13.61	3.73	6	4.36	2	28.03*	4.74	23.29*	4.74	2	1.75	2
Emerging Markets														
Brazil	25.78*	4.10	21.68*	4.10	2	7.56	2	27.80*	3.35	24.45*	3.35	2	7.39	2
China	20.00	6.02	13.98	6.02	7	0.94	2	17.94*	0.49	17.45*	0.49	2	2.28	3
India	18.50	3.35	15.15	3.35	6	0.76	2	27.64*	4.15	23.49*	4.15	2	4.71	2
Russia	24.19*	4.43	19.76*	4.43	2	2.87	2	26.96*	2.55	24.42*	2.55	2	3.00	2
Developed Markets														
Australia	32.90*	6.94	25.97*	6.94	2	5.98	4	31.05	7.45	23.60*	7.45	2	3.08	2
Canada	19.66	4.27	15.39	4.27	6	3.88	2	29.39*	5.69	23.70*	5.69	2	0.77	2
France	21.07*	3.63	17.44*	3.63	6	6.15	2	31.53*	7.52	24.02*	7.52	2	1.71	2
Germany	22.38*	5.12	17.26*	5.12	5	4.81	2	28.35*	4.20	24.15*	4.20	2	0.98	2
Hong Kong	22.68*	3.10	19.58*	3.10	2	5.33	2	25.01*	2.90	22.10*	2.90	2	4.17	2
Japan	19.46	3.51	15.96*	3.51	6	1.76	2	25.84*	3.65	22.19*	3.65	2	2.93	2
Singapore	22.30*	3.45	18.85*	3.45	2	5.96	2	24.52*	2.71	21.80*	2.71	2	1.94	2
Switzerland	24.73*	4.84	19.89*	4.84	2	0.48	2	29.32*	5.99	23.33*	5.99	2	0.72	2
United Kingdom	28.23*	8.19	20.04*	8.19	2	0.41	2	29.79*	5.94	23.85*	5.94	2	0.83	2
United States	23.21*	4.10	19.11*	4.10	2	1.55	2	27.39*	4.86	22.53*	4.86	2	1.48	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D7: Bivariate co-integration test results for Ghana

Market: Ghana	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	11.71	3.71	8.00	3.71	2	3.21	2	31.01*	6.44	25.56*	6.44	6	1.23	4
BRVM	7.58	2.75	4.83	2.75	2	2.16	2	16.38	4.93	11.45	4.93	3	0.58	2
Egypt	16.04	2.24	13.80	2.24	4	0.79	2	18.43*	3.46	14.98*	3.46	3	1.22	3
Kenya	13.98	0.98	12.99	0.98	2	2.26	2	17.66*	1.80	15.87*	1.80	4	2.17	3
Mauritius	17.30	4.02	13.28	4.02	2	1.10	2	27.26*	7.12	20.14*	7.12	3	2.21	2
Morocco	16.26	3.32	12.94	3.32	2	3.17	2	18.89	5.50	13.39	5.50	4	2.07	2
Namibia	8.92	1.99	6.93	1.99	2	2.86	2	26.58*	7.38	19.19*	7.38	4	3.08	2
Nigeria	5.83	0.42	5.41	0.42	2	4.64	2	13.98	2.84	11.14	2.84	4	3.80	2
South Africa	13.38	4.67	8.71	4.67	2	2.03	2	24.97*	8.94	16.04*	8.94	3	3.16	2
Tunisia	25.11*	7.63	17.48*	7.63	2	2.76	2	19.57	3.77	15.80*	3.77	4	0.91	2
Uganda	13.30	2.82	10.48	2.82	2	0.66	2	9.67	2.59	7.08	2.59	5	1.75	2
Zambia	10.87	3.52	7.35	3.52	2	1.96	2	14.15	2.54	11.61	2.54	3	0.53	2
Emerging Markets														
Brazil	17.59	2.64	13.95	2.64	3	1.78	2	23.00*	2.69	20.32*	2.69	4	5.18	2
China	2.85	0.67	2.18	0.67	2	4.01	2	15.58	2.31	13.27	2.31	3	3.73	2
India	13.84	2.99	10.85	2.99	3	1.90	2	19.76	3.23	16.53*	3.23	3	2.41	2
Russia	11.44	1.53	9.91	1.53	2	1.26	2	21.28*	2.21	19.08*	2.21	4	3.51	2
Developed Markets														
Australia	5.87	0.83	5.04	0.83	2	1.70	2	22.50*	9.02	13.48	9.02	3	1.00	2
Canada	9.85	1.49	8.36	1.49	2	3.21	2	23.74*	4.11	19.63*	4.11	4	3.93	2
France	4.64	0.43	4.21	0.43	2	1.97	2	19.94	3.93	16.02*	3.93	4	2.76	2
Germany	10.54	1.87	8.67	1.87	2	5.94	2	23.00*	2.81	20.19*	2.81	4	6.70	2
Hong Kong	9.72	1.26	8.01	1.26	2	3.74	2	21.67*	3.12	18.55*	3.12	3	4.87	2
Japan	5.53	1.02	4.51	1.02	3	2.97	2	14.20	2.17	12.03	2.17	3	0.79	2
Singapore	9.90	1.34	8.57	1.34	2	5.31	2	24.85*	4.82	20.02*	4.82	3	9.22	2
Switzerland	6.59	0.49	6.10	0.49	3	2.20	2	28.65*	9.48	19.17*	9.48	16	0.19	4
United Kingdom	9.39	1.05	8.34	1.05	2	5.38	2	29.11*	3.08	26.04*	3.08	4	4.20	2
United States	8.70	0.50	8.20	0.50	2	3.58	2	21.99*	2.00	19.99*	2.00	4	4.23	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D8: Bivariate co-integration test results for Ghana

Market: Ghana	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	11.25	2.51	8.74	2.51	4	2.63	2	15.93	2.99	12.94	2.99	2	3.66	2
BRVM	20.24*	1.61	18.63*	1.61	2	2.99	3	9.23	2.21	7.01	2.21	3	3.57	2
Egypt	16.02	7.32	8.70	7.32	3	5.07	2	9.26	2.76	6.50	2.76	4	0.62	2
Kenya	20.02	5.05	14.97	5.05	2	3.80	2	6.15	0.65	5.50	0.65	2	0.34	2
Mauritius	17.52	7.04	10.47	7.04	4	3.89	2	11.52	2.66	8.87	2.66	2	0.18	2
Morocco	12.90	2.70	10.20	2.70	2	4.16	2	15.43	5.58	9.85	5.58	2	0.52	2
Namibia	17.24	7.19	10.06	7.19	3	0.57	2	13.35	5.71	7.64	5.71	2	3.28	2
Nigeria	21.52*	3.71	17.81*	3.71	4	1.97	3	8.08	1.24	6.84	1.24	2	5.85	2
South Africa	18.61	5.88	12.74	5.88	2	6.68	2	12.86	2.33	10.54	2.33	2	1.01	2
Tunisia	10.48	2.06	8.41	2.06	3	0.84	2	9.92	3.64	6.28	3.64	2	3.69	2
Uganda	13.16	2.69	10.48	2.69	2	4.12	2	7.82	1.01	6.81	1.01	2	0.52	2
Zambia	34.07*	7.19	26.89*	7.19	5	1.25	4	16.05	4.03	12.03	4.03	2	2.91	2
Emerging Markets														
Brazil	13.89	3.55	10.34	3.55	3	1.50	2	15.20	5.28	9.92	5.28	2	4.88	2
China	12.40	5.03	7.37	5.03	4	5.05	2	10.25	4.82	5.43	4.82	2	5.18	2
India	14.67	4.94	9.74	4.94	3	4.52	2	12.24	5.36	6.88	5.36	2	0.75	2
Russia	13.57	4.50	9.07	4.50	2	4.92	2	19.10	7.72	11.37	7.72	2	5.13	2
Developed Markets														
Australia	17.62	6.55	11.07	6.55	3	1.59	2	7.59	1.64	5.95	1.64	2	0.45	2
Canada	13.37	5.58	7.79	5.58	3	1.17	2	12.72	4.77	7.95	4.77	2	0.39	2
France	16.93	5.51	11.42	5.51	2	5.35	2	8.36	2.56	5.80	2.56	2	0.64	2
Germany	15.58	6.11	9.46	6.11	3	7.35	2	9.45	2.18	7.27	2.18	2	5.32	2
Hong Kong	14.14	4.82	9.32	4.82	2	6.48	2	12.59	5.88	6.27	5.88	2	1.48	2
Japan	13.45	5.09	8.36	5.09	3	2.48	2	7.50	1.59	5.91	1.59	2	1.63	2
Singapore	15.40	5.65	9.74	5.65	2	7.72	2	13.84	6.26	7.58	6.26	2	1.83	2
Switzerland	18.06	6.40	11.66	6.40	2	4.41	2	7.01	1.31	5.71	1.31	2	1.06	2
United Kingdom	17.82	5.46	12.36	5.46	3	3.91	2	10.87	3.09	7.78	3.09	2	1.97	2
United States	16.97	6.24	10.72	6.24	2	4.15	2	10.37	2.32	8.04	2.32	2	0.55	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D9: Bivariate co-integration test results for Kenya

Market: Kenya	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
Botswana	20.36*	7.90*	12.46	7.90*	6	7.83	3	29.61*	9.05	20.56*	9.05	6	3.77	4
BRVM	35.45*	11.86	23.59*	11.86	2	2.14	4	19.24	6.80	12.44	6.80	2	3.69	2
Egypt	24.95*	6.63	18.32*	6.63	3	5.26	2	19.90	5.62	14.28	5.62	5	4.89	2
Ghana	13.98	0.98	12.99	0.98	2	2.26	2	17.66*	1.80	15.87*	1.80	4	2.17	3
Mauritius	21.82*	8.83	12.99	8.83	5	1.35	2	25.03*	8.16	16.87*	8.16	5	3.32	2
Morocco	25.74*	11.97*	13.77	11.97	8	1.33	2	20.76*	8.13	12.63	8.13	5	3.38	2
Namibia	18.57	4.98	13.59	4.98	5	3.35	2	27.58*	9.82*	17.76*	9.82*	3	5.61	2
Nigeria	21.80*	9.59*	12.21	9.59	3	4.36	2	18.04	4.22	13.83	4.22	3	2.50	2
South Africa	20.45*	7.11	13.34	7.11	6	6.26	2	17.41*	0.03	17.37*	0.03	5	6.82	3
Tunisia	23.44*	6.51	16.93*	6.51	3	2.79	2	20.45*	8.85	11.60	8.85	5	2.00	2
Uganda	11.25	3.55	7.70	3.55	4	6.65	2	12.87	3.10	9.76	3.10	2	3.12	2
Zambia	24.91*	11.51*	13.40	11.51	3	0.91	2	16.21	5.26	10.95	5.26	2	0.46	2
Emerging Markets														
Brazil	17.41*	2.70	14.72*	2.70	6	4.89	3	21.18*	6.47	14.71	6.47	9	3.78	2
China	18.81	4.80	14.01	4.80	4	3.22	2	19.92	7.09	12.83	7.09	5	5.88	2
India	19.37	4.83	14.54	4.83	4	5.70	2	19.55*	1.62	17.94*	1.62	4	2.81	3
Russia	20.61*	6.31	14.30	6.31	7	6.72	2	18.33	6.62	11.71	6.62	5	0.81	2
Developed Markets														
Australia	28.09*	5.32	22.77*	5.32	5	4.34	4	26.06*	9.84	16.22*	9.84	3	7.45	2
Canada	23.74*	9.55	14.20	9.55	9	2.14	2	17.97*	2.13	15.83*	2.13	4	2.57	3
France	18.52	4.22	14.30	4.22	8	1.95	2	20.57*	2.17	18.40*	2.17	4	3.11	3
Germany	18.62	4.44	14.18	4.44	8	0.76	2	20.80*	7.80	12.99	7.80	5	2.62	2
Hong Kong	18.59	5.47	13.12	5.47	7	4.41	2	22.56*	10.16*	12.40	10.16	2	2.59	2
Japan	18.09	2.38	15.71	2.38	7	3.06	2	17.10*	2.83	14.27*	2.83	3	4.29	3
Singapore	19.40	5.12	14.28	5.12	7	5.59	2	20.42*	6.81	13.61	6.81	5	4.06	2
Switzerland	23.43*	3.10	20.32*	3.10	8	2.70	3	22.63*	10.40*	12.23	10.40	5	0.46	2
United Kingdom	29.35*	6.61	22.74*	6.61	8	3.10	4	21.67*	6.45	15.23	6.45	6	1.83	2
United States	17.54	1.11	16.43*	1.11	5	6.01	2	15.98	4.27	11.70	4.27	6	1.62	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D10: Bivariate co-integration test results for Kenya

Market: Kenya	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	18.30*	0.62	17.68*	0.62	7	6.64	3	35.80	5.68	30.12*	5.68	3	6.92	4
BRVM	16.39	5.33	11.06	5.33	2	3.78	2	21.05*	7.21	13.84	7.21	2	3.83	2
Egypt	20.60*	7.03	13.58	7.03	5	2.13	2	28.93*	4.59	24.34*	4.59	2	0.85	2
Ghana	20.02	5.05	14.97	5.05	2	3.80	2	6.15	0.65	5.50	0.65	2	0.34	2
Mauritius	22.77*	7.49	15.28	7.49	5	1.91	2	26.59*	6.78	19.81*	6.78	3	1.83	2
Morocco	17.78*	3.46	14.33*	3.46	3	3.73	3	23.31*	7.21	16.00*	7.21	3	3.42	2
Namibia	18.16	4.86	13.30	4.86	6	3.97	2	16.22*	0.64	15.58*	0.64	3	5.26	3
Nigeria	13.17	2.24	10.93	2.24	3	2.20	2	18.60	4.40	14.40	4.40	3	2.63	2
South Africa	18.97	5.33	13.64	5.33	5	6.24	2	19.07*	0.07	19.00*	0.07	6	3.78	3
Tunisia	11.76	2.53	9.23	2.53	5	2.63	2	21.13*	8.97	12.16	8.97	5	2.36	2
Uganda	16.33	3.03	13.30	3.03	4	3.46	2	8.44	1.34	7.10	1.34	2	2.55	2
Zambia	12.69	3.57	9.12	3.57	5	7.97	2	17.19	5.43	11.76	5.43	2	0.35	2
Emerging Markets														
Brazil	19.46	8.90	10.56	8.90	4	4.39	2	24.91*	10.67	14.23	10.67	4	1.88	2
China	12.78	1.87	10.90	1.87	3	7.58	2	26.08*	5.13	20.96*	5.13	3	5.89	4
India	18.78*	1.32	17.46*	1.32	5	0.51	3	20.11*	1.39	18.72*	1.39	4	3.38	3
Russia	20.42*	3.18	17.24*	3.18	2	1.44	3	24.22*	8.76	15.46	8.76	2	2.63	2
Developed Markets														
Australia	14.82	6.26	8.56	6.26	3	2.29	2	26.71*	10.42*	16.30*	10.42*	3	6.44	2
Canada	21.71*	7.68	14.03	7.68	6	4.95	2	20.30*	2.42	17.88*	2.42	4	2.34	3
France	34.44*	7.12	27.32	7.12	5	1.35	4	24.36*	3.57	20.80*	3.57	4	3.52	3
Germany	28.71*	9.03	19.68*	9.03	5	3.28	4	20.67*	9.66*	11.00	9.66	6	2.22	2
Hong Kong	16.21	6.62	9.58	6.62	3	1.93	2	21.75*	9.86*	11.89	9.86	2	1.41	2
Japan	22.09*	8.82	13.27	8.82	5	3.59	2	18.40*	2.82	15.57*	2.82	3	4.57	3
Singapore	21.02*	8.01	13.01	8.01	8	2.83	2	22.92*	8.60	14.32	8.60	5	4.37	2
Switzerland	27.98*	8.24	19.74*	8.24	5	0.88	4	23.05*	10.79*	12.26	10.79	5	0.40	2
United Kingdom	18.78	7.12	11.66	7.12	5	4.19	2	26.61*	11.78*	14.84	11.78	4	4.28	2
United States	16.35	6.09	10.26	6.09	3	5.43	2	19.76	6.81	12.95	6.81	6	0.73	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D11: Bivariate co-integration test results for Mauritius

Market: Mauritius	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
Botswana	19.36	5.73	13.63	5.73	10	1.95	2	24.34*	8.28*	16.05*	8.28*	9	4.00	3
BRVM	22.29*	5.99	16.30*	5.99	2	1.25	2	31.20*	5.41	25.79*	5.41	2	2.81	2
Egypt	19.54	5.56	13.98	5.56	5	4.17	2	18.86	2.51	16.35*	2.51	7	2.93	2
Ghana	17.30	4.02	13.28	4.02	2	1.10	2	27.26*	7.12	20.14*	7.12	3	2.21	2
Kenya	21.82*	8.83	12.99	8.83	5	1.35	2	25.03*	8.16	16.87*	8.16	5	3.32	2
Morocco	19.59	2.68	16.90*	2.68	2	5.69	2	23.58*	3.50	20.09*	3.50	4	1.28	2
Namibia	19.26	4.08	15.18	4.08	3	6.19	2	33.84*	6.48	27.36*	6.48	2	4.71	2
Nigeria	12.53	3.54	8.99	3.54	6	6.12	2	14.99	5.46	9.53	5.46	8	1.64	2
South Africa	20.20	3.38	16.82*	3.38	5	2.97	2	31.43*	5.79	25.64*	5.79	2	4.20	2
Tunisia	20.89*	7.56	13.34	7356	14	1.35	2	25.09*	3.32	21.77*	3.32	4	1.96	2
Uganda	14.80	3.60	11.20	3.60	4	1.65	2	22.22*	7.41	14.82	7.41	2	7.23	2
Zambia	23.83*	9.51*	14.33	9.51*	2	1.40	2	26.22*	3.62	22.60*	3.62	2	2.82	2
Emerging Markets														
Brazil	27.64*	8.85	18.78*	8.85	2	9.05	2	30.86*	5.89	24.97*	5.89	2	6.56	2
China	19.77	2.51	17.26*	2.51	3	6.48	2	14.05	3.78	10.97	3.78	8	4.35	2
India	18.53*	3.61	14.91*	3.61	8	3.57	3	25.22*	3.33	21.89*	3.33	2	4.82	2
Russia	21.11*	8.04	13.07	8.04	7	6.81	2	26.13*	3.13	23.00*	3.13	2	5.73	2
Developed Markets														
Australia	18.76	5.80	12.97	5.80	5	5.35	2	29.83*	5.42	24.41*	5.42	3	1.69	2
Canada	19.79	6.47	13.32	6.47	3	4.97	2	26.23*	3.64	22.60*	3.64	2	3.83	2
France	19.44	7.73	11.72	7.73	5	2.69	2	29.94*	6.33	23.61*	6.33	2	2.94	2
Germany	21.46*	4.67	16.79*	4.67	2	7.69	2	30.14*	6.75	23.39*	6.75	2	1.91	2
Hong Kong	30.90*	7.45	23.45*	7.45	6	6.55	4	32.06*	8.86	23.20*	8.86	2	4.01	2
Japan	18.86	3.80	15.06	3.80	2	8.31	2	26.08*	3.95	22.13*	3.95	2	2.14	2
Singapore	21.99*	7.95	14.03	7.95	7	5.21	2	35.93	8.49	27.44*	8.49	2	3.39	2
Switzerland	15.97	4.48	11.49	4.48	4	1.56	2	27.17*	4.11	23.05*	4.11	2	2.95	2
United Kingdom	11.93	4.21	7.72	4.21	13	3.93	2	29.89*	4.96	24.92*	4.96	2	4.07	2
United States	11.21	0.95	10.26	0.95	5	3.38	2	32.35*	9.89*	22.46*	9.89*	2	3.44	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D12: Bivariate co-integration test results for Mauritius

Market: Mauritius	**Global financial crisis period**							**Eurozone crisis period**						
	Trace test		**Eigenvalue test**		Lag	LM test	Model	**Trace test**		**Eigenvalue test**		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
Botswana	27.28*	3.50	23.78*	3.50	2	1.50	4	16.94*	2.64	14.30*	2.64	8	3.20	3
BRVM	23.28*	8.93	14.36	8.93	2	1.80	2	33.94*	5.80	28.14*	5.80	2	3.22	2
Egypt	17.72	3.51	14.22	3.51	6	0.62	2	29.91*	3.51	26.40*	3.51	2	5.07	2
Ghana	17.52	7.04	10.47	7.04	4	3.89	2	11.52	2.66	8.87	2.66	2	0.18	2
Kenya	22.77*	7.49	15.28	7.49	5	1.91	2	26.59*	6.78	19.81*	6.78	3	1.83	2
Morocco	21.35*	7.78	13.57	7.78	2	4.50	2	26.60*	5.43	21.17*	5.43	2	6.68	2
Namibia	24.99*	7.69	17.30*	7.69	2	2.90	2	31.93*	4.98	26.96*	4.98	2	5.67	2
Nigeria	14.53	2.24	12.29	2.24	2	5.66	2	25.21*	4.26	20.96*	4.26	2	3.92	2
South Africa	20.39*	7.99	12.41	7.99	3	5.10	2	30.63*	5.61	25.02*	5.61	2	5.53	2
Tunisia	20.99*	5.40	15.60	5.40	2	4.11	2	25.30*	3.47	21.82*	3.47	4	1.90	2
Uganda	8.87	2.37	6.50	2.37	4	1.40	2	16.20	1.63	14.57	1.63	2	1.83	2
Zambia	13.10	4.80	8.30	4.80	6	3.21	2	25.56*	3.81	21.75*	3.81	2	2.89	2
Emerging Markets														
Brazil	31.24*	7.58	23.66*	7.58	2	5.15	2	31.05*	6.28	24.77*	6.28	2	6.00	2
China	19.70	3.84	15.86	3.84	2	4.22	2	31.38*	7.98	23.40*	7.98	4	1.84	2
India	26.58*	4.59	21.98*	4.59	2	5.41	2	26.24*	3.67	22.57*	3.67	2	5.59	2
Russia	28.94	6.26	22.68*	6.26	2	3.52	2	26.30*	3.17	23.13*	3.17	2	5.78	2
Developed Markets														
Australia	17.86	6.78	11.08	6.78	3	4.35	2	28.17*	5.14	23.03*	5.14	3	4.46	2
Canada	28.19*	5.81	22.38*	5.81	2	3.47	2	25.14*	3.47	21.67*	3.47	2	3.73	2
France	30.03*	8.22	21.81*	8.22	2	3.09	2	26.29*	3.58	22.71*	3.58	2	3.06	2
Germany	24.33*	5.39	18.93*	5.39	2	1.91	2	29.06*	6.67	22.39*	6.67	2	2.09	2
Hong Kong	26.33*	4.63	21.71*	4.63	2	0.90	2	34.64*	10.28*	24.36*	10.28*	2	3.80	2
Japan	19.57	5.28	14.29	5.28	2	2.01	2	24.08*	3.09	20.99*	3.09	2	2.94	2
Singapore	26.14*	5.42	20.73*	5.42	2	8.81	2	35.09*	9.64*	25.45*	9.64*	2	3.98	2
Switzerland	24.32*	5.05	19.27*	5.05	2	2.39	2	26.43*	2.86	23.58*	2.86	2	3.35	2
United Kingdom	29.81*	6.31	23.50*	6.31	2	4.71	2	28.33*	4.02	24.32*	4.02	2	3.88	2
United States	28.51*	6.42	22.09*	6.42	2	3.55	2	31.15*	9.68*	21.47*	9.68*	2	3.30	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D13: Bivariate co-integration test results for Morocco

