UNIVERSITY OF ZULULAND

African Stock Markets: Empirics of Development, Integration, Efficiency and Investor Herd Behaviour

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201445551

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (PhD)
(Economics)

Faculty of Commerce, Administration and Law
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2017

DECLARATION

I, **Godfred Aawaar** declare that:

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Signature:

Date: 19 / 04 / 2017

ACKNOWLEDGEMENT

"If I have seen further it is by standing upon the shoulders of giants" (Isaac Newton).
And if I have been able to attain further and greater height in education, it is because I have an eternal God who provides, and wonderful and accomplished "minds" that encouraged and supported me. To everything there is a season, and a time to every purpose under the heaven; and really, a time to commence a PhD research and a time to complete it. I am very grateful to God for my entire life.

This document is the result of three years of sustained research at the University of Zululand. This period represents the most challenging and yet most stimulating period in my life. In the end, many people have contributed in diverse ways to enable the timely completion of this research degree. I am particularly heavily indebted to my supervisor, Professor Devi Datt Tewari for his guidance, encouragement and immense support. I have benefitted enormously from his mentorship, comments and critiques which enhanced the quality of this work. I am also grateful to the external examiners for their comments.

I am also very grateful to Professor I. Kaseeram, Deputy Dean (Research and Internationalisation) of the University of Zululand for his immense support which mitigated research related challenges. I am also indebted to Professor Paul Alagidede for his immense support. I am equally thankful to Dr J. B. Dramani, Dr F. Tandoh, and Dr P. A. Yirenkyi, whose diverse critiques and assistance greatly enriched this work.

I am also very grateful to my colleagues and friends (Maxwell, Eric, Adomah Worae, Adams, Kehinde, Mutala and Mavodjo) for their support and encouragement.

Finally, thank you to all my family members for their undiluted love and support. I am particular grateful to the Aawaar family for their encouragement. My special thanks go to my wife, Mrs Justina Aawaar and my children: Kyogtaar, Mwinkaaire and Mwinkaame, who have had to endure my absence during the entire period of this PhD research.

It should be noted that one peer-reviewed journal article: Aawaar, G. M. and Tewari, D. D. (2016): Domestic and Global Determinants of Stock Market Development in Africa, *The Asian Economic Review*, 58(1), 57-78, has been published from this study.

DEDICATION

To the memory of my father, Emilio Aawaar; to my ever-kind and lovely mother, Martina Kyogtaar Naa-i-naa from whom I learned the first principles of economics; and to my lovely wife (Justina) and adorable children (Kyogtaar, Mwinkaaire and Mwinkaame) whose unceasing prayers, support and encouragement underlie my attainment of this great academic glory.

ABSTRACT

Africa's stock markets are as diverse as the 53 economies that constitute the continent. Stock markets in Africa have been described as being less developed, inefficient and isolated or segmented from the rest of the world. However, these views are not entirely accurate in the light of the current state of development. African stock markets have gained prominence and relevance in the global financial scene in the last three decades. The number of exchanges, for instance, has risen from 6 in the 1980s to 29 presently. Most of them may have experienced significant progress in terms of their performance, their integration with the world and their efficiency. Regrettably, unlike the developed and emerging stock markets elsewhere in the world, Africa's stocks markets have suffered a history of global and investor neglect and have accordingly attracted very little research. This study contributes to our knowledge of Africa's stock markets in relation to what factors drive their development, whether their co-movement (regionally and globally) has evolved over time and in scale, whether their integration is associated with their informational efficiency, and whether or not herding behaviour exists in these stock markets. The study used various methodologies to accomplish the objectives including the dynamic GMM estimation, pooled panel OLS regression, wavelet squared coherence analysis, multivariate DCC-GARCH analysis, and the cross-sectional absolute deviation (CSAD) modelling technique. The findings of this study have far-reaching implications: First, we conclude that both domestic (macroeconomic and institutional) and global factors drive stock market development in Africa; sound domestic macroeconomic environment and good quality institutions as well as stable global economic and financial conditions are indispensable drivers of stock market development. Second, we also conclude that the integration and co-movements of Africa's stock markets with the world market is both time-varying and scale-dependent, but with significant variations among market pairs. In addition, greater global co-movements exist in Africa's stock markets at both short- and long-term frequency scales, while intra-regional and inter-regional co-movements exist at various time horizons but are relatively weak. However, the strength of these dependencies differs between pairs of markets and regions. Third, we additionally conclude that market integration is closely associated with informational efficiency, and that a globally integrated stock market tends to be a globally informationally efficient market. Finally, we conclude that herding behaviour exists in Africa's emerging equity markets. Important policy recommendations are suggested in this study.