Market: Morocco	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	17.84	4.27	13.57	4.27	3	6.02	2	21.30*	1.56	19.74*	1.56	8	2.90	3
BRVM	13.33	2.05	11.28	2.05	2	5.13	2	15.74	5.06	10.68	5.06	2	5.96	2
Egypt	30.89*	10.82	20.08*	10.82	2	5.49	4	25.54*	4.46	21.08*	4.46	3	4.35	2
Ghana	16.26	3.32	12.94	3.32	2	3.17	2	18.89	5.50	13.39	5.50	4	2.07	2
Kenya	31.87*	12.24	19.64*	12.24	2	4.47	4	20.76*	8.13	12.63	8.13	5	3.38	2
Mauritius	19.59	2.68	16.90*	2.68	2	5.69	2	23.58*	3.50	20.09*	3.50	4	1.28	2
Namibia	13.38	2.07	11.32	2.07	8	2.56	2	22.77*	6.66	16.11	6.66	2	5.26	2
Nigeria	16.12	3.45	12.66	3.45	2	4.89	2	19.70	2.52	17.18*	2.52	2	3.55	2
South Africa	15.42	1.10	14.32	1.10	8	2.54	2	19.58	4.85	14.74	4.85	2	4.11	2
Tunisia	25.25*	4.65	20.60*	4.65	2	3.94	2	23.25*	7.44	15.82	7.44	5	2.24	2
Uganda	13.02	0.86	12.15	0.86	6	1.12	2	17.15	6.26	10.89	6.26	2	3.25	2
Zambia	13.54	3.64	9.90	3.64	2	2.13	2	20.84*	8.50	12.33	8.50	2	2.64	2
Emerging Markets														
Brazil	23.57*	8.17	15.41	8.17	8	1.54	2	18.91	4.84	14.07	4.84	2	5.68	2
China	17.67	4.07	13.60	4.07	4	0.15	2	19.20	7.32	11.89	7.32	4	2.97	2
India	17.80	2.02	15.78	2.02	3	2.87	2	17.06	4.17	12.89	4.17	2	5.89	2
Russia	31.28*	6.49	24.79*	6.49	8	2.65	4	20.46*	6.02	14.44	6.02	3	4.61	2
Developed Markets														
Australia	20.62*	4.34*	16.28*	4.34*	2	3.86	3	19.03	4.26	14.77	4.26	2	2.74	2
Canada	16.60	7.33	9.27	7.33	9	2.99	2	17.78	3.53	14.25	3.53	2	2.17	2
France	32.25*	10.68	21.57*	10.68	9	7.57	4	18.59	5.18	13.41	5.18	2	3.09	2
Germany	14.29	2.37	11.93	2.37	8	4.66	2	19.35	5.91	13.44	5.91	2	2.39	2
Hong Kong	20.46*	7.24	13.22	7.24	3	3.25	2	17.96	5.32	13.64	5.32	2	2.82	2
Japan	22.92*	5.32	17.59*	5.32	3	5.20	2	15.34	4.74	10.59	4.74	2	2.76	2
Singapore	19.13	5.32	13.81	5.32	3	5.00	2	19.85	4.19	15.66	4.19	2	3.58	2
Switzerland	24.51*	9.23*	15.28	9.23	8	4.93	2	21.79*	3.88	17.91*	3.88	2	1.93	2
United Kingdom	21.84*	4.98	16.86*	4.98	4	7.63	2	19.44	5.07	14.37	5.07	2	2.89	2
United States	14.10	1.05	13.05	1.05	2	6.64	2	17.62	5.30	12.32	5.30	2	2.59	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D14: Bivariate co-integration test results for Morocco

Market: Morocco	**Global financial crisis period**							**Eurozone crisis period**						
	Trace test		**Eigenvalue test**		Lag	LM test	Model	**Trace test**		**Eigenvalue test**		Lag	LM stat	Model
	$r=0$	$r\leq1$	$r=0$	$r\leq1$				$r=0$	$r\leq1$	$r=0$	$r\leq1$			
Botswana	37.49*	4.05	33.44*	4.05	2	5.93	4	33.15*	5.56	19.39*	5.56	4	1.34	4
BRVM	13.00	3.61	9.40	3.61	3	3.54	2	19.12	5.35	13.78	5.35	2	6.37	2
Egypt	18.54	2.38	16.16*	2.38	8	6.29	2	27.97*	5.79	22.18*	5.79	3	4.66	2
Ghana	12.90	2.70	10.20	2.70	2	4.16	2	15.43	5.58	9.85	5.58	2	0.52	2
Kenya	17.78*	3.46	14.33*	3.46	3	3.73	3	23.31*	7.21	16.00*	7.21	3	3.42	2
Mauritius	21.35*	7.78	13.57	7.78	2	4.50	2	26.60*	5.43	21.17*	5.43	2	6.68	2
Namibia	13.40	4.69	8.71	4.69	2	1.93	2	20.36*	4.17	16.19*	4.17	2	4.68	2
Nigeria	12.08	4.86	7.22	4.86	2	3.84	2	21.88*	3.27	18.61*	3.27	2	2.98	2
South Africa	15.03	5.24	9.79	5.24	2	4.79	2	18.36	3.04	15.32	3.04	2	3.74	2
Tunisia	17.67	4.77	12.91	4.77	2	1.90	2	20.84*	6.06	14.78	6.06	5	5.81	2
Uganda	13.65	4.75	8.90	4.75	10	4.59	2	7.98	2.71	5.27	2.71	2	2.36	2
Zambia	17.24	7.28	9.96	7.28	6	5.48	2	23.32*	8.73	14.59	8.73	2	2.66	2
Emerging Markets														
Brazil	18.25	7.84	10.41	7.84	2	6.86	2	20.42*	5.32	15.10	5.32	2	4.45	2
China	9.49	3.24	6.25	3.24	2	1.82	2	15.65*	0.04	15.61*	0.04	4	3.56	3
India	16.63	5.56	11.07	5.56	2	2.66	2	18.36	4.10	14.26	4.10	2	5.13	2
Russia	17.54	7.08	10.46	7.08	2	3.11	2	20.55*	5.45	15.10	5.45	3	1.72	2
Developed Markets														
Australia	14.40	6.27	8.13	6.27	2	1.80	2	18.89	3.87	15.02	3.87	2	1.98	2
Canada	17.56	5.39	12.18	5.39	2	2.53	2	18.16	3.45	14.71	3.45	2	1.62	2
France	20.70*	6.14	14.55	6.14	2	1.45	2	16.25	2.91	13.33	2.91	2	2.08	2
Germany	18.87	5.10	13.77	5.10	2	2.15	2	19.23	5.64	13.59	5.64	2	1.72	2
Hong Kong	15.49	4.92	10.57	4.92	2	2.42	2	20.88*	6.10	14.78	6.10	2	2.11	2
Japan	19.31	5.82	13.49	5.82	2	1.22	2	14.83	3.42	11.40	3.42	2	2.06	2
Singapore	17.81	7.18	10.63	7.18	2	5.97	2	21.06*	5.09	15.97*	5.09	2	2.61	2
Switzerland	16.65*	0.06	16.59*	0.06	2	1.31	2	19.32	2.47	16.84*	2.47	2	1.40	2
United Kingdom	16.14	5.26	10.88	5.26	2	1.58	2	18.21	4.05	14.16	4.05	2	2.02	2
United States	18.66	5.40	13.25	5.40	2	4.36	2	18.38	5.97	12.41	5.97	2	1.69	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D15: Bivariate co-integration test results for Namibia

Market: Namibia	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$				$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$			
Botswana	31.51*	4.12	27.40*	4.12	3	1.46	4	15.78*	0.31	15.47*	0.31	7	4.12	3
BRVM	35.40*	7.35	28.05*	7.35	2	1.29	4	24.16*	6.93	17.23*	6.93	2	3.32	2
Egypt	19.21*	4.21*	15.00*	4.21*	3	6.13	3	32.51*	8.95	23.56*	8.95	2	2.78	2
Ghana	8.92	1.99	6.93	1.99	2	2.86	2	26.58*	7.38	19.19*	7.38	4	3.08	2
Kenya	18.57	4.98	13.59	4.98	5	3.35	2	27.58*	9.82*	17.76*	9.82*	3	5.61	2
Mauritius	19.26	4.08	15.18	4.08	3	6.19	2	33.84*	6.48	27.36*	6.48	2	4.71	2
Morocco	13.38	2.07	11.32	2.07	8	2.56	2	22.77*	6.66	16.11	6.66	2	5.26	2
Nigeria	13.42	2.36	11.06	2.36	3	5.29	2	25.88*	3.73	22.15*	3.73	5	1.99	2
South Africa	16.86	4.80	12.06	4.80	2	2.69	2	17.04	4.24	12.80	4.24	3	2.39	2
Tunisia	19.94	3.60	16.34*	3.60	2	3.77	2	26.47*	9.30	17.17*	9.30	5	0.81	2
Uganda	14.50	5.76	8.74	5.76	4	1.79	2	27.72*	4.27	23.45*	4.27	4	6.97	2
Zambia	22.30*	2.71	19.59*	2.71	2	2.37	2	21.53*	4.33	17.20*	4.33	2	3.25	2
Emerging Markets														
Brazil	16.01	3.24	12.77	3.24	3	0.14	2	27.42*	12.51*	14.90	12.51	4	2.11	2
China	11.15	4.23	6.92	4.23	4	2.00	2	21.91*	5.49	16.43*	5.49	3	4.14	2
India	15.83	6.22	9.61	6.22	8	5.30	2	20.55*	9.12	11.43	9.12	3	1.66	2
Russia	21.32*	7.75	13.56	7.75	8	3.11	2	28.07*	13.36*	14.71	13.36	2	5.29	2
Developed Markets														
Australia	10.49	4.17	6.31	4.17	3	2.15	2	19.93	6.21	13.72	6.21	2	6.25	2
Canada	21.70*	6.94	14.76	6.94	9	3.21	2	21.74	8.29	13.45	8.29	2	4.18	2
France	13.80	6.45	7.35	6.45	6	5.73	2	20.20	6.68	13.52	6.68	2	5.85	2
Germany	18.01	7.35	10.66	7.35	4	5.83	2	23.42*	8.32	15.10	8.32	2	5.64	2
Hong Kong	17.27	7.97	11.30	7.97	3	5.90	2	18.64	6.34	12.30	6.34	3	2.91	2
Japan	9.62	2.62	7.00	2.62	4	0.82	2	18.78	6.48	12.30	6.48	2	3.43	2
Singapore	26.78*	6.76	20.02*	6.76	9	2.19	4	19.86	5.57	14.28	5.57	3	6.01	2
Switzerland	10.35	3.28	7.07	3.28	4	4.38	2	21.05*	5.84	15.21	5.84	2	2.99	2
United Kingdom	17.03	6.97	10.06	6.97	4	6.38	2	31.82*	6.48	25.34*	6.48	6	2.58	4
United States	8.32	0.85	7.47	0.85	8	6.17	2	22.14*	8.20	13.95	8.20	2	4.27	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r = 0$ = 20.26 (15.89) and $r \leq 1$ = 9.16 (9.16); Model 3 when $r = 0$ =15.49 (14.26) and $r \leq 1$ = 3.84 (3.84); and Model 4 when $r = 0$ = 25.87 (19.39) and $r \leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D16: Bivariate co-integration test results for Namibia

Market: Namibia	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	20.03	4.38	15.65	4.38	4	4.28	2	37.63*	10.61	27.02*	10.61	3	8.05	4
BRVM	11.55	3.69	7.87	3.69	2	1.62	2	20.18	4.05	16.13*	4.05	2	4.59	2
Egypt	16.18*	0.00	16.18*	0.00	2	2.03	3	31.01*	8.34	22.67*	8.34	2	3.20	2
Ghana	17.24	7.19	10.06	7.19	3	0.57	2	13.35	5.71	7.64	5.71	2	3.28	2
Kenya	18.16	4.86	13.30	4.86	6	3.97	2	16.22*	0.64	15.58*	0.64	3	5.26	3
Mauritius	24.99*	7.69	17.30*	7.69	2	2.90	2	31.93*	4.98	26.96*	4.98	2	5.67	2
Morocco	13.40	4.69	8.71	4.69	2	1.93	2	20.36*	4.17	16.19*	4.17	2	4.68	2
Nigeria	8.52	2.40	6.12	2.40	2	3.72	2	18.82	1.74	17.08*	1.74	2	4.62	2
South Africa	16.93	2.87	14.06	2.87	2	7.45	2	16.17	5.47	10.69	5.47	3	2.06	2
Tunisia	21.44*	5.94	15.49	5.94	2	0.52	2	24.41*	9.39*	15.02	9.39	5	1.72	2
Uganda	13.81	3.35	10.45	3.35	4	1.85	2	12.72	3.08	9.64	3.08	3	3.30	2
Zambia	11.19	4.34	6.84	4.34	6	5.15	2	18.92	3.46	15.46	3.46	2	4.11	2
Emerging Markets														
Brazil	15.28	5.71	9.57	5.71	4	1.25	2	24.10*	10.17*	13.92	10.17	4	1.12	2
China	9.82	2.64	7.18	2.64	2	2.74	2	29.43*	7.44	21.99*	7.44	3	3.28	4
India	13.73	4.00	9.73	4.00	2	5.59	2	19.61	9.41	10.20	9.41	3	1.07	2
Russia	17.51	4.28	13.23	4.28	2	2.14	2	26.17*	11.53*	14.65	11.53	2	5.98	2
Developed Markets														
Australia	13.03	4.31	8.73	4.31	2	1.67	2	17.12	6.50	10.62	6.50	2	5.79	2
Canada	18.78	5.70	13.08	5.70	2	4.46	2	18.94	8.57	10.37	8.57	2	4.55	2
France	10.88	4.01	6.88	4.01	2	2.11	2	16.45	4.87	11.59	4.87	2	5.82	2
Germany	12.67	3.90	8.77	3.90	2	1.84	2	19.93	8.98	10.95	8.98	2	4.47	2
Hong Kong	9.51	4.00	5.52	4.00	2	2.52	2	13.74	3.58	10.15	3.58	2	5.49	2
Japan	9.10	2.29	6.81	2.29	2	1.22	2	15.18	5.46	9.72	5.46	2	4.08	2
Singapore	16.13	6.11	10.01	6.11	4	1.73	2	23.49*	7.89	15.60	7.89	6	1.47	2
Switzerland	8.66	3.66	5.01	3.66	2	0.85	2	18.41	4.55	13.86	4.55	2	3.95	2
United Kingdom	19.69	5.31	14.38	5.31	2	2.60	2	18.08*	0.67	17.40*	0.67	6	3.80	3
United States	11.77	4.57	7.20	4.57	2	1.30	2	23.44*	10.01*	13.42	10.01	3	1.75	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D17: Bivariate co-integration test results for Nigeria

Market: Nigeria	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r \leq 1$	$r=0$	$r \leq 1$				$r=0$	$r \leq 1$	$r=0$	$r \leq 1$			
Botswana	12.45	4.83	7.62	4.83	9	1.31	2	30.00*	7.31	22.69*	7.31	9	2.78	2
BRVM	15.55	5.05	10.50	5.05	7	2.28	2	14.99	3.87	11.07	3.87	2	4.95	2
Egypt	15.75*	3.08	12.67	3.08	3	3.33	3	23.55*	1.46	22.10*	1.46	2	5.25	2
Ghana	5.83	0.42	5.41	0.42	2	4.64	2	13.98	2.84	11.14	2.84	4	3.80	2
Kenya	21.80*	9.59*	12.21	9.59	3	4.36	2	18.04	4.22	13.83	4.22	3	2.50	2
Mauritius	12.53	3.54	8.99	3.54	6	6.12	2	25.80*	4.22	21.58*	4.22	2	4.29	2
Morocco	16.12	3.45	12.66	3.45	2	4.89	2	19.70	2.52	17.18*	2.52	2	3.55	2
Namibia	13.42	2.36	11.06	2.36	3	5.29	2	25.88*	3.73	22.15*	3.73	5	1.99	2
South Africa	20.71*	3.24	17.47*	3.24	15	4.13	2	21.31*	2.36	18.95*	2.36	2	2.47	2
Tunisia	19.61	2.97	16.64*	2.97	2	6.01	2	21.52*	2.10	19.41*	2.10	4	2.80	2
Uganda	12.03	2.73	9.31	2.73	6	2.93	2	20.85*	9.11	11.74	9.11	3	2.35	2
Zambia	12.78	4.32	8.46	4.32	2	3.54	2	16.04	2.40	13.64	2.40	2	1.58	2
Emerging Markets														
Brazil	16.99	3.04	13.95	3.04	9	0.09	2	20.25	4.09	16.16*	4.09	2	6.25	2
China	9.38	2.41	6.97	2.41	4	0.41	2	22.26*	3.89	18.37*	3.89	2	3.29	2
India	14.56	2.11	12.45	2.11	3	3.25	2	19.52	4.23	15.28	4.23	5	2.02	2
Russia	13.92	4.13	9.79	4.13	10	1.90	2	21.05*	3.18	17.87	3.18	4	4.60	2
Developed Markets														
Australia	21.35*	5.28	16.07*	5.28	4	3.50	2	21.67*	2.89	18.78*	2.89	3	1.32	2
Canada	15.44	4.91	10.53	4.91	13	3.69	2	17.97	2.01	15.95*	2.01	2	1.81	2
France	22.41*	7.12	15.29	7.12	13	3.72	2	15.57	2.23	13.34	2.23	2	3.23	2
Germany	17.10*	2.67	14.43*	2.67	13	1.10	3	17.43	2.91	14.52	2.91	2	2.02	2
Hong Kong	12.94	4.49	8.45	4.49	2	4.57	2	20.58*	7.03	13.55	7.03	5	3.24	2
Japan	18.94*	3.57	15.37*	3.57	4	1.68	3	14.15	2.38	11.78	2.38	2	2.23	2
Singapore	17.20	5.17	12.03	5.17	3	4.15	2	19.13	3.42	15.71	3.42	2	4.39	2
Switzerland	30.35*	8.85	21.51*	8.85	13	3.54	4	18.19	4.06	14.13	4.06	5	0.82	2
United Kingdom	31.62*	11.95	19.67*	11.95	13	3.02	4	27.68*	4.54	23.14*	4.54	5	2.61	2
United States	19.22	11.73	17.49*	11.73	13	1.87	2	16.06	4.99	11.07	4.99	2	2.34	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r \leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r \leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r \leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D18: Bivariate co-integration test results for Nigeria

Market: Nigeria	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	21.42*	4.84	16.58*	4.84	2	4.22	2	27.74*	3.63	24.11*	3.63	7	3.44	2
BRVM	9.45	4.64	4.81	4.64	2	1.89	2	18.19	4.48	13.71	4.48	2	4.37	2
Egypt	20.25	2.58	17.67*	2.58	5	6.92	2	26.09*	1.92	24.17*	1.92	7	2.88	2
Ghana	21.52*	3.71	17.81*	3.71	4	1.97	3	8.08	1.24	6.84	1.24	2	5.85	2
Kenya	13.17	2.24	10.93	2.24	3	2.20	2	18.60	4.40	14.40	4.40	3	2.63	2
Mauritius	14.53	2.24	12.29	2.24	2	5.66	2	25.21*	4.26	20.96*	4.26	2	3.92	2
Morocco	12.08	4.86	7.22	4.86	2	3.84	2	21.88*	3.27	18.61*	3.27	2	2.98	2
Namibia	8.52	2.40	6.12	2.40	2	3.72	2	18.82	1.74	17.08*	1.74	2	4.62	2
South Africa	10.52	3.00	7.52	3.00	3	2.45	2	19.69	1.94	17.75*	1.94	2	2.31	2
Tunisia	11.08	1.95	9.13	1.95	2	3.81	2	22.47*	2.11	20.36*	2.11	4	2.52	2
Uganda	9.88	1.57	8.30	1.57	2	2.60	2	8.36	1.95	6.41	1.95	2	2.45	2
Zambia	16.33	4.96	11.36	4.96	6	5.84	2	16.20	2.51	13.69	2.51	2	1.21	2
Emerging Markets														
Brazil	13.29	4.05	9.24	4.05	2	6.60	2	19.99	4.11	15.88	4.11	2	4.35	2
China	7.63	2.14	5.50	2.14	2	2.56	2	27.89*	6.20	21.69*	6.20	2	2.03	2
India	12.05	1.62	10.43	1.62	2	3.58	2	20.33*	4.08	16.25*	4.08	5	1.41	2
Russia	16.99	5.06	11.93	5.06	4	2.91	2	21.42*	3.16	18.26*	3.16	4	4.14	2
Developed Markets														
Australia	11.65	3.00	8.65	3.00	2	4.27	2	24.96*	2.43	22.52*	2.43	6	2.41	2
Canada	12.33	1.66	10.67	1.66	2	1.84	2	17.32	2.07	15.25	2.07	2	1.32	2
France	9.70	1.95	7.75	1.95	2	2.81	2	14.12	1.72	12.40	1.72	2	2.64	2
Germany	11.13	2.02	9.11	2.02	2	2.38	2	22.39*	6.07	16.32*	6.07	5	2.65	2
Hong Kong	13.30	4.49	8.81	4.49	5	3.98	2	21.45*	6.73	14.73	6.73	5	3.18	2
Japan	15.55	2.66	12.89	2.66	2	3.82	2	14.03	2.51	11.52	2.51	2	1.17	2
Singapore	14.11	2.07	12.04	2.07	3	1.17	2	18.11	3.49	14.62	3.49	2	4.69	2
Switzerland	11.01	1.44	9.57	1.44	2	2.17	2	14.77	1.54	13.22	1.54	2	1.45	2
United Kingdom	22.22*	2.96	19.26*	2.96	4	6.20	2	24.29*	4.07	20.22*	4.07	5	3.02	2
United States	11.12	3.50	7.62	3.50	2	1.81	2	15.72	4.87	10.86	4.87	2	2.04	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D19: Bivariate co-integration test results for South Africa

Market: South Africa	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	24.34*	5.25	19.09*	5.25	7	3.57	2	21.82*	0.01	21.81*	0.01	2	3.87	3
BRVM	36.09*	5.77	30.32*	5.77	2	0.45	4	24.15*	6.47	17.68*	6.47	2	1.24	2
Egypt	21.09*	6.45	14.64	6.45	4	3.07	2	35.93*	12.07*	23.86*	12.07*	2	1.54	2
Ghana	13.38	4.67	8.71	4.67	2	2.03	2	24.97*	8.94	16.04*	8.94	3	3.16	2
Kenya	20.45*	7.11	13.34	7.11	6	6.26	2	17.41*	0.03	17.37*	0.03	5	6.82	3
Mauritius	20.20	3.38	16.82*	3.38	5	2.97	2	31.43*	5.79	25.64*	5.79	2	4.20	2
Morocco	15.42	1.10	14.32	1.10	8	2.54	2	19.58	4.85	14.74	4.85	2	4.11	2
Namibia	16.86	4.80	12.06	4.80	2	2.69	2	17.04	4.24	12.80	4.24	3	2.39	2
Nigeria	20.71*	3.24	17.47*	3.24	15	4.13	2	21.31*	2.36	18.95*	2.36	2	2.47	2
Tunisia	21.89*	2.69	19.20*	2.69	2	6.33	2	23.40*	6.55	16.85*	6.55	5	1.49	2
Uganda	20.69*	8.20	12.50	8.20	4	5.22	2	25.79*	3.30	22.49*	3.30	2	7.44	2
Zambia	27.29*	4.54	22.76*	4.54	2	1.96	4	19.89	3.00	16.89*	3.00	2	1.49	2
Emerging Markets														
Brazil	17.87	7.19	10.68	7.19	2	5.53	2	29.19*	13.34*	15.85	13.34	4	1.01	2
China	14.08	3.06	11.02	3.06	4	2.52	2	25.00*	5.78	19.22*	5.78	2	1.32	2
India	19.70*	4.11*	15.60*	4.11*	15	3.25	3	24.10*	10.20*	13.90	10.20	3	1.09	2
Russia	21.26*	8.73	12.54	8.73	8	2.78	2	27.22*	13.50*	13.72	13.50	2	2.90	2
Developed Markets														
Australia	14.67	4.63	10.04	4.63	2	4.53	2	24.48*	7.82	16.66*	7.82	2	3.48	2
Canada	32.48*	13.97*	18.51*	13.97*	15	3.48	2	28.10*	11.01*	17.08*	11.01*	2	1.61	2
France	29.01*	9.26*	19.74*	9.26*	15	4.43	2	25.14*	7.69	17.45*	7.69	2	3.29	2
Germany	24.61*	10.49*	14.12	10.49	15	1.02	2	27.22*	8.41	18.81*	8.41	2	2.12	2
Hong Kong	18.51	9.01	9.50	9.01	2	5.64	2	20.59*	6.88	13.68	6.88	2	4.05	2
Japan	14.20	2.67	11.53	2.67	4	1.34	2	19.63	7.36	12.28	7.36	2	0.53	2
Singapore	24.74*	10.12*	14.64	10.12	6	3.77	2	22.11*	7.85	14.26	7.85	3	4.86	2
Switzerland	20.17	5.59	14.58	5.59	15	3.98	2	23.11*	6.31	16.80	6.31	2	0.60	2
United Kingdom	31.13*	9.06	22.07*	9.06	15	3.53	2	26.46*	0.02	26.45*	0.02	2	3.06	3
United States	25.75*	2.30	23.45*	2.30	16	4.08	2	26.42*	8.16	18.25*	8.16	2	2.41	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D20: Bivariate co-integration test results for South Africa

Market: South Africa	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	15.43	3.84	11.59	3.84	4	3.12	2	17.43*	0.17	17.26*	0.17	2	7.03	3
BRVM	11.04	3.71	7.33	3.71	2	5.10	2	20.99*	3.69	17.30*	3.69	2	2.30	2
Egypt	26.07*	6.48	19.59*	6.48	2	5.16	4	35.45*	12.06*	23.39*	12.06*	2	1.93	2
Ghana	18.61	5.88	12.74	5.88	2	6.68	2	12.86	2.33	10.54	2.33	2	1.01	2
Kenya	18.97	5.33	13.64	5.33	5	6.24	2	19.07*	0.07	19.00*	0.07	6	3.78	3
Mauritius	20.39*	7.99	12.41	7.99	3	5.10	2	30.63*	5.61	25.02*	5.61	2	5.53	2
Morocco	15.03	5.24	9.79	5.24	2	4.79	2	18.36	3.04	15.32	3.04	2	3.74	2
Namibia	16.93	2.87	14.06	2.87	2	7.45	2	16.17	5.47	10.69	5.47	3	2.06	2
Nigeria	10.52	3.00	7.52	3.00	3	2.45	2	19.69	1.94	17.75*	1.94	2	2.31	2
Tunisia	31.15*	8.08	23.07*	8.08	2	1.40	2	23.89*	7.76	16.13*	7.76	4	1.39	2
Uganda	12.98	3.48	9.50	3.48	4	5.70	2	17.32	5.11	12.22	5.11	6	1.28	2
Zambia	12.69	3.21	9.47	3.21	12	1.54	2	18.60	2.60	16.00*	2.60	2	2.27	2
Emerging Markets														
Brazil	15.45	5.32	10.13	5.32	4	2.01	2	27.54*	11.86*	15.67	11.86	4	0.53	2
China	14.25	4.35	9.91	4.35	7	2.26	2	42.52*	11.83	30.70*	11.83	2	2.78	4
India	13.36	3.98	9.38	3.98	3	1.78	2	24.29*	11.67*	12.62	11.67	3	3.87	2
Russia	18.36	4.67	13.69	4.67	2	5.15	2	25.75*	11.74*	14.01	11.74	2	3.03	2
Developed Markets														
Australia	15.75	3.66	12.10	3.66	2	5.39	2	22.87*	7.73	15.14	7.73	2	3.03	2
Canada	19.45	6.22	13.23	6.22	2	7.74	2	31.68*	8.94	22.74*	8.94	2	1.77	4
France	12.45	3.69	8.76	3.69	2	5.18	2	21.90*	5.35	16.55*	5.35	2	3.04	2
Germany	15.48	3.91	11.57	3.91	2	3.93	2	24.55*	8.62	15.93*	8.62	2	1.53	2
Hong Kong	11.52	3.83	7.70	3.83	2	4.39	2	15.70	4.94	10.77	4.94	2	2.13	2
Japan	8.79	3.05	5.73	3.05	2	5.61	2	17.20	5.86	11.35	5.86	2	1.09	2
Singapore	18.92	8.16	10.76	8.16	3	6.80	2	20.04	8.40	11.64	8.40	2	6.11	2
Switzerland	10.14	3.51	6.63	3.51	2	5.88	2	20.82*	4.94	15.88	4.94	2	1.40	2
United Kingdom	28.93*	9.06	19.87*	9.06	2	5.90	4	38.28*	11.99	26.28*	11.99	2	3.17	4
United States	15.07	4.53	10.54	4.53	2	4.89	2	24.72*	7.87	16.85*	7.87	2	4.66	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D21: Bivariate co-integration test results for Tunisia

Market: Tunisia	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\le1$	$r=0$	$r\le1$				$r=0$	$r\le1$	$r=0$	$r\le1$			
Botswana	20.10	2.20	17.90	2.20	3	2.85	2	19.88*	0.23	19.64*	0.23	6	1.34	3
BRVM	18.91	1.84	17.06*	1.84	2	2.64	2	18.07	4.32	13.75	4.32	2	2.89	2
Egypt	21.59*	6.94*	14.65*	6.94*	2	3.60	3	36.58*	5.23	31.35*	5.23	2	4.01	2
Ghana	25.11*	7.63	17.48*	7.63	2	2.76	2	19.57	3.77	15.80*	3.77	4	0.91	2
Kenya	23.44*	6.51	16.93*	6.51	3	2.79	2	20.45*	8.85	11.60	8.85	5	2.00	2
Mauritius	26.43*	5.58	20.84*	5.58	2	2.82	2	25.09*	3.32	21.77*	3.32	4	1.96	2
Morocco	20.89*	7.56	13.34	7356	14	1.35	2	23.25*	7.44	15.82	7.44	5	2.24	2
Namibia	19.94	3.60	16.34*	3.60	2	3.77	2	26.47*	9.30	17.17*	9.30	5	0.81	2
Nigeria	19.61	2.97	16.64*	2.97	2	6.01	2	21.52*	2.10	19.41*	2.10	4	2.80	2
South Africa	21.89*	2.69	19.20*	2.69	2	6.33	2	23.40*	6.55	16.85*	6.55	5	1.49	2
Uganda	20.73*	1.99	18.74*	1.99	2	5.90	2	12.43	5.03	7.40	5.03	4	1.52	2
Zambia	22.86*	3.92	18.94*	3.92	2	3.09	2	22.37*	8.83	13.54	8.83	4	3.37	2
Emerging Markets														
Brazil	29.56*	10.62*	18.94*	10.62*	3	1.75	2	22.70*	4.59	18.11*	4.59	4	1.49	2
China	19.14	4.41	14.73	4.41	9	3.84	2	19.68	8.16	11.52	8.16	4	0.95	2
India	23.55*	6.31	17.23*	6.31	3	1.10	2	18.27	5.29	12.98	5.29	5	3.19	2
Russia	20.83*	6.43	14.39	6.43	9	2.83	2	25.67*	9.28*	16.39*	9.28*	4	1.17	2
Developed Markets														
Australia	17.73	3.82	13.91	3.82	2	3.54	2	20.69*	4.57	16.12*	4.57	4	1.86	2
Canada	19.52	5.12	14.40	5.12	2	3.64	2	23.81*	5.60	18.21*	5.60	4	1.41	2
France	15.93	6.90	9.03	6.90	15	5.99	2	18.75	5.11	13.64	5.11	4	3.58	2
Germany	19.01	3.53	15.48	3.53	2	6.99	2	18.02	4.20	13.81	4.20	2	1.78	2
Hong Kong	22.49*	7.63	14.86	7.63	2	5.29	2	22.88*	4.75	18.13*	4.75	4	1.76	2
Japan	16.38	2.43	13.95	2.43	3	4.35	2	19.48	7.11	12.37	7.11	4	4.88	2
Singapore	20.03	5.37	14.66	5.37	3	0.74	2	25.93*	3.06	22.88*	3.06	4	2.62	2
Switzerland	16.61	2.50	14.11	2.50	3	3.56	2	17.44	4.35	13.09	4.35	2	1.84	2
United Kingdom	15.25	3.44	11.81	3.44	14	4.19	2	26.42*	6.39	20.03*	6.39	4	4.63	2
United States	15.88	1.27	14.60	1.27	2	4.96	2	18.34	5.21	13.13	5.21	2	1.32	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\le1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\le1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\le1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D22: Bivariate co-integration test results for Tunisia

Market: Tunisia	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$				$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$			
Botswana	35.17*	10.95	24.21*	10.95	2	3.46	4	34.11*	3.37	30.73*	3.37	4	0.22	4
BRVM	12.08	4.06	8.03	4.06	2	1.25	2	18.21	3.63	14.59	3.63	2	3.06	2
Egypt	31.28*	7.35	23.93*	7.35	2	2.58	2	23.37*	2.68	20.69*	2.68	4	2.27	2
Ghana	10.48	2.06	8.41	2.06	3	0.84	2	9.92	3.64	6.28	3.64	2	3.69	2
Kenya	11.76	2.53	9.23	2.53	5	2.63	2	21.13*	8.97	12.16	8.97	5	2.36	2
Mauritius	20.99*	5.40	15.60	5.40	2	4.11	2	25.30*	3.47	21.82*	3.47	4	1.90	2
Morocco	17.67	4.77	12.91	4.77	2	1.90	2	20.84*	6.06	14.78	6.06	5	5.81	2
Namibia	21.44*	5.94	15.49	5.94	2	0.52	2	24.41*	9.39*	15.02	9.39	5	1.72	2
Nigeria	11.08	1.95	9.13	1.95	2	3.81	2	22.47*	2.11	20.36*	2.11	4	2.52	2
South Africa	31.15*	8.08	23.07*	8.08	2	1.40	2	23.89*	7.76	16.13*	7.76	4	1.39	2
Uganda	12.67	2.85	9.83	2.85	5	4.75	2	10.76	1.45	9.30	1.45	2	5.28	2
Zambia	13.65	2.19	11.46	2.19	12	1.61	2	18.83	5.89	12.94	5.89	2	0.82	2
Emerging Markets														
Brazil	14.02	5.34	8.68	5.34	2	5.52	2	22.01*	4.78	17.23*	4.78	4	1.74	2
China	8.34	3.89	4.45	3.89	2	1.72	2	17.17*	1.35	15.82*	1.35	4	1.25	3
India	20.42*	5.41	15.01	5.41	2	1.16	2	18.83	5.45	13.37	5.45	5	3.12	2
Russia	18.88	5.85	13.03	5.85	2	1.59	2	25.67*	9.10	16.57*	9.10	4	1.26	2
Developed Markets														
Australia	14.35	5.32	9.03	5.32	2	2.54	2	20.48*	3.94	16.53*	3.94	5	6.38	2
Canada	21.41*	7.24	14.17	7.24	2	0.64	2	21.97*	5.61	16.37*	5.61	4	0.38	2
France	16.35	4.68	11.67	4.68	2	4.24	2	16.43	5.11	11.32	5.11	4	3.51	2
Germany	10.66	3.51	7.14	3.51	2	2.92	2	17.53	5.17	12.36	5.17	2	1.42	2
Hong Kong	16.60	3.94	12.66	3.94	2	0.65	2	24.34*	4.29	20.05*	4.29	4	0.62	2
Japan	18.45	4.69	13.76	4.69	3	3.18	2	17.86	6.52	11.34	6.52	4	3.59	2
Singapore	18.37	6.65	11.72	6.65	2	7.60	2	24.49*	3.36	21.13*	3.36	4	2.34	2
Switzerland	12.95	3.93	9.02	3.93	2	3.67	2	16.93	3.76	13.17	3.76	2	1.47	2
United Kingdom	14.77	6.21	8.55	6.21	2	2.54	2	23.11*	6.91	16.20*	6.91	4	4.60	2
United States	10.29	4.27	6.02	4.27	2	0.83	2	18.24	6.25	11.99	6.25	2	1.18	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r = 0$ = 20.26 (15.89) and $r \leq 1$ = 9.16 (9.16); Model 3 when $r = 0$ =15.49 (14.26) and $r \leq 1$ = 3.84 (3.84); and Model 4 when $r = 0$ = 25.87 (19.39) and $r \leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author’s computation

Table D23: Bivariate co-integration test results for Uganda

Market: Uganda	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	22.98*	4.02	18.96*	4.02	3	6.13	2	35.11*	7.66	27.45*	7.66	2	3.89	2
BRVM	19.92	5.82	14.10	5.82	2	0.40	2	15.62	3.41	12.21	3.41	2	3.37	2
Egypt	20.08	5.69	14.39	5.69	4	6.86	2	30.51*	7.28	23.23*	7.28	2	2.97	2
Ghana	13.30	2.82	10.48	2.82	2	0.66	2	9.67	2.59	7.08	2.59	5	1.75	2
Kenya	11.25	3.55	7.70	3.55	4	6.65	2	12.87	3.10	9.76	3.10	2	3.12	2
Mauritius	14.80	3.60	11.20	3.60	4	1.65	2	22.22*	7.41	14.82	7.41	2	7.23	2
Morocco	13.02	0.86	12.15	0.86	6	1.12	2	17.15	6.26	10.89	6.26	2	3.25	2
Namibia	14.50	5.76	8.74	5.76	4	1.79	2	27.72*	4.27	23.45*	4.27	4	6.97	2
Nigeria	12.03	2.73	9.31	2.73	6	2.93	2	20.85*	9.11	11.74	9.11	3	2.35	2
South Africa	20.69*	8.20	12.50	8.20	4	5.22	2	25.79*	3.30	22.49*	3.30	2	7.44	2
Tunisia	20.73*	1.99	18.74*	1.99	2	5.90	2	12.43	5.03	7.40	5.03	4	1.52	2
Zambia	22.93*	5.09	17.84*	5.09	2	2.07	2	13.90	4.16	9.75	4.16	2	2.40	2
Emerging Markets														
Brazil	13.51	2.87	10.64	2.87	4	5.47	2	17.92	3.71	14.21	3.71	2	3.53	2
China	11.94	2.27	9.68	2.27	2	4.58	2	23.94*	9.86*	14.08	9.86	2	2.69	2
India	17.07	7.53	9.54	7.53	4	2.67	2	16.88	2.86	14.02	2.86	2	3.08	2
Russia	13.55	5.17	8.38	5.17	5	3.96	2	21.20*	4.34	16.86*	4.34	2	4.83	2
Developed Markets														
Australia	11.71	4.24	7.48	4.24	5	1.83	2	18.19	2.14	16.05*	2.14	2	2.49	2
Canada	14.50	6.42	8.07	6.42	4	4.13	2	20.56*	3.48	17.08*	3.48	2	3.46	2
France	10.74	3.61	7.13	3.61	5	2.27	2	16.87	2.42	14.45	2.42	2	2.94	2
Germany	18.07	5.53	12.54	5.53	5	3.69	2	21.51*	3.01	18.49*	3.01	2	4.90	2
Hong Kong	14.27	6.86	7.41	6.86	4	4.38	2	13.87*	4.80	9.06	4.80	2	6.54	2
Japan	10.28	1.71	8.57	1.71	4	5.20	2	18.12	4.56	13.57	4.56	2	2.67	2
Singapore	15.81	5.52	10.28	5.52	5	3.72	2	15.91	5.66	10.25	5.66	4	1.96	2
Switzerland	9.84	2.28	7.56	2.28	5	3.48	2	19.06	4.18	14.89	4.18	4	3.07	2
United Kingdom	15.78	4.66	11.12	4.66	5	5.36	2	20.58	3.03	17.54*	3.03	2	2.06	2
United States	12.74	1.37	11.37	1.37	4	5.70	2	14.92	1.95	12.97	1.95	2	3.96	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D24: Bivariate co-integration test results for Uganda

Market: Uganda	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r\leq 1$	$r=0$	$r\leq 1$				$r=0$	$r\leq 1$	$r=0$	$r\leq 1$			
Botswana	12.97	2.23	10.75	2.23	4	3.61	2	9.48	3.36	6.12	3.36	2	3.52	2
BRVM	16.16	1.75	14.41	1.75	2	8.82	2	10.96	3.30	7.67	3.30	2	3.64	2
Egypt	15.97	3.16	12.81	3.16	5	4.45	2	7.87	1.62	6.26	1.62	4	2.52	2
Ghana	13.16	2.69	10.48	2.69	2	4.12	2	7.82	1.01	6.81	1.01	2	0.52	2
Kenya	16.33	3.03	13.30	3.03	4	3.46	2	8.44	1.34	7.10	1.34	2	2.55	2
Mauritius	8.87	2.37	6.50	2.37	4	1.40	2	16.20	1.63	14.57	1.63	2	1.83	2
Morocco	13.65	4.75	8.90	4.75	10	4.59	2	7.98	2.71	5.27	2.71	2	2.36	2
Namibia	13.81	3.35	10.45	3.35	4	1.85	2	12.72	3.08	9.64	3.08	3	3.30	2
Nigeria	9.88	1.57	8.30	1.57	2	2.60	2	8.36	1.95	6.41	1.95	2	2.45	2
South Africa	12.98	3.48	9.50	3.48	4	5.70	2	17.32	5.11	12.22	5.11	6	1.28	2
Tunisia	12.67	2.85	9.83	2.85	5	4.75	2	10.76	1.45	9.30	1.45	2	5.28	2
Zambia	2.16	2.73	19.43	2.73	6	2.77	2	17.63	1.50	16.14	1.50	2	5.87	2
Emerging Markets														
Brazil	14.60	5.93	8.67	5.93	7	0.30	2	14.17	2.17	12.00	2.17	3	5.25	2
China	14.45	4.25	10.20	4.25	2	1.87	2	8.61	3.14	5.47	3.14	3	6.19	2
India	12.91	4.85	8.05	4.85	4	4.96	2	7.49	2.96	4.54	2.96	4	2.98	2
Russia	21.72*	5.50	16.23*	5.50	5	7.53	2	12.95	1.91	11.04	1.91	3	5.48	2
Developed Markets														
Australia	13.61	2.80	10.81	2.80	5	3.68	2	10.04	2.25	7.79	2.25	5	4.58	2
Canada	15.72	3.54	12.18	3.54	5	3.82	2	8.34	1.59	6.75	1.59	5	5.00	2
France	14.36	6.20	8.16	6.20	7	5.12	2	9.32	2.21	7.10	2.21	4	1.37	2
Germany	13.05	4.16	8.89	4.16	5	2.71	2	13.58	3.01	10.57	3.01	3	2.83	2
Hong Kong	13.34	4.49	8.85	4.49	4	5.50	2	12.64	2.90	9.74	2.90	3	2.77	2
Japan	16.65	5.20	11.36	5.20	5	5.34	2	13.88	2.47	11.42	2.47	4	1.72	2
Singapore	19.67	5.23	14.44	5.23	5	2.76	2	31.31*	2.85	28.45*	2.85	6	4.20	4
Switzerland	11.91	4.69	7.22	4.69	5	1.21	2	18.392	1.78	17.14*	1.78	3	5.43	2
United Kingdom	13.94	5.05	8.89	5.05	6	2.49	2	11.92	2.90	9.05	2.90	6	3.06	2
United States	13.00	3.82	9.18	3.82	5	2.45	2	9.29	3.46	5.83	3.46	3	6.16	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r\leq 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r\leq 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r\leq 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D25: Bivariate co-integration test results for Zambia