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LIST OF ACRONYMS

ACF	Autocorrelation Function
ADF	Augmented Dickey Fuller
ADF-F	Augmented Dickey Fuller-Fisher Type Unit Root Test
ADRs	American Depository Receipts
AG-DCC	Asymmetric Generalised Dynamic Conditional Correlation
AIC	Akaike Information Criterion
APT	Arbitrage Pricing Theory
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distribution Lag
ASEA	African Securities Exchange Association
ASEAN	Association of Southeast Asian Nations
AVD	Absolute Value of the Deviation
BEKK-GARCH	Baba-Engle-Kraft-Kroner GARCH Model
BRICS	Emerging markets of Brazil, Russia, India, China & South Africa
BRVM	Bourse Regionale des Valeurs Mobilieres
CAPM	Capital Asset Pricing Model
CCC	Constant Conditional Correlation
CCK	Chang-Chen-Khorana
CDVM	Conseil Deontologique des Valeurs Mobilieres
CIP	Covered Interest Parity
CMWC	Continuous Morlet Wavelet Coherency
CPI	Consumer Price Index
CSAD	Cross-section Absolute Deviation
CSSD	Cross-sectional Standard Deviation
DCC	Dynamic Conditional Correlation
DCC-GARCH	DCC-Generalised Autoregressive Conditional Heteroskedasticity
DWT	Discrete Wavelet Transform
EAME	Europe, Africa & Middle East
ECB	European Currency Board
ECM	Error Correction Model
ECSAD	Expected Cross-sectional Absolute Deviation
ECT	Error Correction Term

EGARCH	Exponential Generalised Autoregressive Conditional Heteroskedasticity
EMDB	Emerging Market Database
EMH	Efficient Market Hypothesis
EMU	European Monetary Union
ETF	Exchange Traded Funds
FDI	Foreign Direct Investment
FEVD	Forecast Error Variance Decomposition
G-7	Seven of the World's Greatest Nations
GARCH	Generalised Autoregressive Conditional Heteroskedasticity
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GDPPC	Gross Domestic Product Per Capita
GEINDEX	Global Equity Index
GLS	Generalised Least Squares
GMM	Generalised Method of Moments
ICAPM	International Capital Asset Pricing Model
ICRG	International Country Risks Guide
IFC	International Finance Corporation
IMF	International Monetary Fund
IPS	Im-Pesaran-Shin
IRF	Impulse Response Function
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LLC	Levin-Lin-Chu
LLF	Log-Likelihood Function
LM	Lagrange Multiplier
LSV	Lakonishok-Shleifer-Vishny
MENA	Middle East & North Africa
M-GARCH	Multivariate Generalised Autoregressive Condition Heteroskedasticity
MSCI	Morgan Stanley Capital International
MTP	Major Trading Partners
NYSE	New York Stock Exchange
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PACF	Partial Autocorrelation Function
PCM	Portfolio-Change Measure

PRS	Political Risk Service of the International Country Risk Guide
RGDP	Real Gross Domestic Product
RIP	Real Interest Parity
S&P 500	The Standard and Poor's first 500 stocks in the United States
SACU	Southern Africa Custom Union
SBIC	Schwartz Bayesian Information Criterion
SMD	Stock Market Development
SSA	Sub-Saharan Africa
UEMOA	West African Economic and Monetary Union
UIP	Uncovered Interest Parity
UNITAR	United Nations Institute for Training and Research
VAR	Vector Autoregressive
VECH-GARCH	Vector Autoregressive Conditional Heteroskedasticity-GARCH
VECM	Vector Error Correction Model
WACMIC	West African Capital Market Integration Committee
WBG	World Bank Group
WCOP	World Commodity Prices
WDI	World Development Indicators
WFE	World Federation of Exchanges
WGI	Worldwide Governance Indicators
XWT	Cross Wavelet Transform

CHAPTER 1
Introduction

"......the health of the stock market, epitomized by the market index appeared to mirror the health of the economy, or even to serve as a surrogate for it." UNITAR, 2000