Market: Zambia	Full-sample period							Pre-crisis/stable period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r \le 1$	$r=0$	$r \le 1$				$r=0$	$r \le 1$	$r=0$	$r \le 1$			
Botswana	21.81*	7.72	14.10	7.72	3	1.60	2	31.58*	4.75	26.84*	4.75	2	3.51	4
BRVM	13.48	4.25	9.23	4.25	2	2.19	2	10.26	2.22	8.04	2.22	2	2.37	2
Egypt	29.56*	10.61	18.95*	10.61	2	0.84	4	27.55*	4.49	23.05*	4.49	2	1.65	2
Ghana	10.87	3.52	7.35	3.52	2	1.96	2	14.15	2.54	11.61	2.54	3	0.53	2
Kenya	24.91*	11.51*	13.40	11.51	3	0.91	2	16.21	5.26	10.95	5.26	2	0.46	2
Mauritius	23.83*	9.51*	14.33	9.51	2	1.40	2	26.22*	3.62	22.60*	3.62	2	2.82	2
Morocco	13.54	3.64	9.90	3.64	2	2.13	2	20.84*	8.50	12.33	8.50	2	2.64	2
Namibia	22.30*	2.71	19.59*	2.71	2	2.37	2	21.53*	4.33	17.20*	4.33	2	3.25	2
Nigeria	12.78	4.32	8.46	4.32	2	3.54	2	16.04	2.40	13.64	2.40	2	1.58	2
South Africa	27.29*	4.54	22.76*	4.54	2	1.96	4	19.89	3.00	16.89*	3.00	2	1.49	2
Tunisia	22.86*	3.92	18.94*	3.92	2	3.09	2	22.37*	8.83	13.54	8.83	4	3.37	2
Uganda	22.93*	5.09	17.84*	5.09	2	2.07	2	13.90	4.16	9.75	4.16	2	2.40	2
Emerging Markets														
Brazil	24.57*	9.54*	15.02	9.54	2	5.12	2	15.56	4.87	10.69	4.87	2	3.76	2
China	11.32	3.71	7.61	3.71	3	4.23	2	17.46	2.42	15.04	2.42	2	1.18	2
India	31.86*	8.38	23.48*	8.38	3	1.27	2	16.04	4.64	11.40	4.64	2	2.54	2
Russia	30.71*	8.46	22.25*	8.46	2	1.03	4	17.95	7.01	10.95	7.01	2	4.15	2
Developed Markets														
Australia	22.93*	5.37	17.57*	5.37	2	1.12	2	16.41	3.27	13.14	3.27	2	2.03	2
Canada	26.53*	6.69	19.84*	6.69	2	1.75	2	16.51	3.77	12.74	3.77	2	0.34	2
France	20.50*	5.48	15.03	5.48	2	1.60	2	15.78	3.90	11.88	3.90	2	2.44	2
Germany	19.03*	3.16	15.87*	3.16	4	1.42	3	18.40	5.03	13.37	5.03	2	1.52	2
Hong Kong	19.58*	3.43	16.15*	3.43	2	4.09	3	13.85	3.90	9.95	3.90	2	1.44	2
Japan	19.37	4.53	14.84	4.53	4	0.03	2	15.63	4.27	11.37	4.27	2	5.34	2
Singapore	24.91*	6.88	18.03*	6.88	2	4.46	2	18.33	3.64	14.69	3.64	2	1.76	2
Switzerland	22.92*	5.23	17.69*	5.23	3	2.95	2	15.62	3.38	12.24	3.38	2	0.55	2
United Kingdom	26.28*	7.27	19.01*	7.27	4	5.20	2	15.95	4.63	11.32	4.63	2	2.57	2
United States	15.16	2.28	12.88	2.28	2	2.95	2	14.86	4.65	10.22	4.65	2	2.49	2

Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r \le 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r \le 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r \le 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

Source: Author's computation

Table D26: Bivariate co-integration test results for Zambia

Market: Zambia	Global financial crisis period							Eurozone crisis period						
	Trace test		Eigenvalue test		Lag	LM test	Model	Trace test		Eigenvalue test		Lag	LM stat	Model
	$r=0$	$r \le 1$	$r=0$	$r \le 1$				$r=0$	$r \le 1$	$r=0$	$r \le 1$			
Botswana	15.09	6.81	8.29	6.81	5	6.55	2	26.19*	4.78	21.39*	4.78	2	6.26	4
BRVM	10.62	3.29	7.32	3.29	6	6.68	2	11.56	3.09	8.47	3.09	2	1.89	2
Egypt	17.34	3.73	13.61	3.73	6	4.36	2	28.03*	4.74	23.29*	4.74	2	1.75	2
Ghana	34.07*	7.19	26.89*	7.19	5	1.25	4	16.05	4.03	12.03	4.03	2	2.91	2
Kenya	12.69	3.57	9.12	3.57	5	7.97	2	17.19	5.43	11.76	5.43	2	0.35	2
Mauritius	13.10	4.80	8.30	4.80	6	3.21	2	25.56*	3.81	21.75*	3.81	2	2.89	2
Morocco	17.24	7.28	9.96	7.28	6	5.48	2	23.32*	8.73	14.59	8.73	2	2.66	2
Namibia	11.19	4.34	6.84	4.34	6	5.15	2	18.92	3.46	15.46	3.46	2	4.11	2
Nigeria	16.33	4.96	11.36	4.96	6	5.84	2	16.20	2.51	13.69	2.51	2	1.21	2
South Africa	12.69	3.21	9.47	3.21	12	1.54	2	18.60	2.60	16.00*	2.60	2	2.27	2
Tunisia	13.65	2.19	11.46	2.19	12	1.61	2	18.83	5.89	12.94	5.89	2	0.82	2
Uganda	2.16	2.73	19.43	2.73	6	2.77	2	17.63	1.50	16.14	1.50	2	5.87	2
Emerging Markets														
Brazil	24.65*	9.79*	14.86	9.79	12	1.14	2	15.56	5.20	10.37	5.20	2	2.66	2
China	14.35	4.57	9.78	4.57	13	7.00	2	18.44*	0.07	18.36	0.07	2	1.21	3
India	19.39	5.96	13.44	5.96	13	2.80	2	16.60	4.82	11.78	4.82	2	1.95	2
Russia	14.28	4.98	9.30	4.98	6	7.00	2	17.83	6.55	11.29	6.55	2	4.39	2
Developed Markets														
Australia	20.55*	3.89	16.67*	3.89	6	6.04	2	15.14	3.34	11.80	3.34	2	1.25	2
Canada	13.29	3.67	9.63	3.67	6	5.99	2	15.61	3.97	11.64	3.97	2	0.44	2
France	15.27	4.35	10.91	4.35	6	6.75	2	13.53	3.24	10.28	3.24	2	1.83	2
Germany	16.57	4.75	11.82	4.75	6	7.83	2	16.48	5.15	11.34	5.15	2	1.16	2
Hong Kong	16.57	4.60	11.97	4.60	6	6.24	2	14.59	4.03	10.56	4.03	2	0.60	2
Japan	17.90	6.82	10.67	6.82	6	3.52	2	15.71	4.06	11.65	4.06	2	4.37	2
Singapore	18.01	4.24	13.77	4.24	8	3.74	2	16.36	4.03	12.34	4.03	2	0.99	2
Switzerland	19.74	1.71	18.03*	1.71	12	7.21	2	15.22	2.97	12.24	2.97	2	0.43	2
United Kingdom	18.04	2.90	15.14	2.90	6	4.48	2	14.33	4.54	9.80	4.54	2	1.89	2
United States	17.42	7.14	10.28	7.14	6	2.18	2	13.77	5.20	8.58	5.20	2	1.80	2

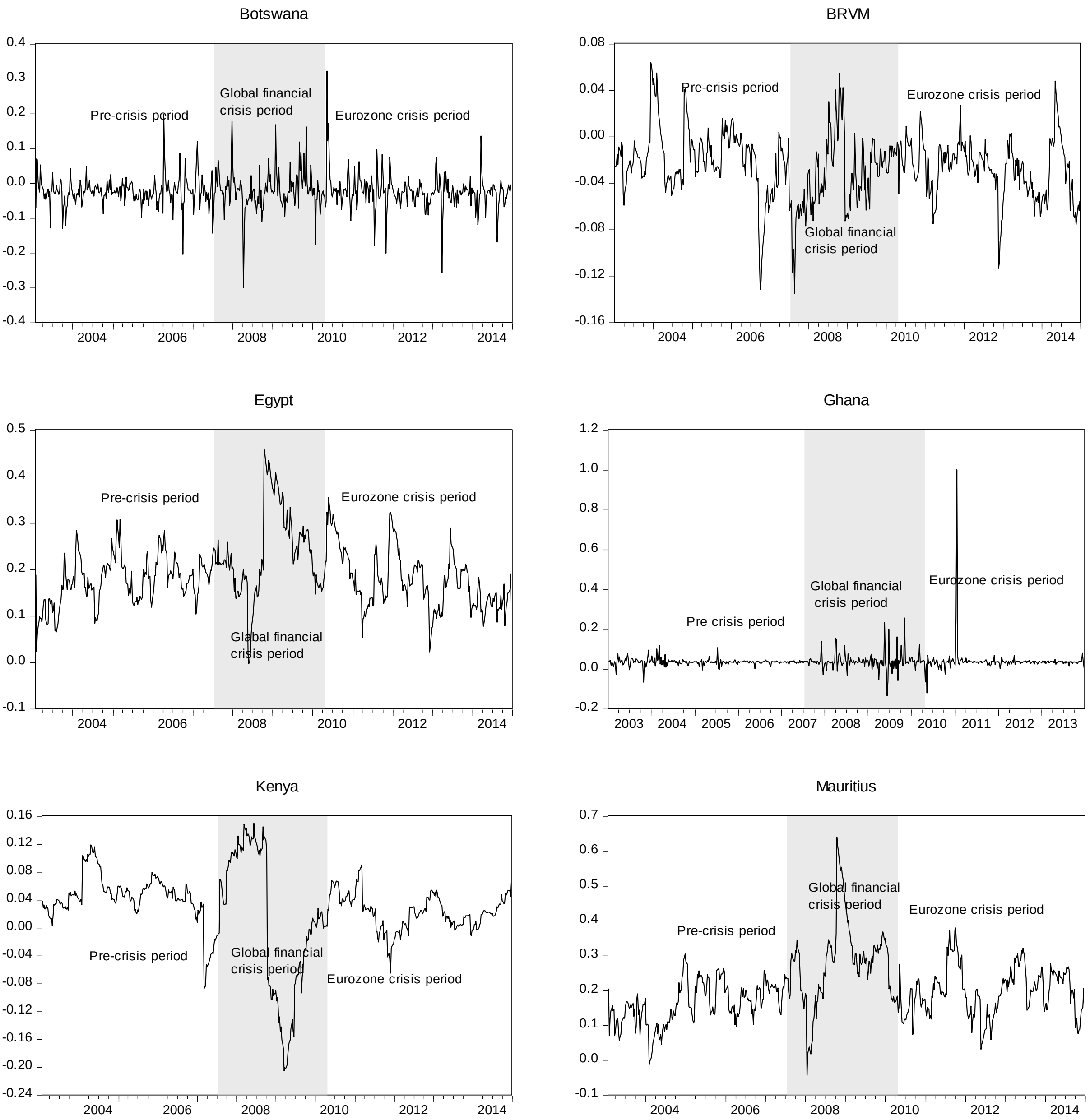
Note: *denotes significance at 5%. The critical values for the trace (eigenvalue) statistic for Model 2 when $r=0$ = 20.26 (15.89) and $r \le 1$ = 9.16 (9.16); Model 3 when $r=0$ =15.49 (14.26) and $r \le 1$ = 3.84 (3.84); and Model 4 when $r=0$ = 25.87 (19.39) and $r \le 1$ = 12.52 (12.52). The null hypothesis of no co-integration is rejected at 5% level of significance. The LM stat represents the Lagrange Multiplier test statistic for serial correlation.

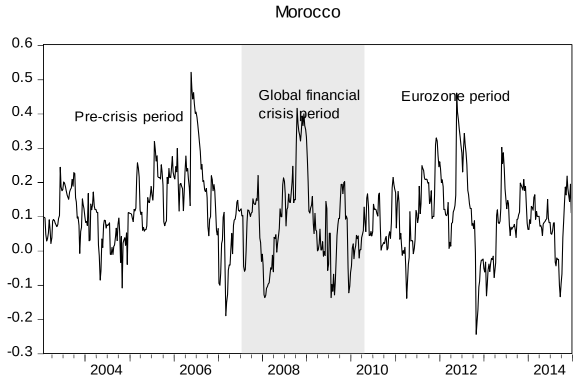
Source: Author's computation

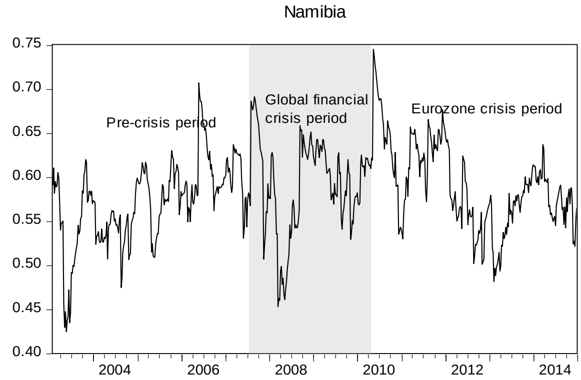
APPENDIX E

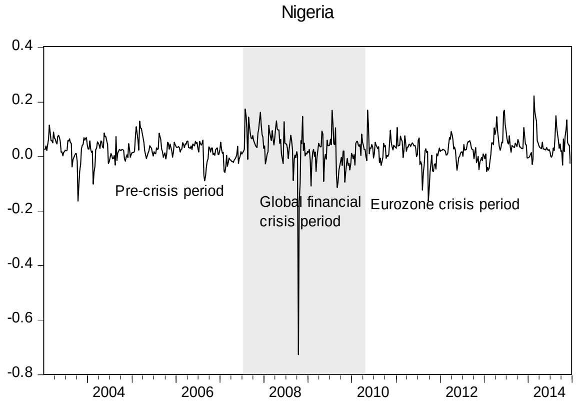
DYNAMIC CONDITIONAL CORRELATION

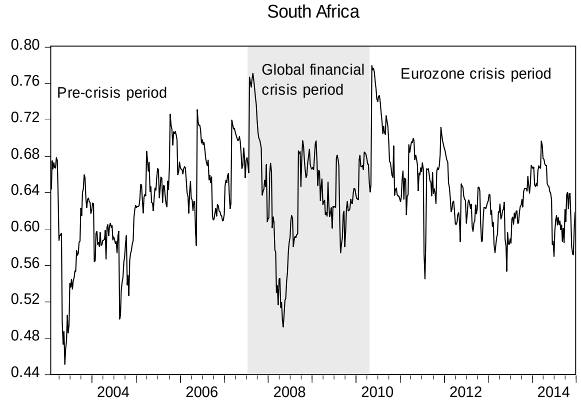
Figure 7. 1: DCC between Australia and African stock markets

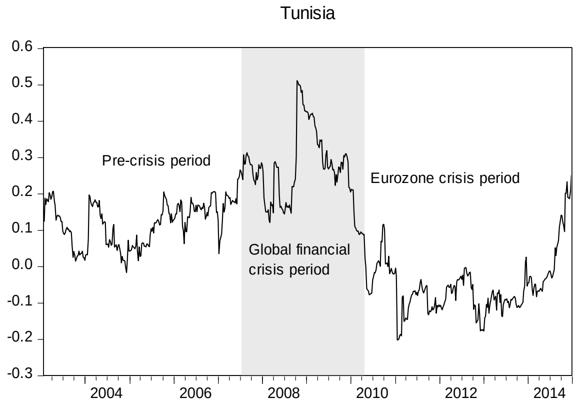


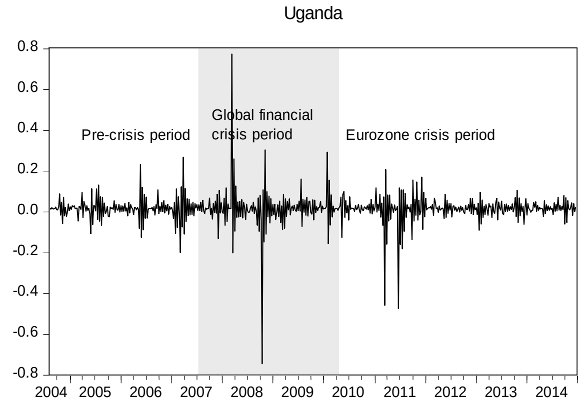


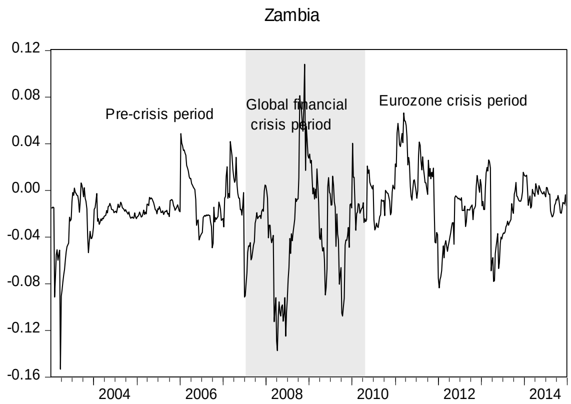






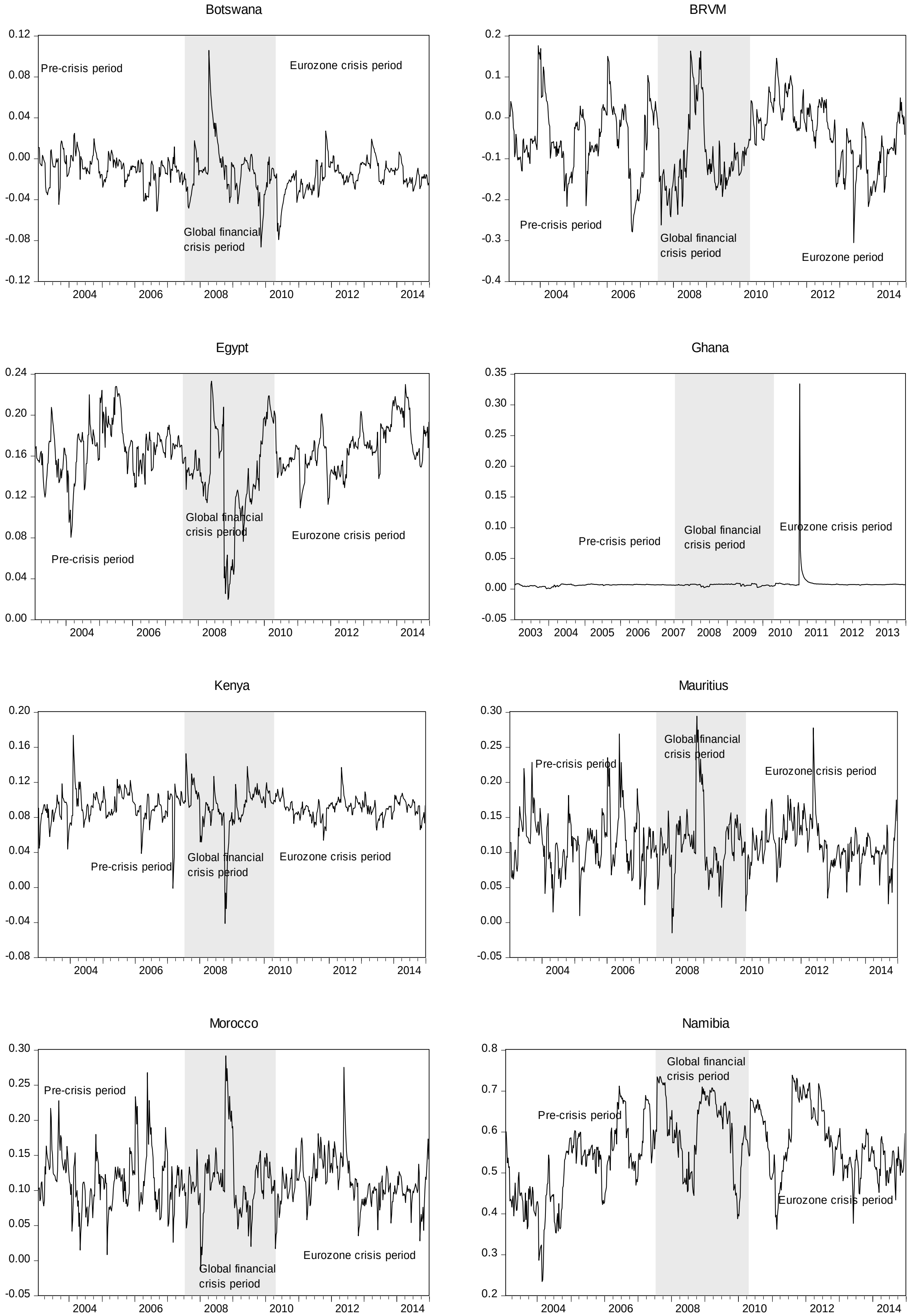


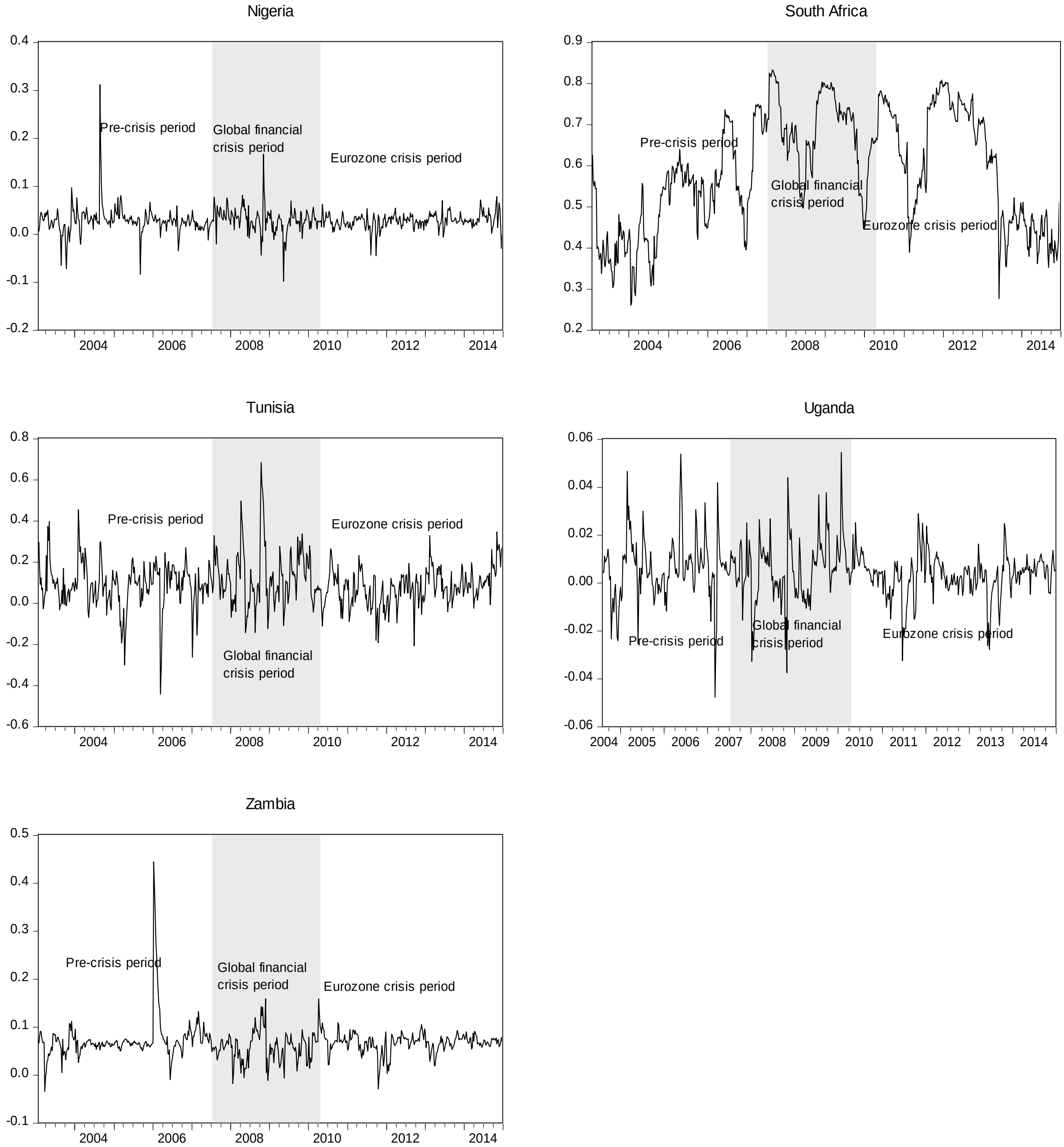




Source: Author's computation

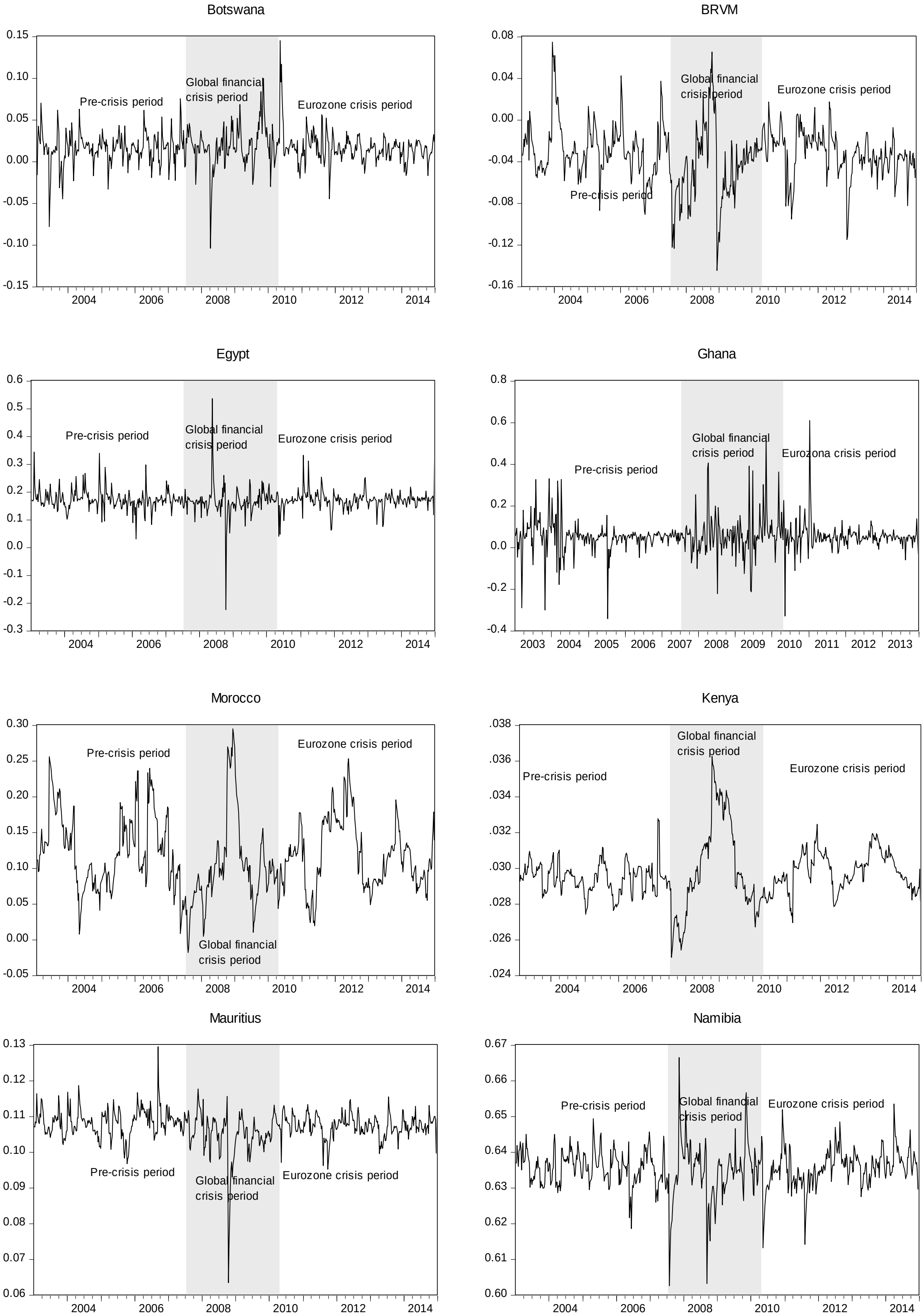
Figure 7. 2: DCC between Brazil and African stock markets

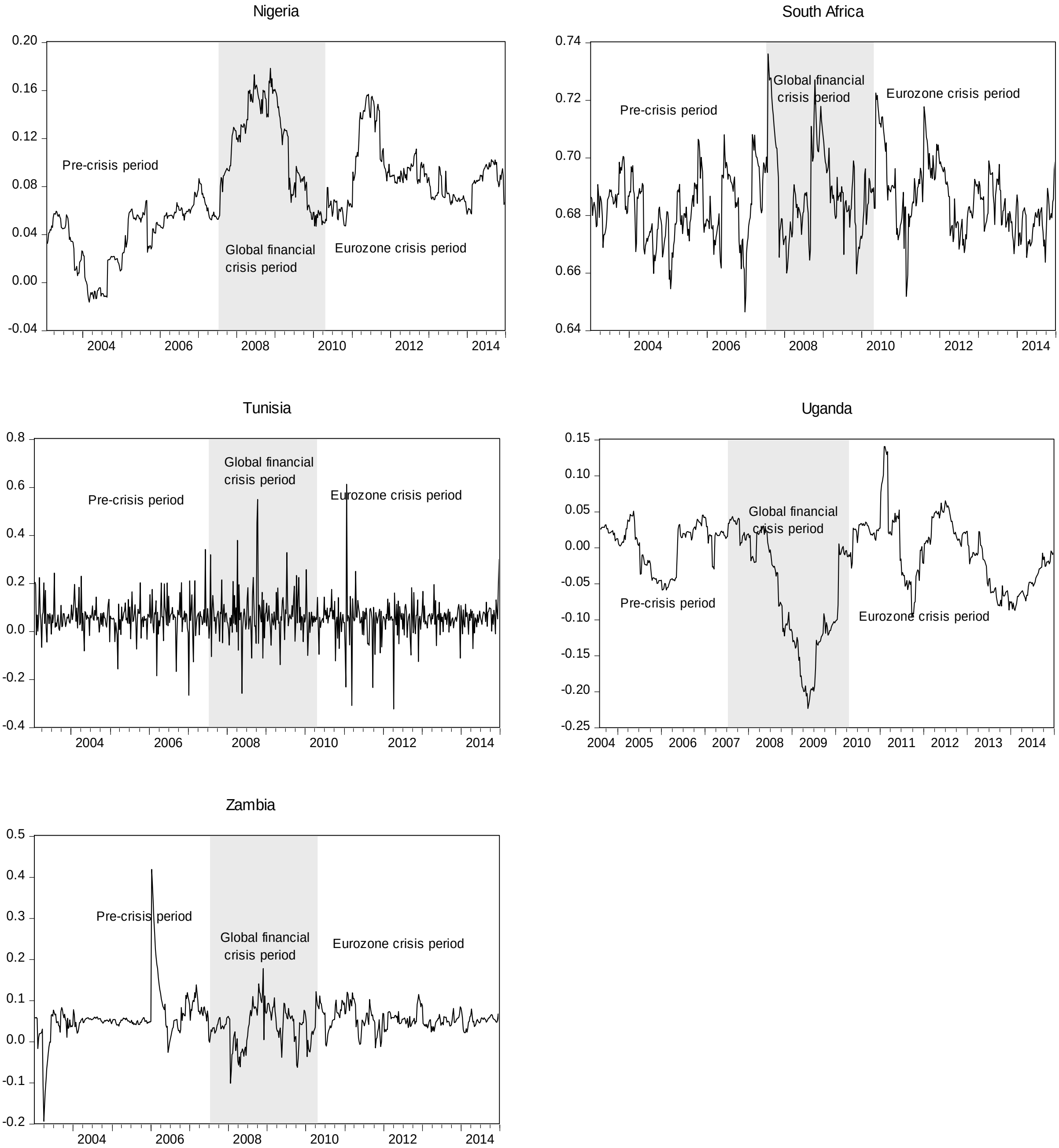




Source: Author's computation

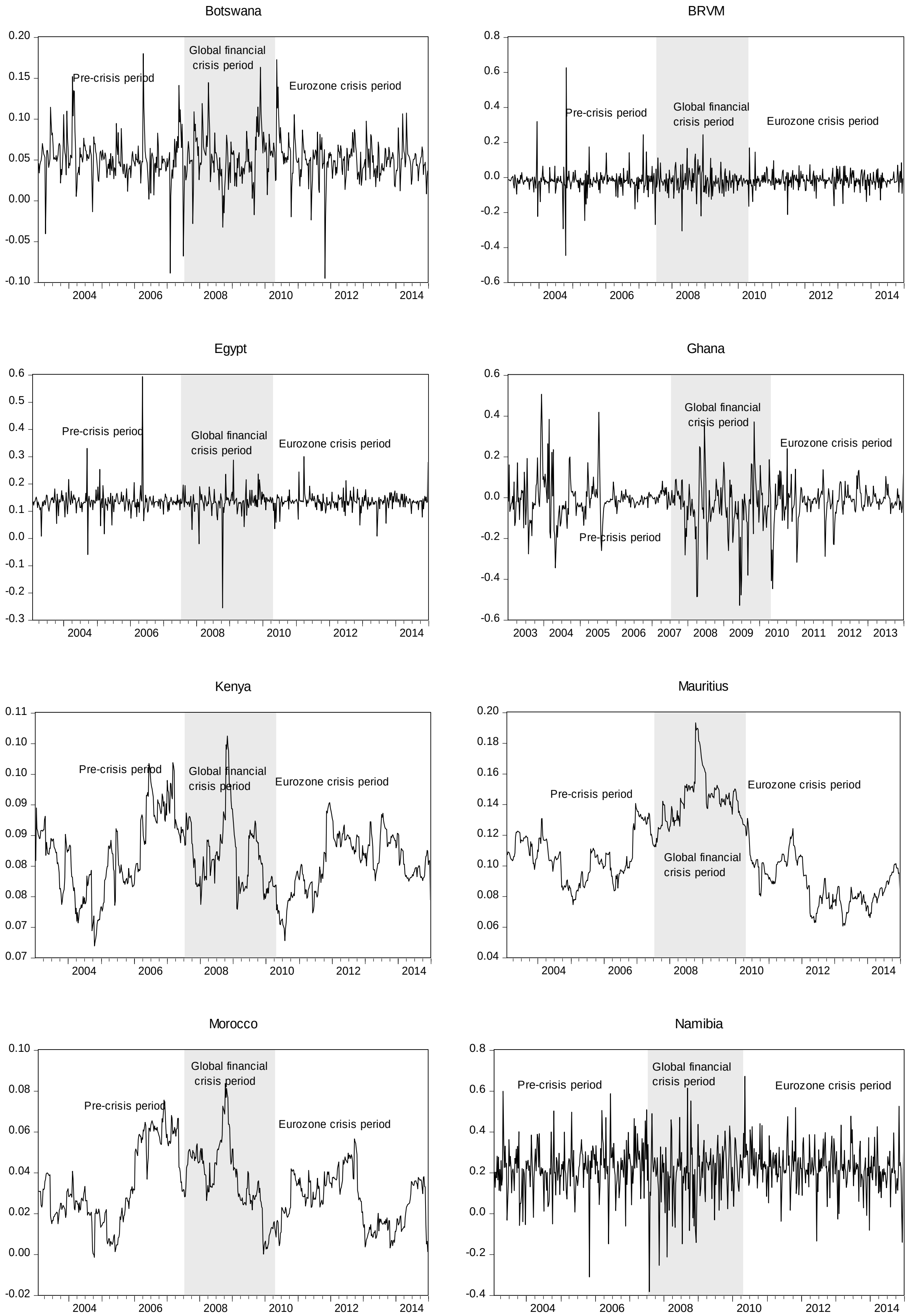
Figure 7. 3: DCC between Canada and African stock markets

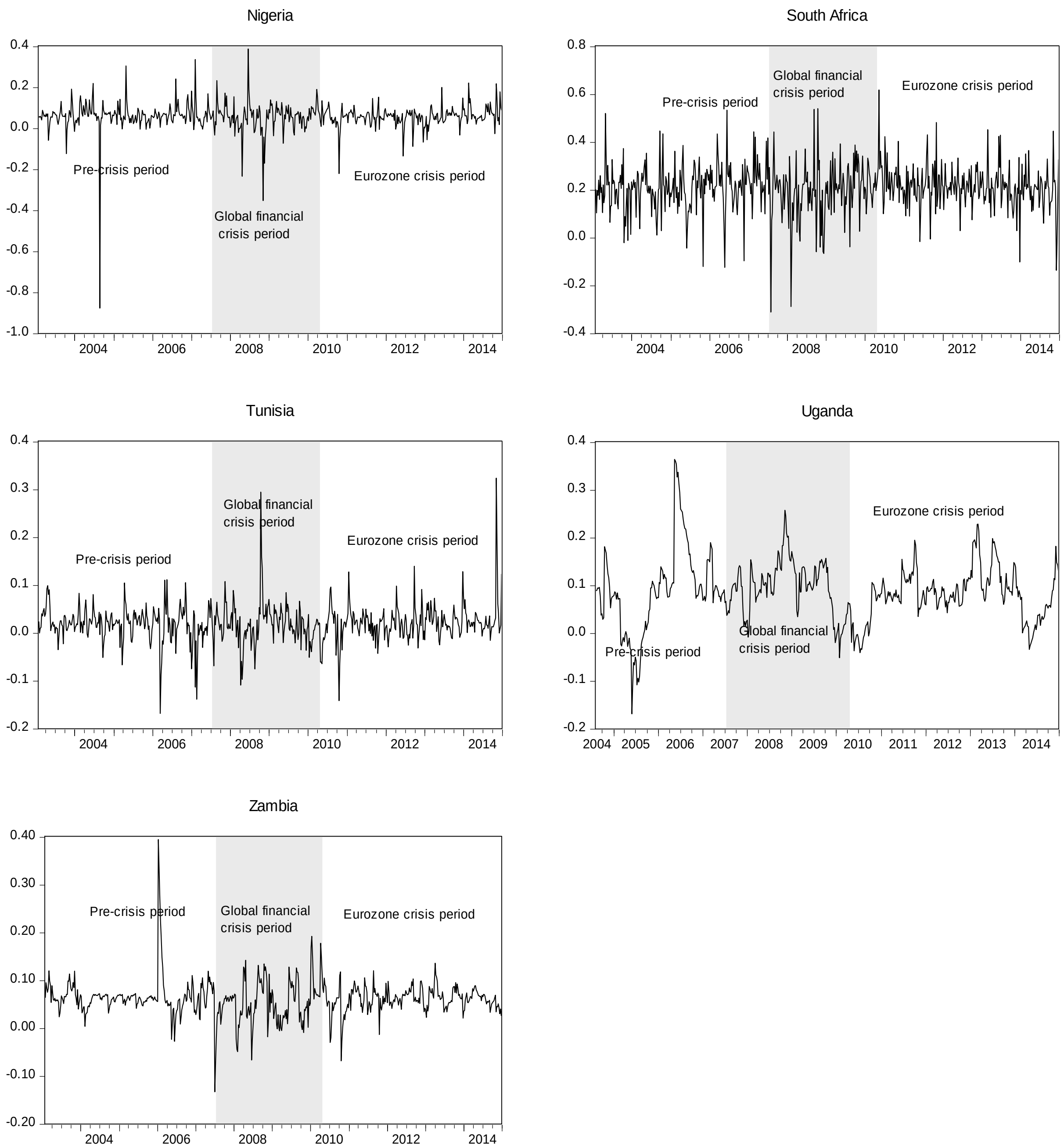




Source: Author’s computation

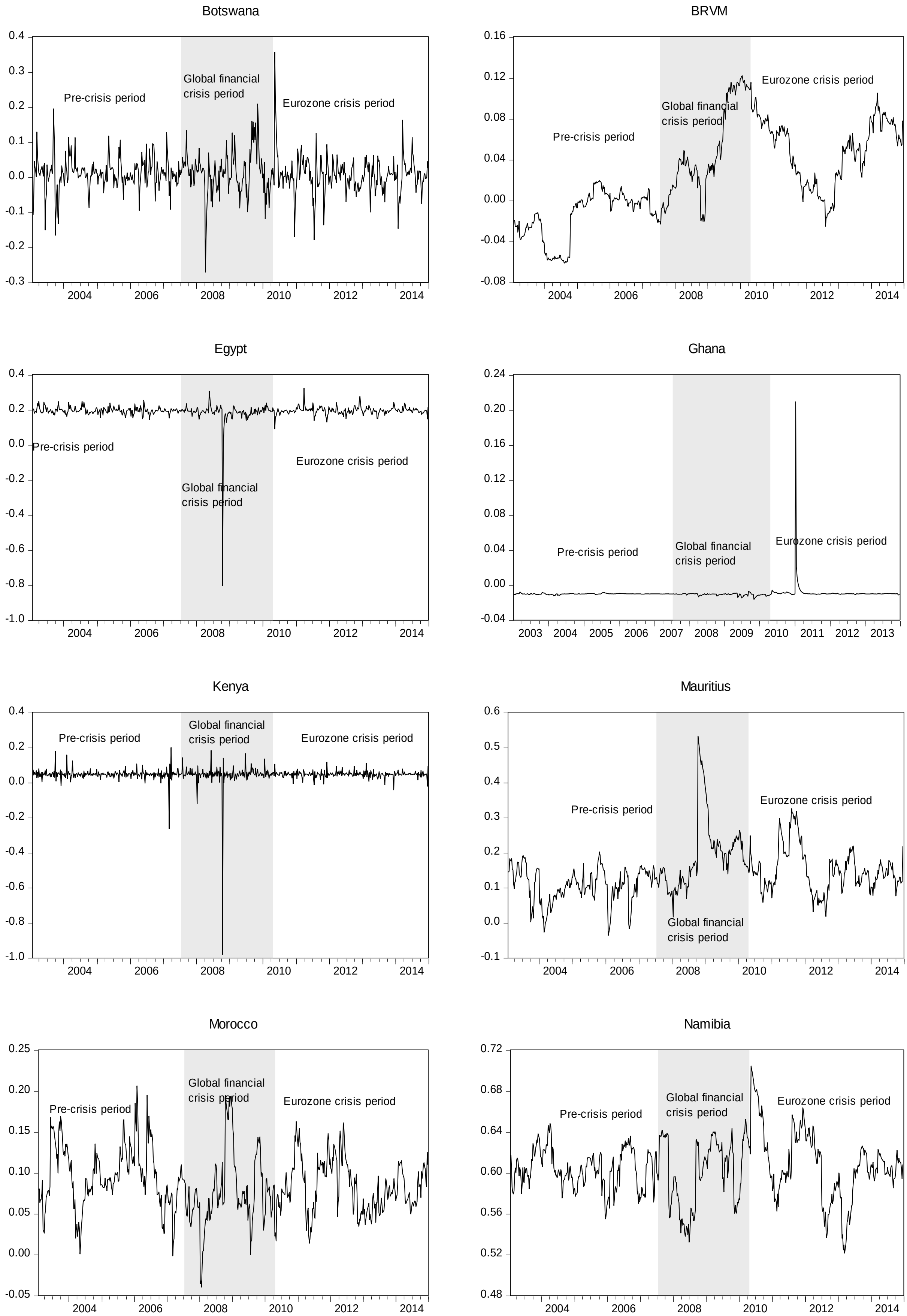
Figure 7. 4: DCC between China and African stock markets