1.1 Background and Problem Statement

Stock markets are now regarded as an important source of economic wellbeing of nations worldwide. Firms raise capital in the form of equities to finance long-term investments and governments also influence macroeconomic conditions through the stock market. Investors heavily depend on stock markets for their livelihood and business growth. To policymakers and consumers and indeed many other stakeholders, the health of the stock market is indicative of the state of economic activities and conditions in the country. Thus the development of stock markets around the world is crucial for the overall long-term development of economies. At the dawn of the twenty-first century, world economies and financial markets have become interwoven, to degrees, such that global episodes and information become national news and are reflected in domestic markets almost instantaneously. Financial liberalisation, advocated by global institutions such as the Bretton Woods institutions is the impetus of this development. The liberalisation policy meant deregulation and the removal of state laws restricting foreign ownership and participation in domestic stock markets. The development has direct effects on the structure, behaviour and performance of stock markets in particular. Consequently, during the past two decades, stock markets around the world have grown significantly and have become increasingly linked, and emerging markets are a large contributor of this development (Yartey, 2008). Capital flows across countries have improved remarkably and foreign participation in emerging markets has grown tremendously. For example, global stock market capitalisation stood at a little over $64 trillion in 2013, representing a growth rate of 17 percent per annum over the previous year's (World Federation Exchanges, WFE, 2014). Around the same time, market capitalisation of Europe, Africa and Middle-East (EAME) regions grew at 22 percent per annum, similar to those in the Americas. Also, from the late 1990s to late 2000s, African stock markets had experienced a phenomenal increase in the number of stock exchanges, number of listings as well as returns on investments. Since 1995, there has been at least one African stock market in the list of the world's top ten best-performing markets each year (Giovannetti and Velucchi, 2013) with significant improvement in capitalisation and liquidity. Aside from the oldest exchanges in

South Africa and Egypt which were established in the 1880s, there were only 4 stock exchanges in sub-Saharan Africa and 2 in North Africa some 20 years ago. Currently, there are 29 stock exchanges in Africa representing 38 African countries intentions to establish more (ASEA, 2012; Ntim, 2012). Interestingly, one of the few regional stock exchanges in the world, the Bourse Regionale des Valuers Mobilieres (i.e. BRVM exchange) is domiciled in Abidjan, Cote d' Voire, serving the eight members of the West African Economic and Monetary Union (UEMOA). According to Beine et al. (2010) and Lucey and Muckley (2011), the evolution of world stock markets has indeed been greatly influenced and stimulated, leading to increasing interactions among markets.

Stock market integration, market efficiency and investor herding play crucial roles in financial development and economic growth. Finance theory suggests that an integrated stock market is far more efficient than segmented national markets (Giovannetti and Velucchi, 2013). Similarly, asset pricing models predict that integrated markets are more responsive and sensitive to global events than to domestic factors. Market integration promotes international risk sharing, leading to more effective and efficient resource allocation and capital formation through saving, and economic growth in the long run (Bracker et al., 1999; Kim and Singal, 2000). Thus developments in the global and emerging stock markets have ramifications for the continuous development of stock markets. Also, the development of, and interactions among stock markets in Africa and their integration with the world financial market have serious growth implications. For example, Governments' independent macroeconomic policy objectives, regional investors and international portfolio managers, among others can be severely affected by stock markets that are closely linked. An integrated stock market promotes efficient allocation of capital, improves market liquidity, and reduces cost of capital for firms and transaction costs for investors. However, as stock markets develop, and become increasingly interconnected, forming an integrated global market, spillover effects may become prevalent. Domestic markets, especially those in developing and emerging markets become less remote and then react promptly to events from other markets (Hooy and Lim, 2013). Fundamentally, a shock in one market easily gets transmitted to another market (which may not even be closely linked to the shock-originating market). The experiences of many markets from financial crises around the world (including the US stock market crisis in 1987, the Mexican currency crisis in 1994-1995, the Asian crisis in 1997-1998, the collapse of the Russian stock market in 1998, the recent global financial crisis of 2007-2008 which started in the US, and even the very recent Eurozone debt crisis since late

2009) attest to this fact. Evidence shows that the impact of all these crises hit many markets globally rather than only the source market (Aizenman et al., 2012; Neaime, 2012; Jithendranathan, 2013, p.115). For example, by early March in 2009, the US stock market, where the crisis started had tumbled by 43 percent, emerging markets fell by 50 percent on average, and frontier markets plunged by 60 percent, on average (Samarakoon, 2011).