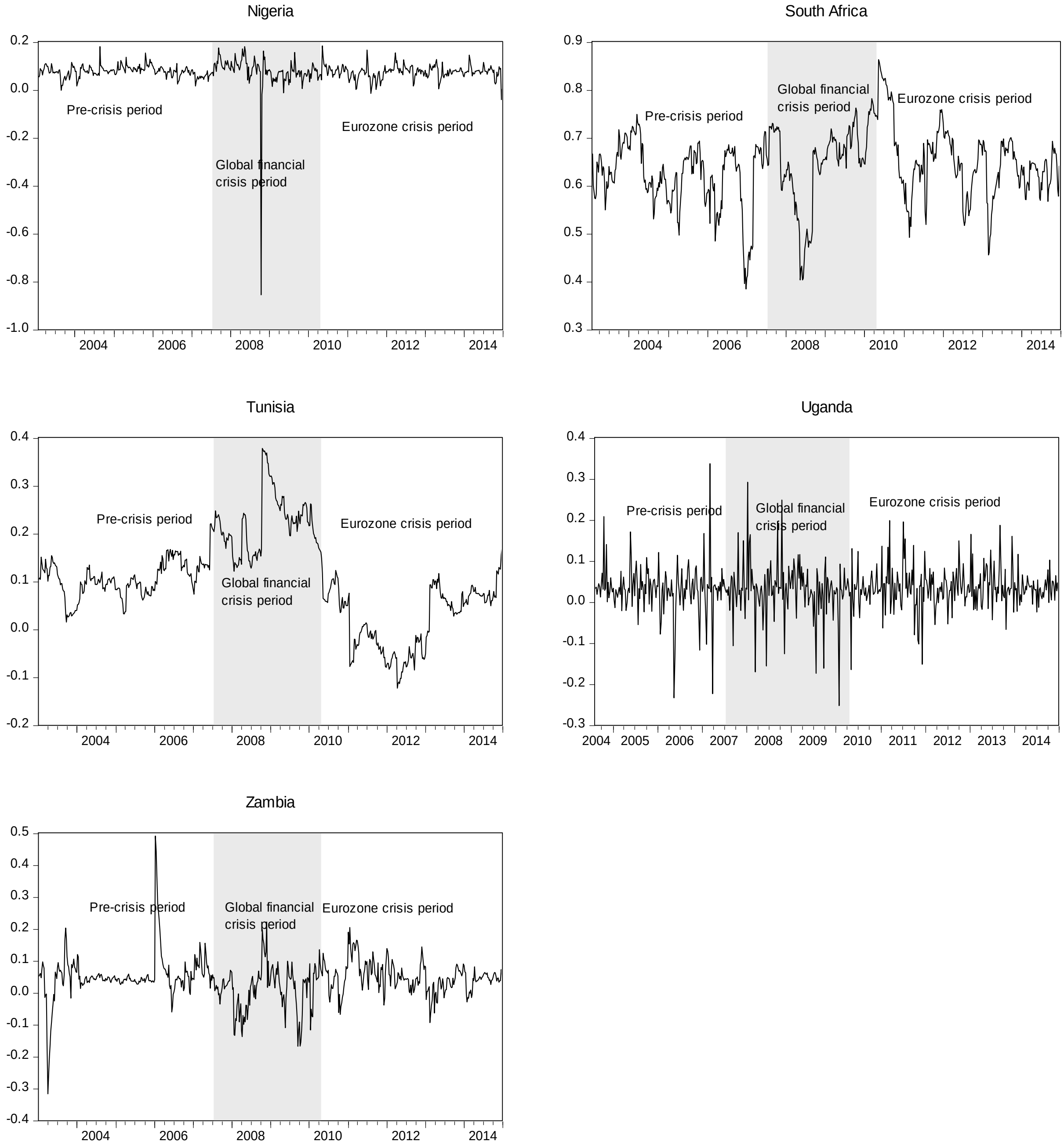




Source: Author’s computation

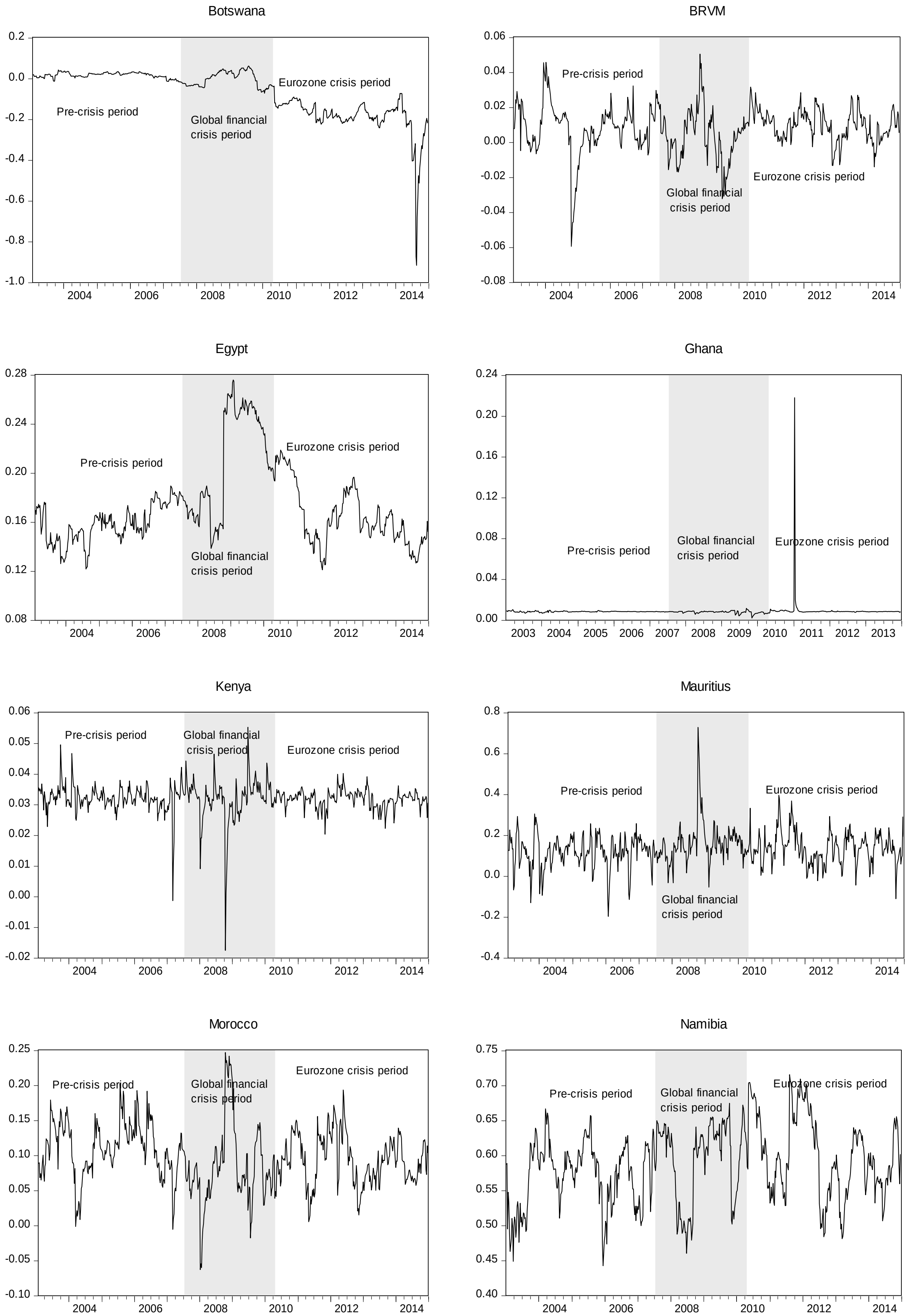
Figure 7. 5: DCC between France and African stock markets

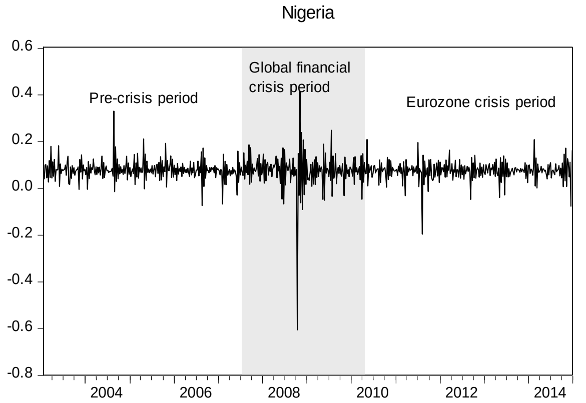


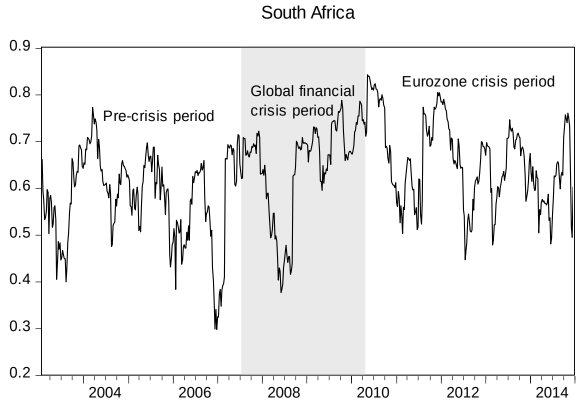


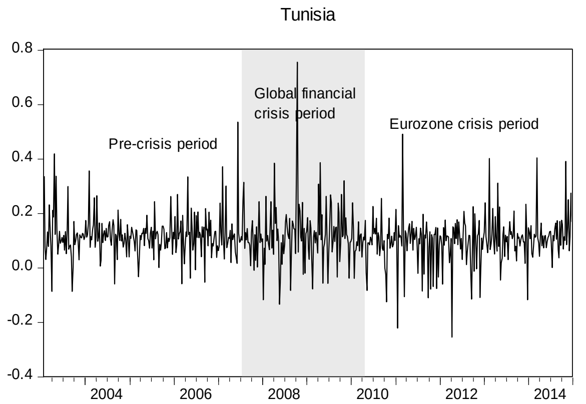
Source: Author's computation

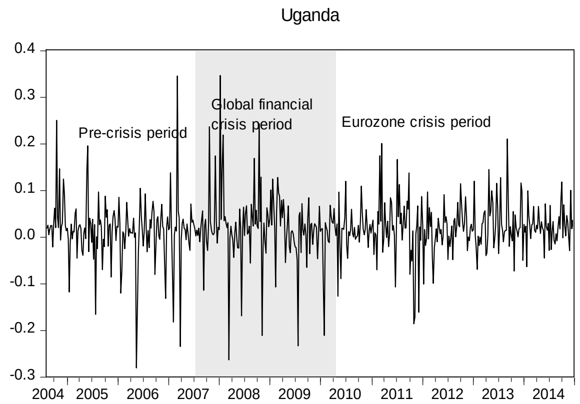
Figure 7. 6: DCC between Germany and African stock markets

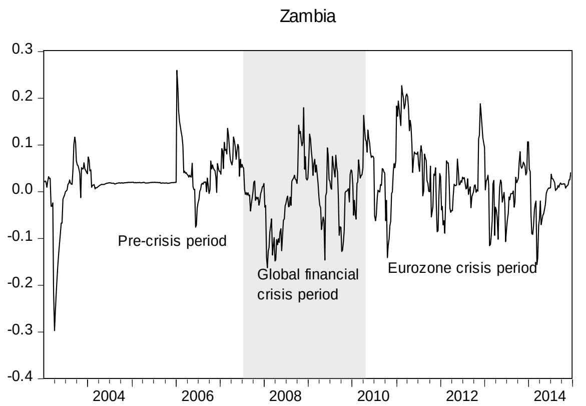






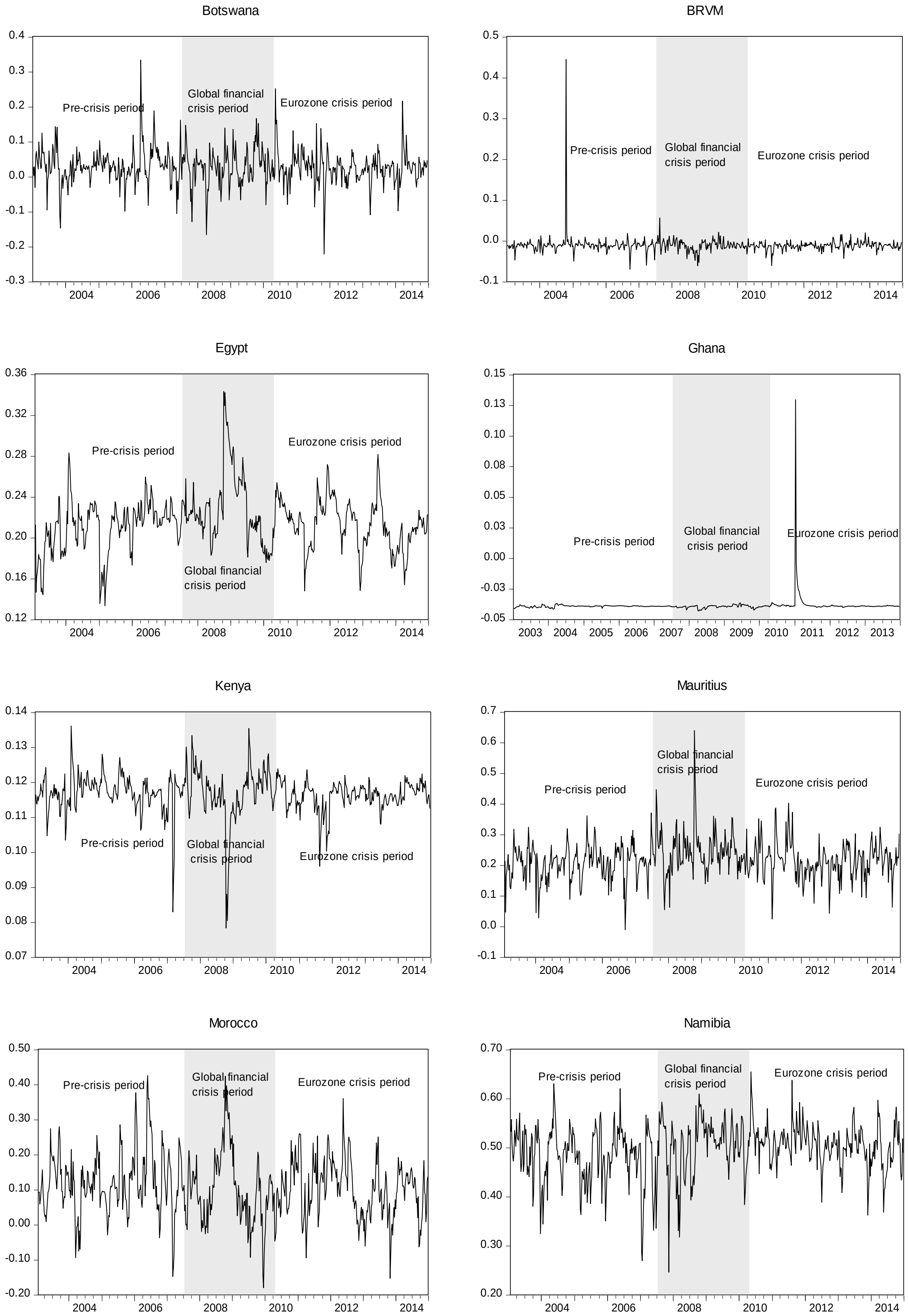


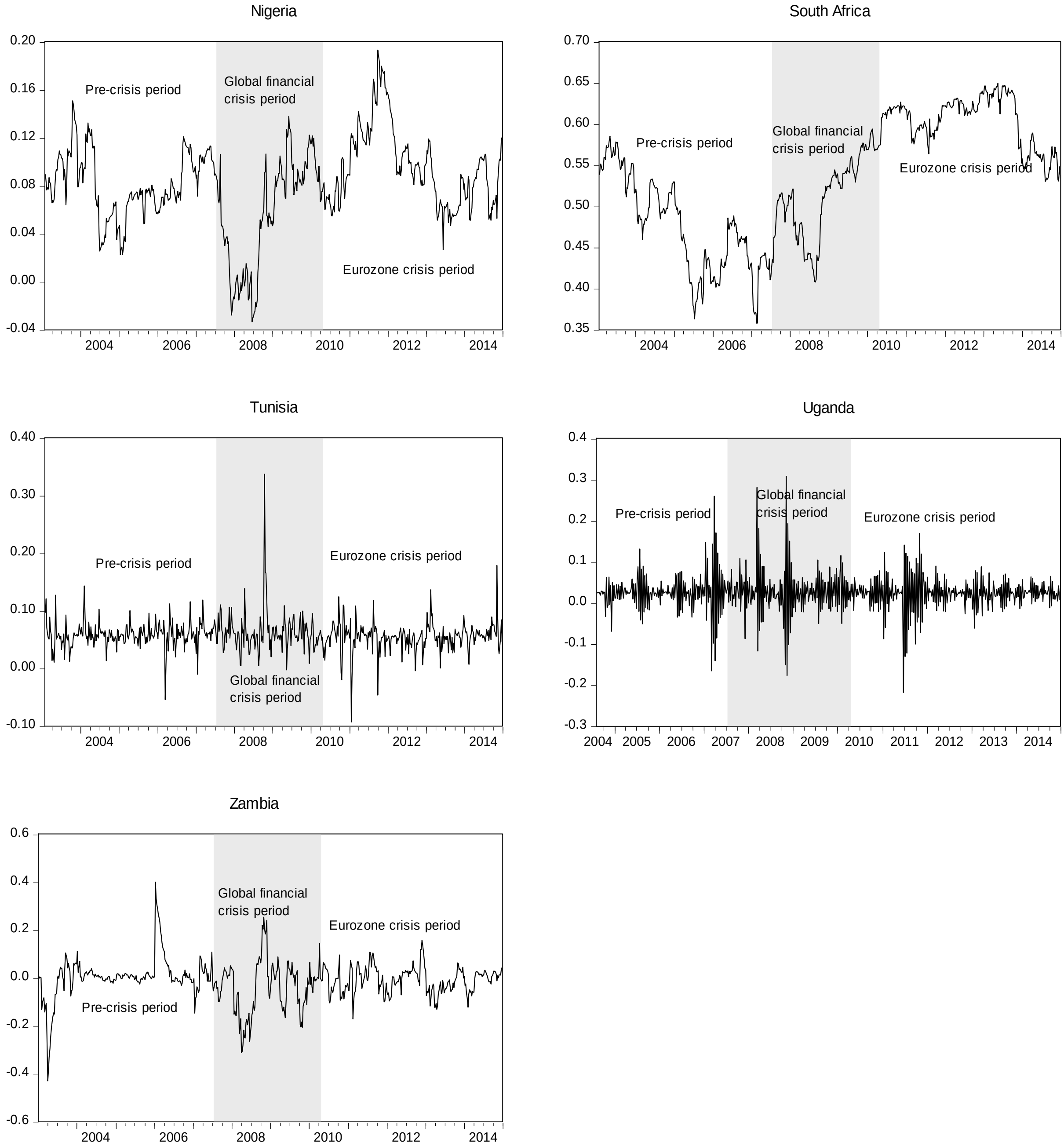




Source: Author's computation

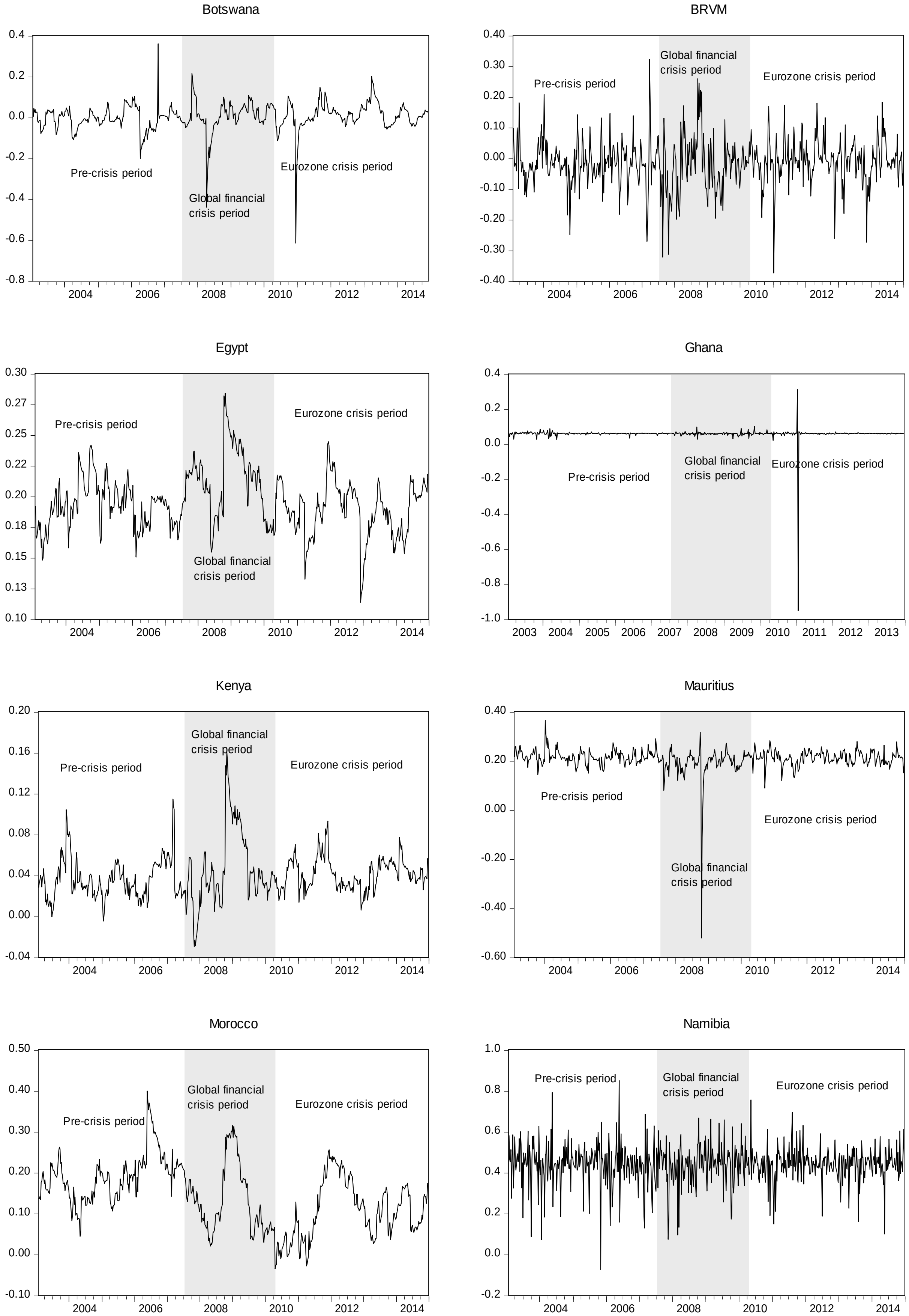
Figure 7. 7: DCC between Hong Kong and African stock markets

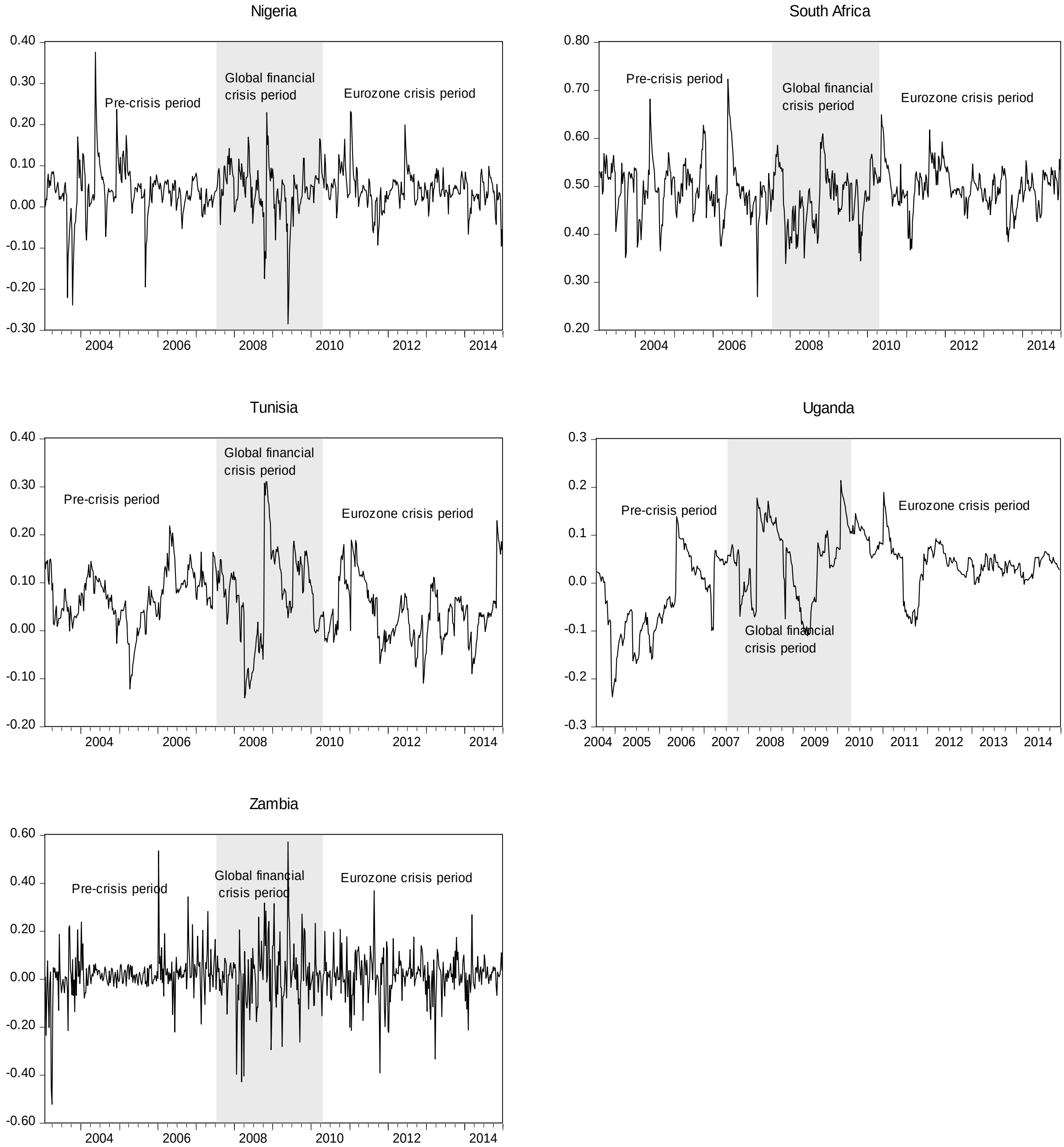




Source: Author's computation

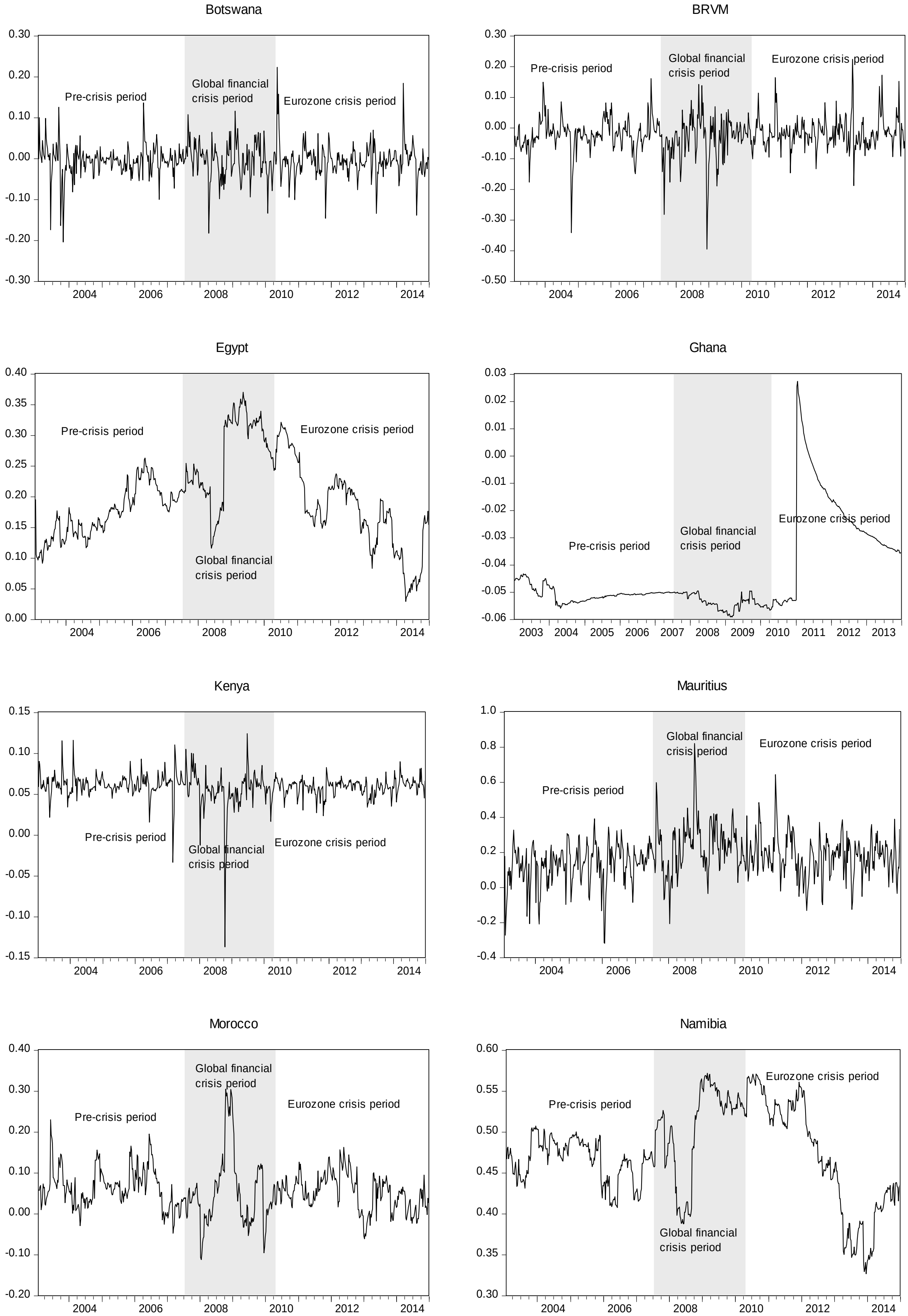
Figure 7. 8: DCC between India and African stock markets

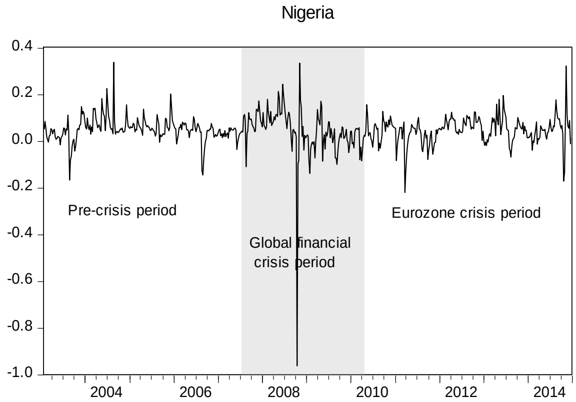


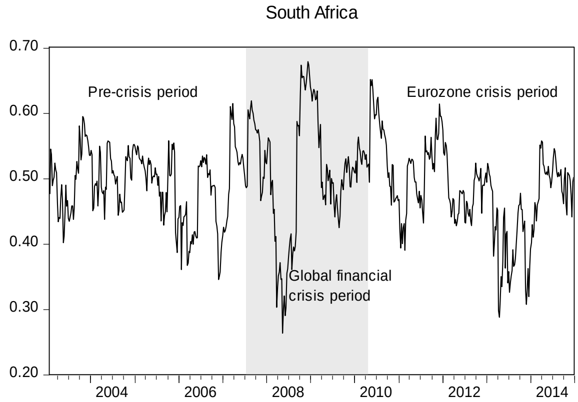


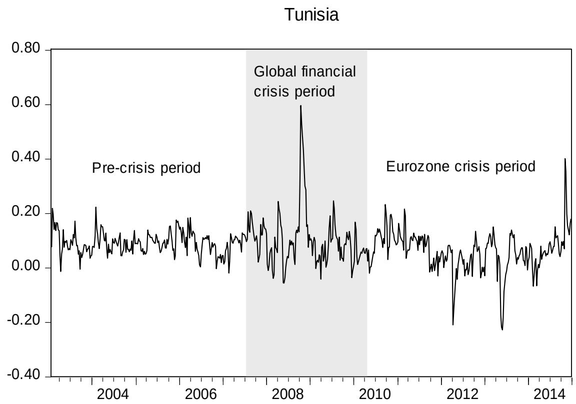
Source: Author's computation

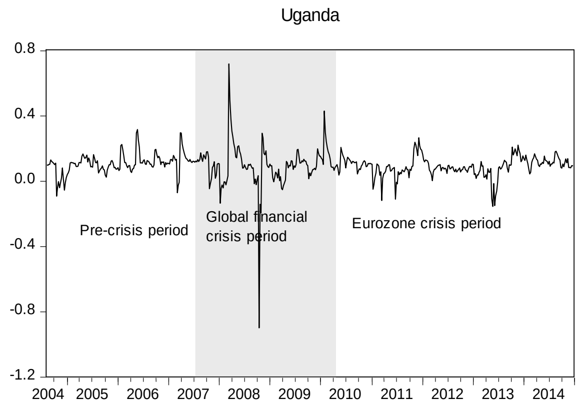
Figure 7. 9: DCC between Japan and African stock markets

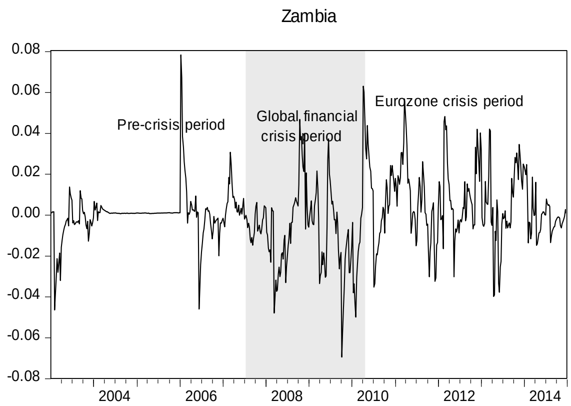






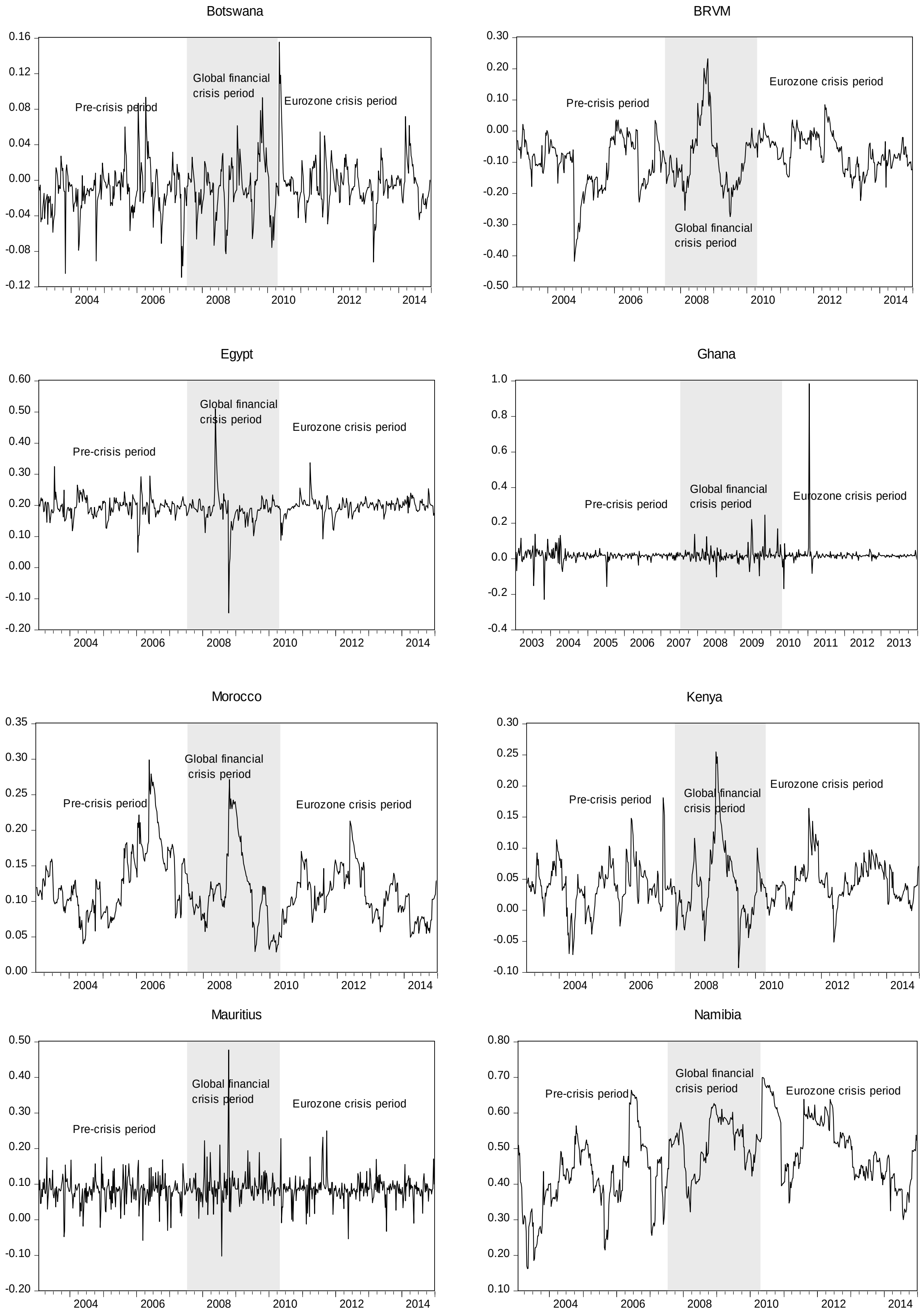


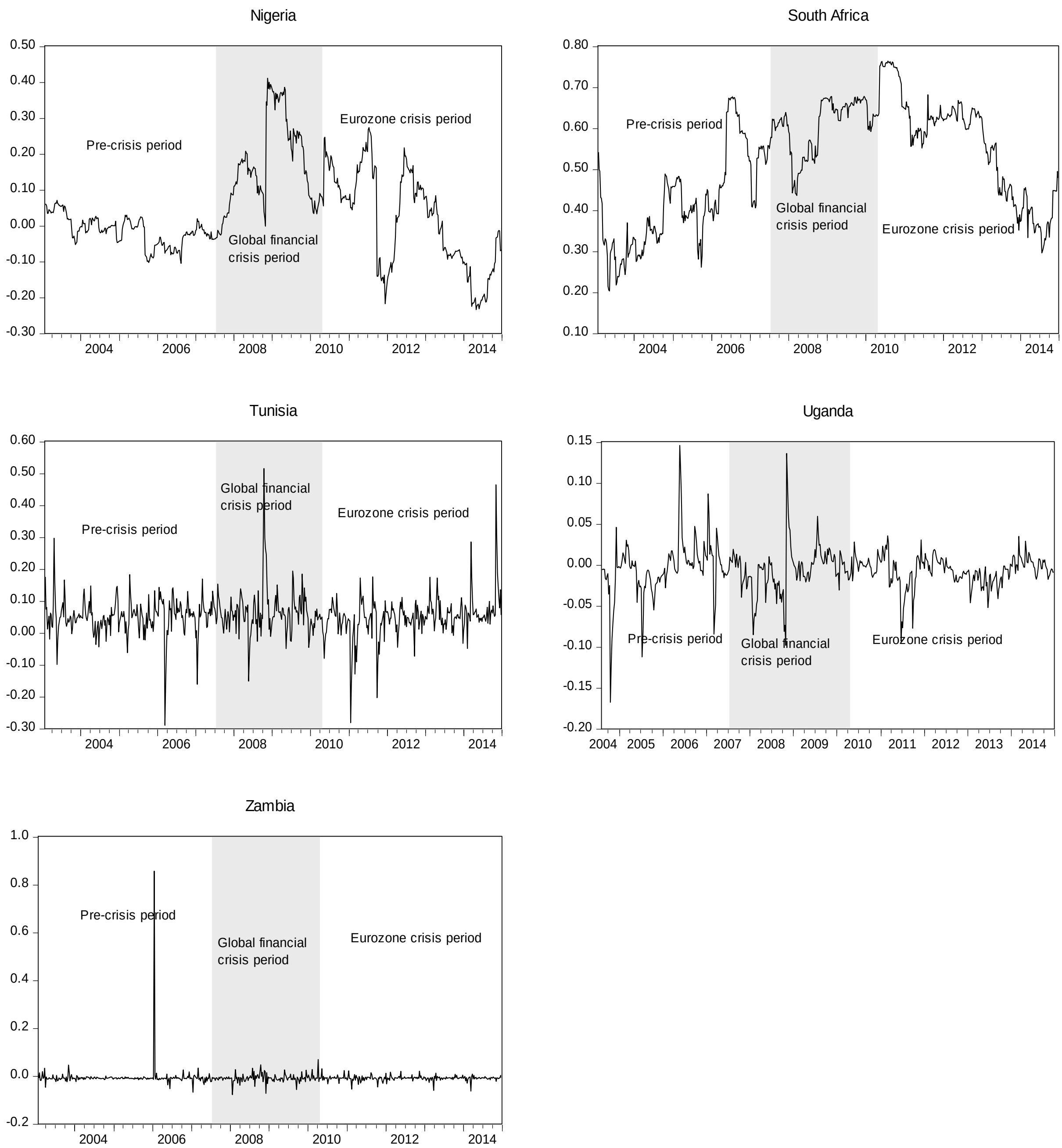




Source: Author’s computation

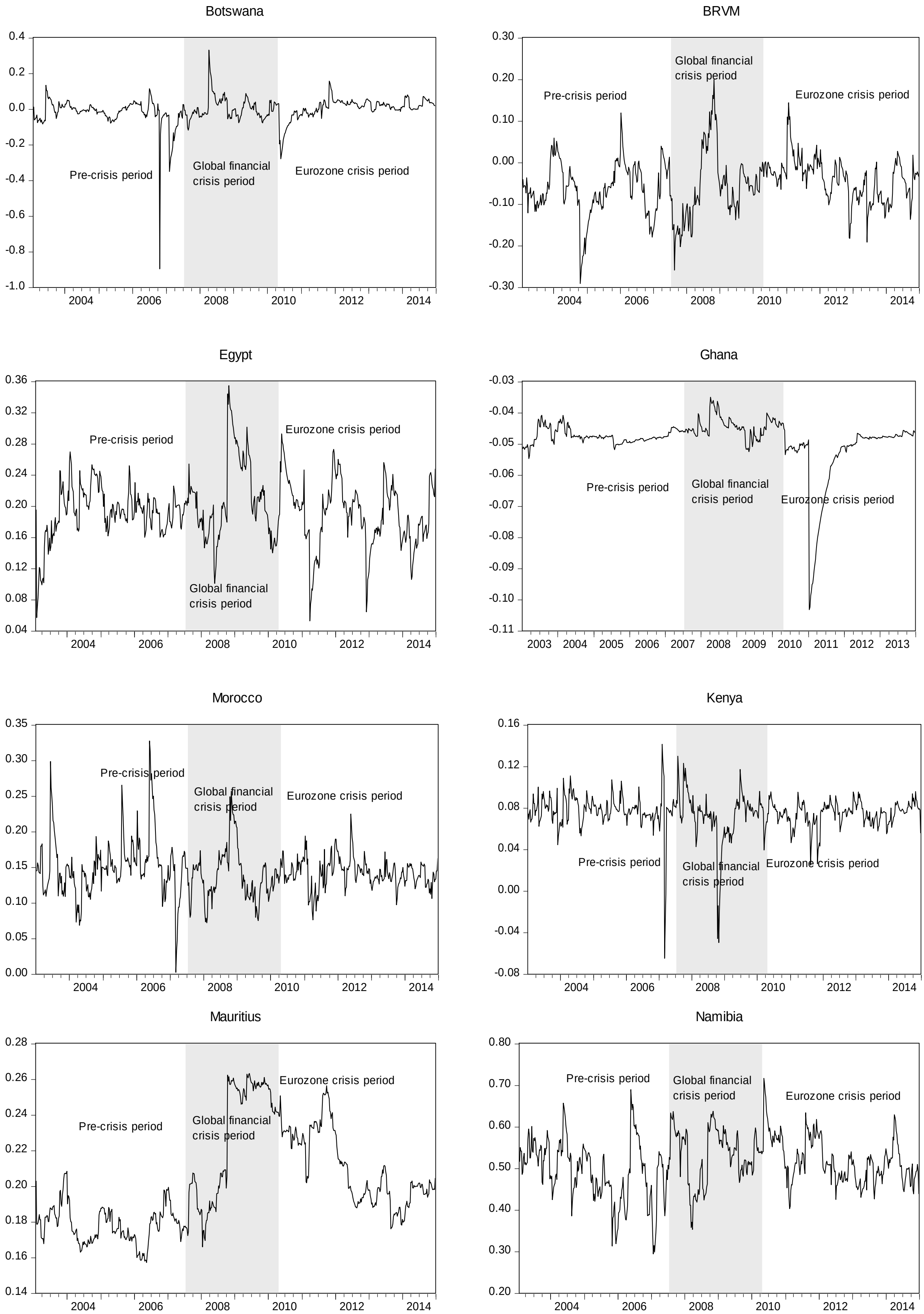
Figure 7. 10: DCC between Russia and African stock markets