Also, investor herding in stock markets is reportedly a major subject in global discussions about excess volatility and spillover transmission across international markets. For example, Blasco et al. (2012) report a direct linear effect of investor herding on volatility; Avramov et al. (2006) document strong evidence of the impact of both herding and contrarian investors on intraday volatility, and dating back in the 1980s and 1990s, Froot, et al. (1992) and Wang (1993) all support the assertion that investor herding causes extreme price movements in financial markets. Indeed, fundamental linkages in the form of financial, real economic, and political interactions among countries have been found to only partly explain shock spillovers. Studies on contagion and spillover effects however show that, shock spillovers among markets are attributed to herd behaviour and other irrational behaviours of investors such as momentum trading (Belke and Setzer, 2004). Meanwhile, Markowitz's basic principle of modern portfolio theory suggests that transmission of shocks from one stock market to others can increase the correlation between the asset returns in these markets and reduce potential benefits from cross-border portfolio diversification.

In effect, stock market integration and investor herding influence national stock markets, though there exists fundamental differences. They propagate shocks and spillovers across markets, increase volatility, cause market instability and reduce portfolio diversification benefits (Belke and Setzer, 2004; Yao et al., 2014). The two concepts however differ substantially; while market integration is desirable and can facilitate information transmission and price discovery process and thus promote market efficiency through greater investments and technology transfers, investor herding is not desirable and often causes market inefficiency (Li et al., 2004; Hooy and Lim, 2013). In a market where herding exists, it will require a larger number of securities to be held in an investment portfolio to achieve the same level of diversification that is achievable in a herding-free market (Chang et al., 2000; Yao et al., 2014). Herding behaviour thus imposes additional costs on investors and causes markets (regardless of their level of integration) to destabilise. In addition, investor herding is a major cause of market co-movements (Belke and Setzer, 2004; Chiang and Zeng, 2010). Rapid transmission of shocks across markets (including markets uncorrelated economically) during crises has been observed to be a common feature, mainly due to pure contagion (Belke and Setzer 2004). Pure contagion is the international transmission of shocks which cannot be explained solely by the linkages of real or financial fundamentals between markets, but by herding. Markets move together or interact when market participants imitate each other in their investment and trading decisions.

Like market efficiency, stock market integration and investor herd behaviour are important issues of global concerns. They are even more relevant today as the world discusses financial development, regional and global integration of markets, markets volatility, and transmission of shocks and volatility. Their presence has serious ramifications for stock market development, asset allocation, future market efficiency, portfolio diversification, and risk management. The main focus of this study therefore is to empirically investigate stock market development in Africa; the evolving integration[1] of the African stock markets; the efficiency effect of market integration; and the presence of investor herding in stock markets in Africa.

On the basis of the foregoing discussion, this study poses the following key research questions:

(i) What domestic and global factors determine stock market development in Africa?
(ii) Has the integration among African stock markets and between them and the global market evolved over time?
(iii) Is market integration associated with informational efficiency of stock markets in Africa?
(iv) Can herding behaviour be detected in Africa's equity markets and does herding behaviour differ depending on market conditions?

1.2 Motivations for the Study

Developing and emerging markets in general and African stock markets in particular have liberalised, to various extents, their financial markets by the removal of restrictions on foreign ownership and participation. As a result, there is marked improvement in foreign ownership and participation in domestic market securities leading to growing capital and portfolio flows. Stock markets in Africa have indeed responded positively to these global

[1] From the onset, we define integration in terms of co-movement between equity markets.

changes, evidenced by the creation and rehabilitation of many stock exchanges, improved market performance in terms of market size, liquidity and trading and to some extent, improved informational flow and efficiency in these markets. In particular, the question of whether financial liberalisation has made African markets more integrated with the rest of the world and whether market integration facilitates stock market development and efficiency in Africa has often come up in both academic and policy discussions.

Motivations for this study are fourfold. First, there is a need to examine domestic and global determinants of stock market development in Africa. Previous studies that examined the determinants of stock market development from developing or emerging markets perspective, such as Yartey (2007, 2008) and Yartey and Adjasi (2007) covered only macroeconomic and institutional factors and never considered the influence of global factors. In fact, several studies have found evidence which suggests that when a market becomes increasingly integrated globally, it becomes more responsive to global events and information and that global factors significantly affect its performance (Hooy and Lim, 2013; Bae et al., 2012; Albuquerque et al., 2009; Hammoudeh and Li, 2008; Hou and Moskowitz, 2005). There is also growing evidence that financial liberalisation has further integrated the world stock markets and that Africa has come far with regard to its correlation with the world. Global factors that commonly affect all countries (such as the growth of influential economies, global financial conditions, international macroeconomic stability, world commodities prices movements and the recent global financial crisis) may play important role in the development of African stock markets. This necessitates studying the stock market development effect of global factors in Africa.

Second, it is also our motivation to investigate, for the benefit of many stakeholders such as investors, policy makers and stock markets, the evolving integration of stock markets in Africa. Many prior studies have found African markets to be segmented from the global capital markets, yet many African markets such as South Africa, Egypt, and Nigeria among others had suffered a great deal from the 2008 financial crisis which started in the United States. It would be interesting to find out whether integration among African stock markets and with the global stock market has evolved and improved over time.

A third motivation is to study the market efficiency effects of stock market integration in Africa. For a very long time, international finance literature has treated market integration and informational efficiency of stock markets as completely distinct subjects. As pointed out by Hooy and Lim (2013), the literature is very sparse around the world and in fact nearly non-existent on African markets. Nevertheless, the few previous studies examining the efficiency effect of financial liberalisation (Hooy and Kim, 2013; Bae et al., 2012) generally find conclusive evidence that information efficiency of domestic stock markets improves significantly with the level of stock market integration. Moreover, studies that have tested market efficiency typically come to the conclusion that most African stock markets are weak-form inefficient. No study, until now, has attempted to investigate whether there is a link between integration and informational efficiency of stock markets in Africa. If increasing market integration promotes the informational efficiency of stock markets in Africa then appropriate policy responses to deepen stock market integration in Africa are desirable. On the other hand, promoting the further integration of African stock markets with global markets will be counter developmental if stock market integration is inimical to stock market efficiency. It is an interesting hypothesis to be tested and studied.

Fourth, investor behaviour in the form of herding has been said to heighten market volatility, impede information flow and cause markets to become inefficient (Tan et al., 2008). It has also been said that the removal of restrictions on foreign participation in domestic securities markets has led to increased capital flow through foreign participation and that the presence of global investors can induce herding in the domestic market (Balcilar et al., 2013). Investor herding, to the best of our knowledge, has remained an unexplored subject in African stock markets. The few studies that examine the herding effect of liberalised capital flows (Balcilar et al., 2013; Demirer and Ulussever, 2011; Hammoudeh and Li, 2008) limit their studies in the Gulf Cooperation Council (GCC) markets. In the African markets, until very recently when Niyitegeka and Tewari (2013) investigated herding in the South African market, the only study is Gilmour and Smit (2002) which looked at herd behaviour among South African fund managers. In the light of the aforementioned knowledge vacuum and given the importance of herding to investors and policy makers, there is a need to undertake the present study.

1.3 Research Objectives

The overall objective of this study is to empirically analyse African stock markets in relation to their development, integration and investor herd behaviour over the period 1998-2014. More specifically, the study seeks to accomplish the following:

(i) To examine the domestic and global factors determining stock market development in Africa;

(ii) To investigate the evolving co-movement or integration among African stock markets and between them and the global stock market;

(iii) To analyse the association between market integration and informational efficiency of stock markets in Africa; and

(iv) To investigate herding behaviour in Africa's emerging equity markets.

1.4 Contributions of the Study

This study is important and timely for a number of reasons. First, the study contributes to the limited literature on determinants of stock market development by examining broadly domestic and global factors that influence stock market development in Africa. No previous study has considered determinants of stock market development from both domestic and global perspectives. Yet the influence of global factors, such as the growth of influential economies, global financial conditions, world commodities prices movements and the recent global financial crisis could significantly drive the performance of national stock markets particularly in vulnerable region as Africa. This means that the role of global factors in African stock market development is being studied for the very first time.

Second, almost all existing studies on stock market integration in Africa have suggested that African stock markets (South Africa being the exception) are inefficient and segmented from global markets. However, experiences from the effects of global market news and shocks and the recent global financial crisis in 2007-2009 suggest otherwise. Even if African stock markets were segmented from global markets, can they be found to be regionally integrated now or is the integration improving among stock markets in Africa? Can we establish transmission of shocks or spillovers from powerful global stock markets such as the US and China in the African stock markets which could be a measure of the extent of integration of these markets? This study intends to contribute to discussions on these issues, and in particular, within the context of increasing global market integration and financial crisis. Also, studying evolving interactions among these markets and between them and global stock markets will provide better understanding of the extent to which market segmentation is disappearing, or the state of market integration in Africa. Additionally, knowledge will be further advanced on the relationship between stock market integration and informational efficiency of the African stock markets, with a view to determining the market efficiency effect of stock market integration in Africa. This will inform and shape policies and regulations and ensure more effective risk management and portfolio diversification strategies by investors and fund managers.