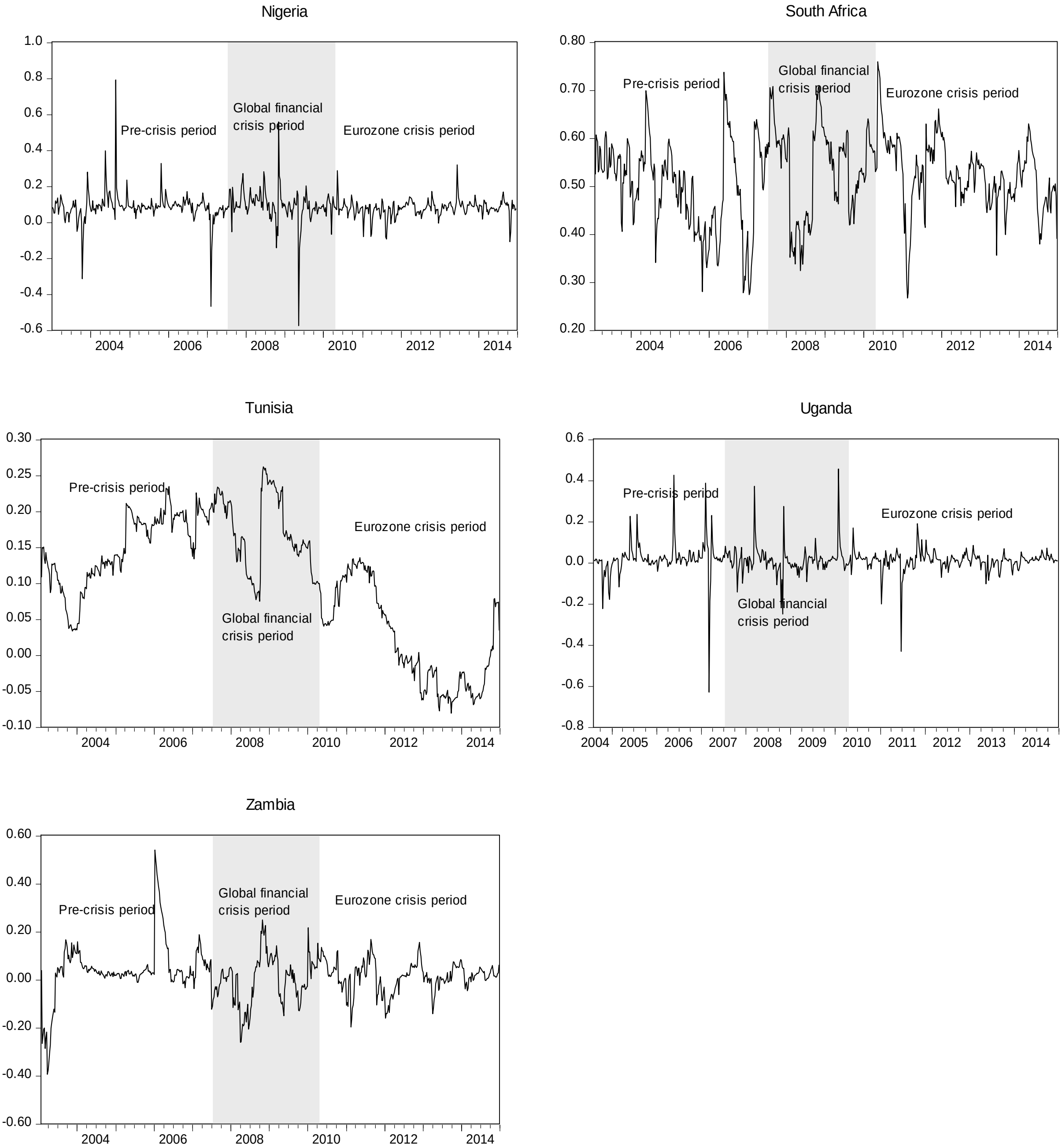




Source: Author's computation

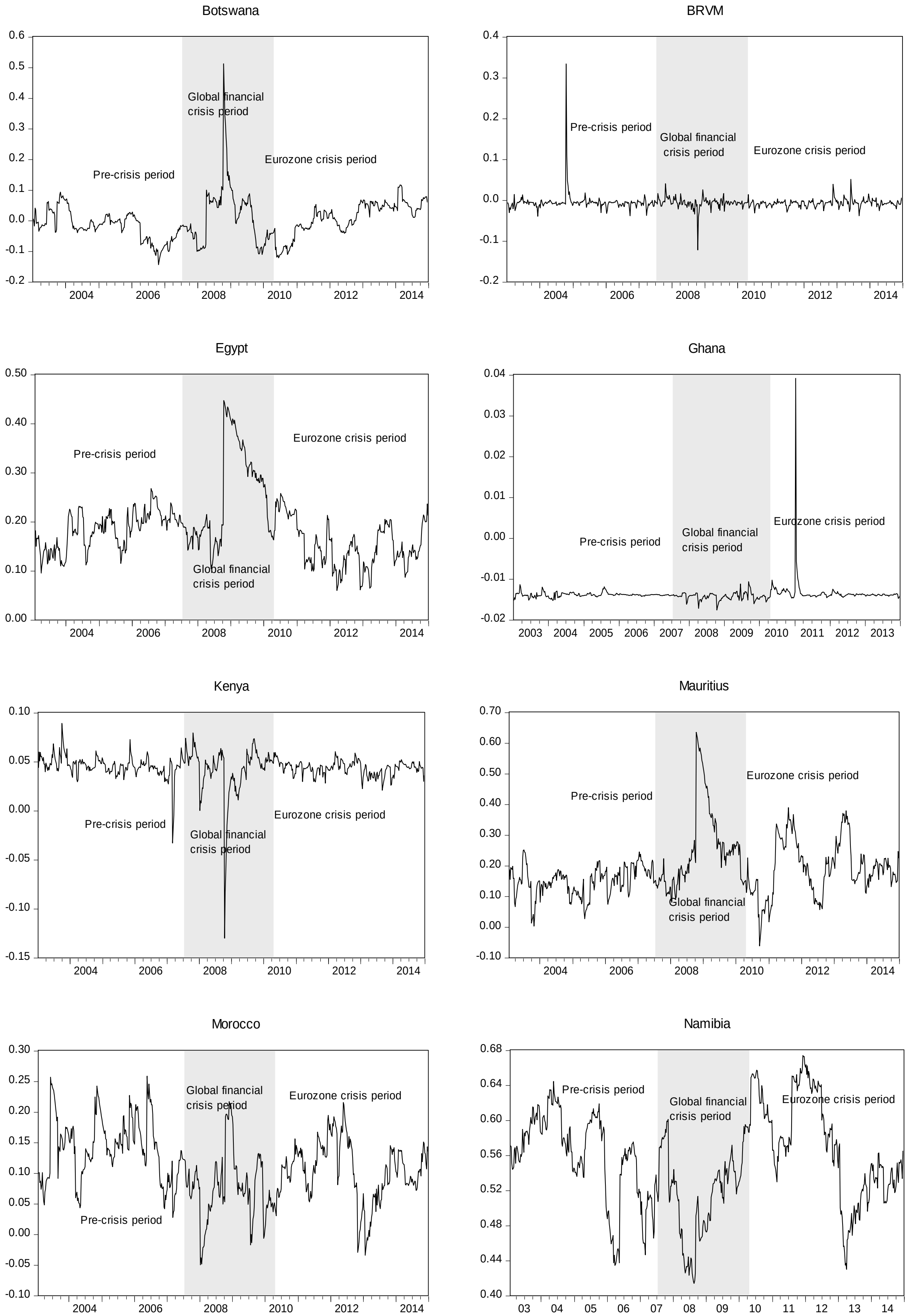
Figure 7. 11: DCC between Singapore and African stock markets

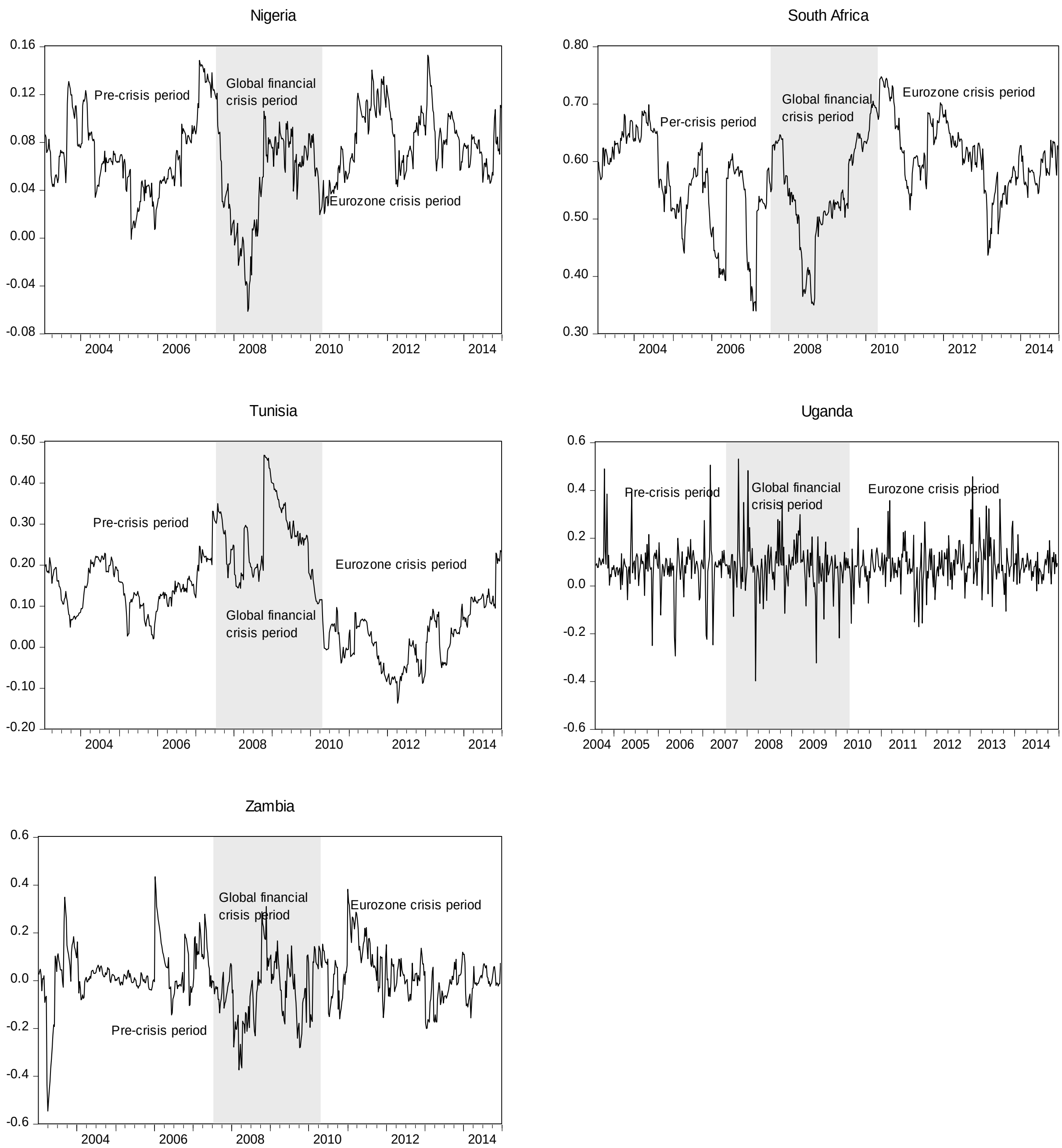




Source: Author’s computation

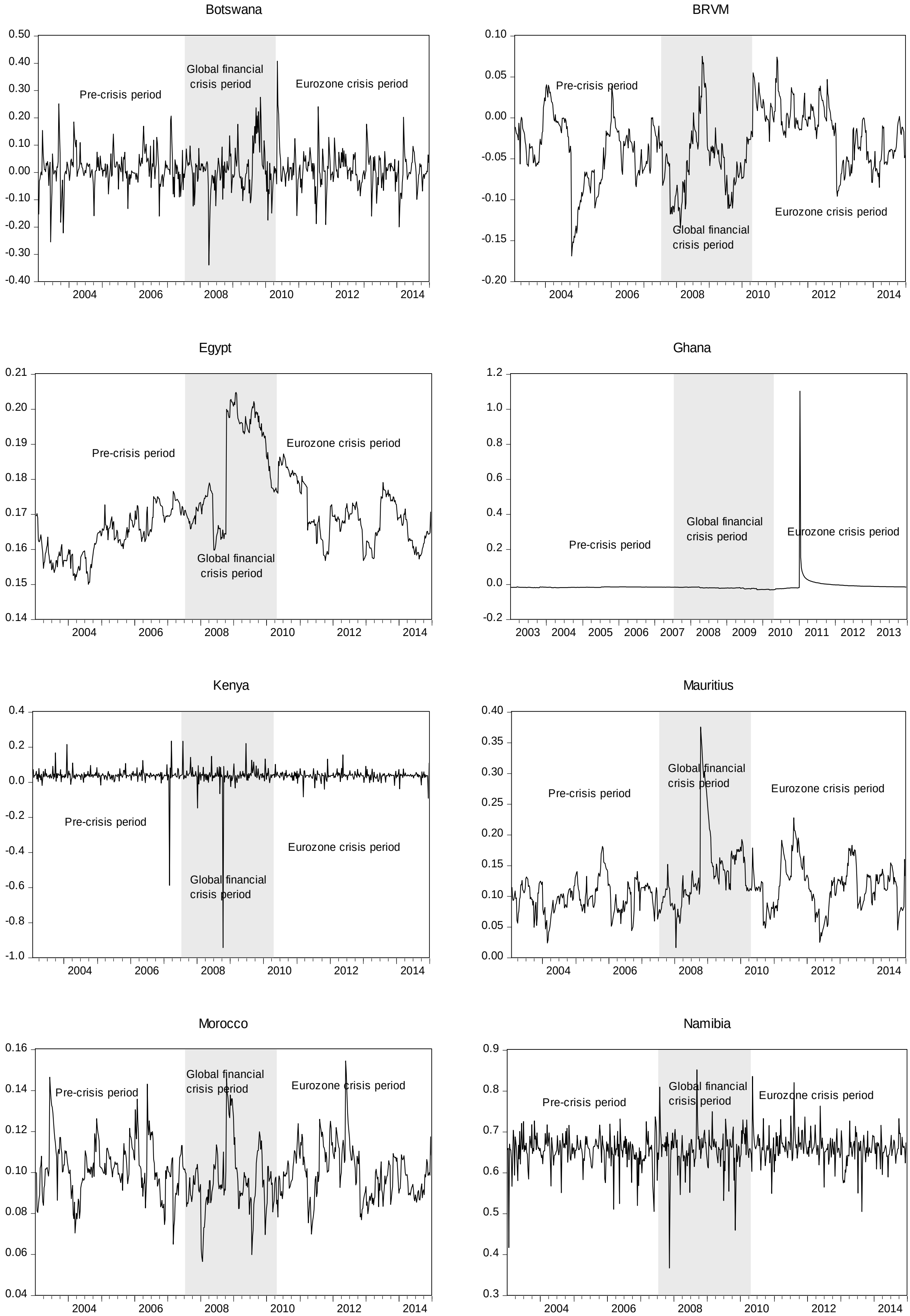
Figure 7. 12: DCC between Switzerland and African stock markets

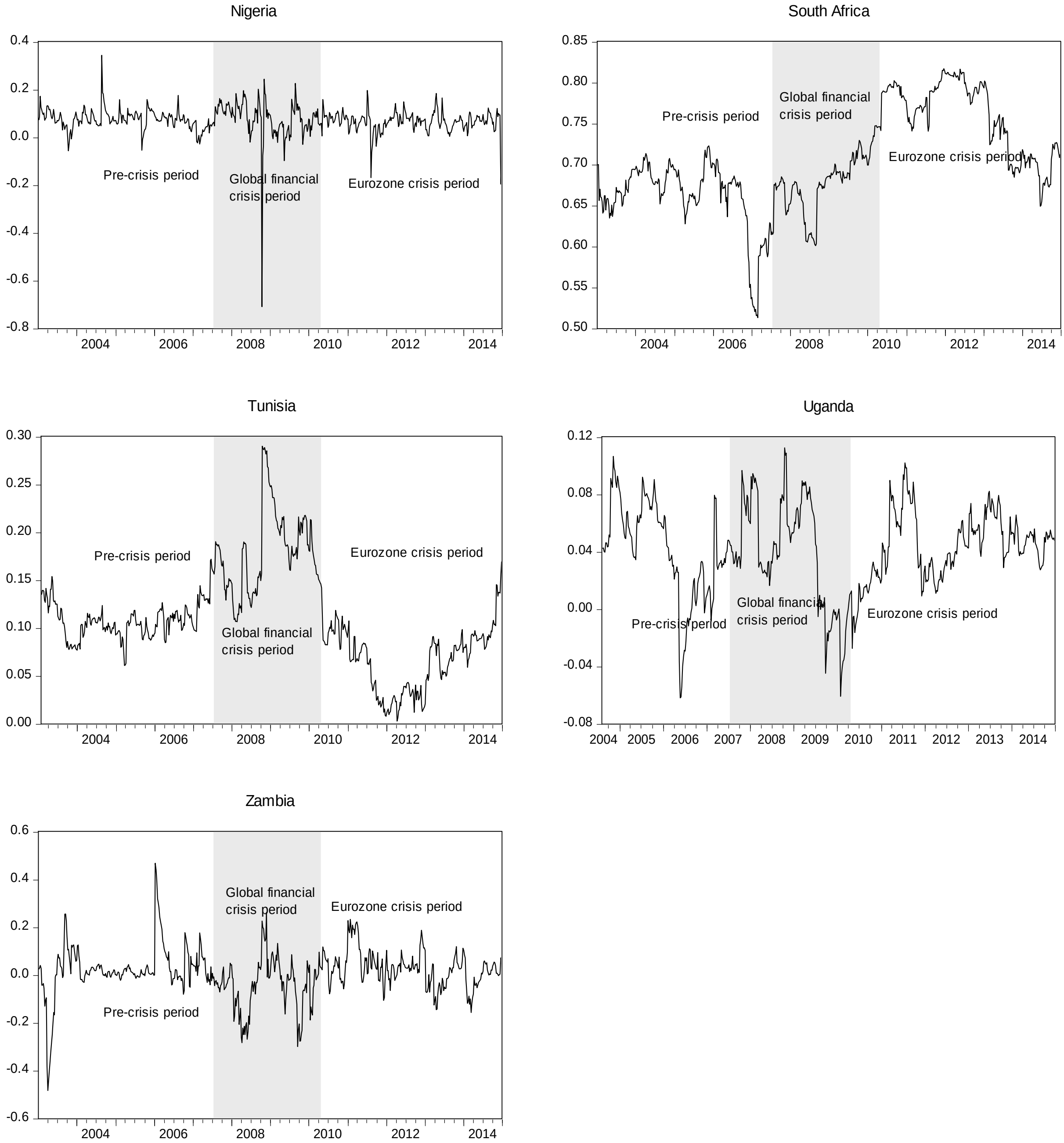




Source: Author’s computation

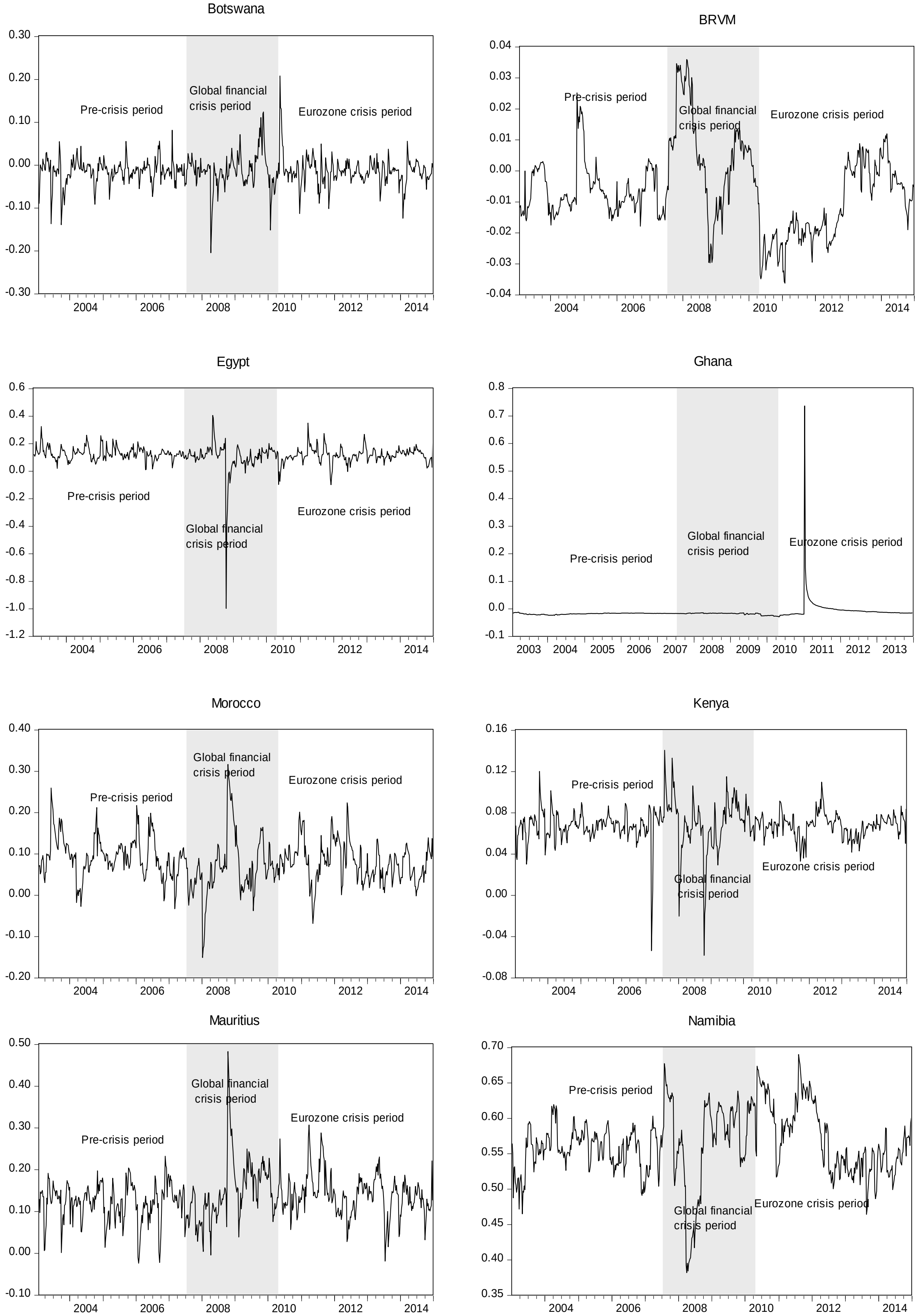
Figure 7. 13: DCC between United Kingdom and African stock markets

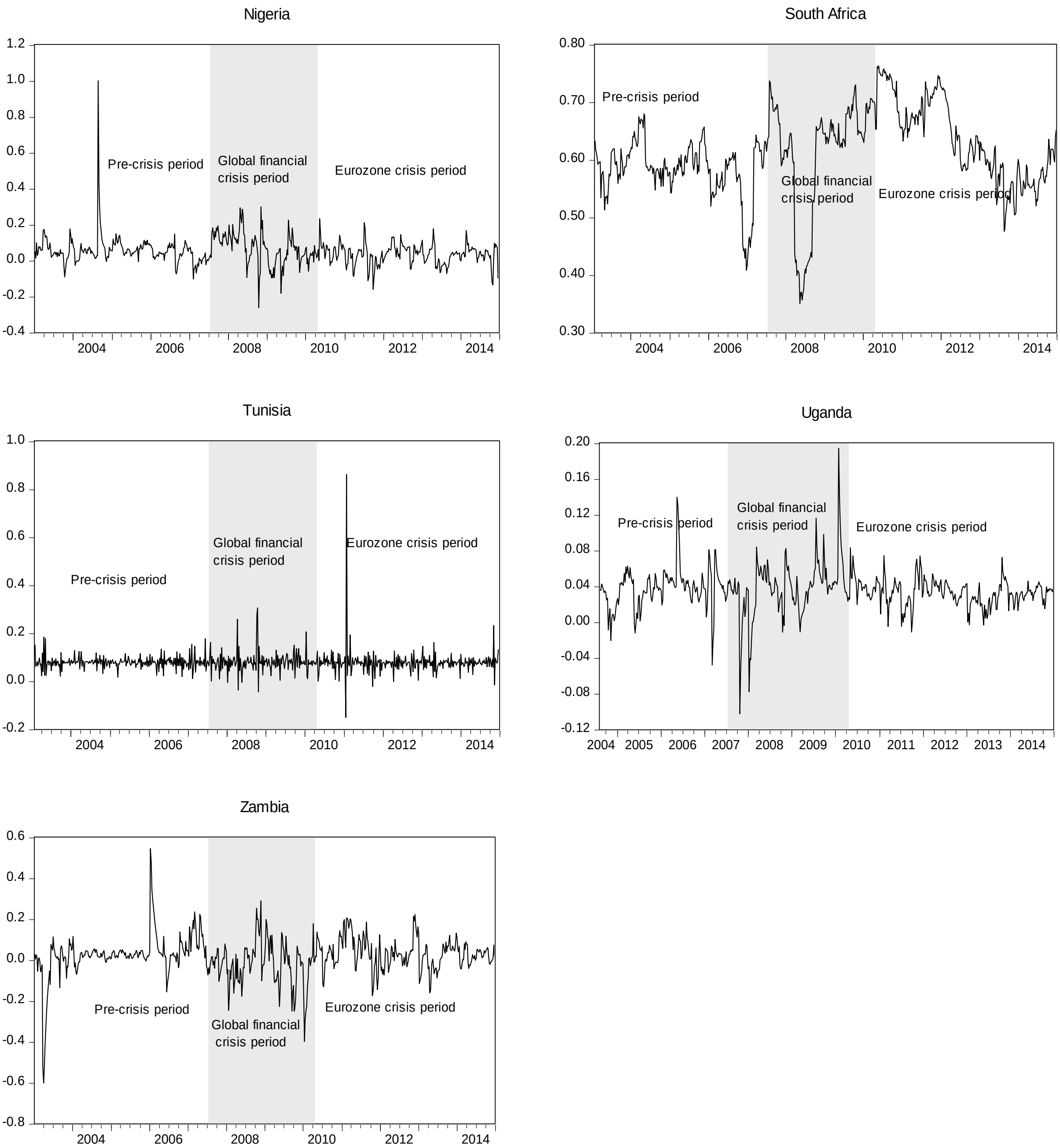




Source: Author's computation

Figure 7. 14: DCC between United States and African stock markets





Source: Author's computation