Fourth, investor herd behaviour in particular and the growing relevance of behavioural finance in financial markets in general are studied. Unlike developed markets and emerging markets in Asia, Europe and Latin America which have given prominence to the topic, studies on investor herding in Africa are very scarce. The very few studies which have been carried out looked at individual markets only, particularly in South Africa, and countries in the Gulf Cooperation Council. This study contributes toward filling this void by extending the literature on investor herd behaviour in particular and behavioural finance in general. Finally, the study will be a useful guide to policy makers, governments, financial markets regulators, fund managers and investors who constantly make policies to promote investment and growth, or make investment decisions within the stock markets in Africa. This study is therefore not only important to these stakeholders, but also timely due to the emerging relevance of African markets within the global economic and financial systems and the fact that the African continent is being viewed as the next continent in the next wave of financial and economic development.

1.5 Scope and Major Hurdles

This study analyses African stock markets with regard to their development determinants, efficiency, integration, and investor herding. The study mainly focuses on the major stock markets (i.e. emerging and frontier markets) with specific analysis of the domestic and global determinants of their development, the evolving integration among them and with the rest of the world, the association between market integration and informational efficiency, and whether or not investors herd in Africa's stock markets. More specifically, the stock markets in the following African countries are studied: South Africa, Egypt, Morocco, Tunisia, Kenya, Nigeria, Ghana, Cote D'Ivoire, Botswana, Namibia, and Zimbabwe. These markets represent the major stock markets in Africa and can adequately serve as an appropriate proxy of the entire African stock market. In fact, South Africa, Egypt, Morocco and Nigeria alone share close to 80 percent of the African stock markets.

The study encountered a number of hurdles. The major hurdles and limitations faced related to availability of African stock market data; non-reporting of data by some countries to major data sources such as the International Country Risk Guide (ICRG) for institutional factors, bureaucratic protocols involved to obtain research funds to access data and other relevant econometric software, and the usual financial constraints. The hurdles were effectively managed and limitations successfully circumvented, leading to the overall success of the study.

1.6 The Organisation of the Study

This study is structured in seven chapters. Figure 1.1 presents a schematic structure of the study indicating the research process and progress through to the end. In particular, the study involves four separate essays: the first essay examines domestic and global factors influencing the development of African stock markets; the second investigates the evolving co-movement/integration of African stock markets and global markets; the third analyses the association between market integration and market efficiency in Africa; and the fourth investigates investor herd behaviour in stock markets in Africa and whether asymmetric effects of herding can be detected during different market conditions. The study is expected to be a useful guide to academic researchers, governments and policy makers, and the investing community who constantly either make policies to promote and regulate financial markets or make decisions to invest in the African and international stock markets. Policy guidelines on stock market development, portfolio diversification, risk management and market participation are natural results of the study.

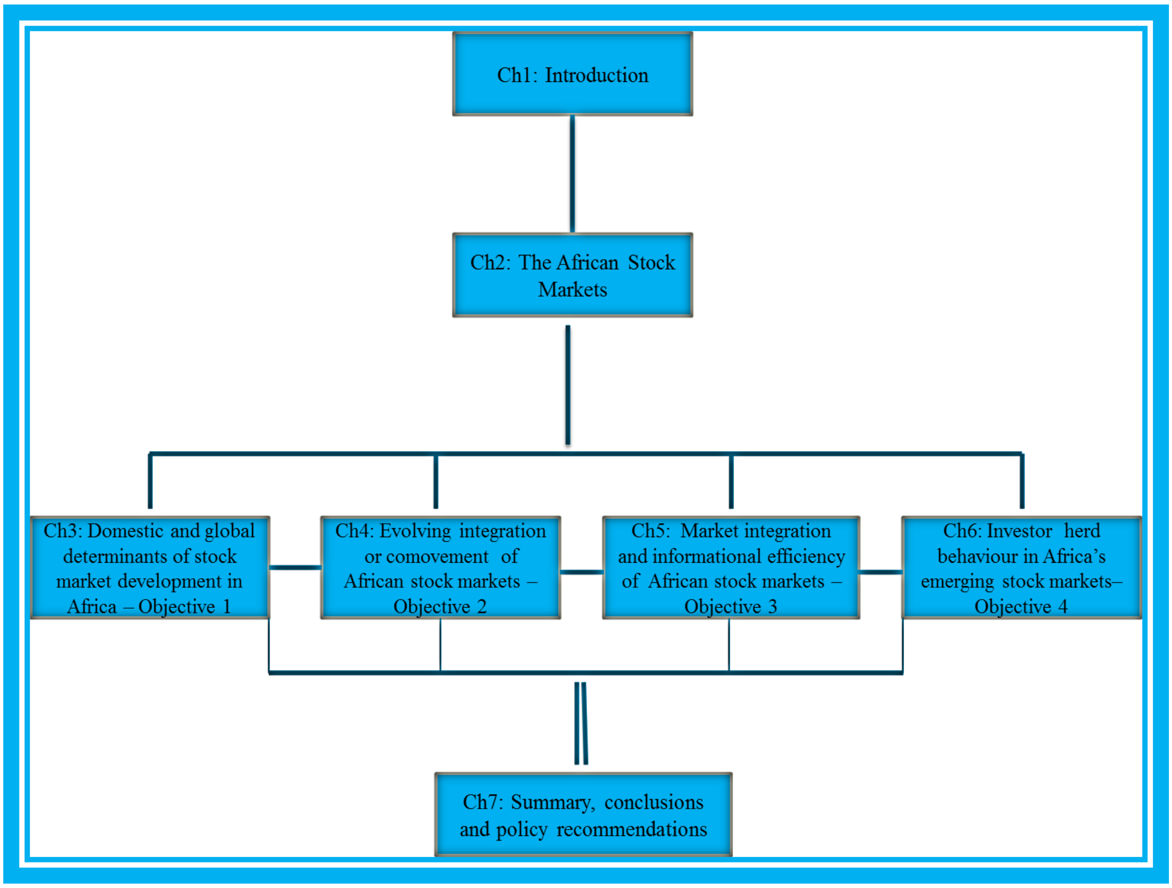

Figure 1.1: Schematic Structure of the Study

A snapshot of the chapters beyond this introductory chapter is presented as follows.

Chapter Two – The African stock markets. The chapter provides an overview of the African stock markets in relation to the state of their development and the stylised facts about these stock markets. The chapter also explores the indicators of their development and the institutional setups as well as various policy interventions being considered to develop stock markets in Africa.

Chapter Three – Domestic and global determinants of stock market development in Africa. This chapter accomplishes the first objective of this study which examines the domestic and global factors driving stock market development in Africa. After a discussion of the theoretical and empirical literature related to this objective, the chapter fits an augmented Calderon-Rossell model to analyse comprehensively institutional, macroeconomic and global factors affecting stock market development in Africa.

Chapter Four – Evolving integration of African stock markets with the world market. The second objective of this study, which is to investigate evolving integration among African stock markets and between them and the world market, is accomplished in this chapter. The chapter starts off by presenting the background on international stock market integration. Theoretical and empirical literature on stock market integration are discussed, followed by an outline of the data and methodology (based on wavelet squared coherence analysis and DCC-GARCH analysis) to examine African stock market co-movement. The results and discussions are afterward presented.

Chapter Five – Market integration and informational efficiency of stock markets in Africa. This fifth chapter accomplishes objective three of the study which seeks to examine the relationship between stock market integration and informational efficiency of stock markets in Africa so as determine whether there exists a positive association between market integration and informational efficiency of stock markets in Africa.

Chapter Six – Investor herd behaviour in Africa's emerging stock markets. This chapter investigates the presence of herd behaviour and the asymmetric effects of herding during various market conditions in Africa's emerging stock markets. The theoretical works and empirical literature on herding in stock markets, data and research methodology, and the results are discussed.

Chapter Seven – Summary, Conclusions and Policy Recommendations. This final chapter of the study presents a summary of the findings, conclusions and policy implications and recommendations as well as suggestions for future research.

1.7 Definition of Terminologies Used in the Study

Some key terminologies used in the study deserve particular mention and definition.

African stock markets, as used in this study, refer to the main national stock exchanges operating in leading African countries where securities such as shares or stocks of companies are traded. It is used interchangeably with African equity markets. *Market integration*, in this study, is primarily concerned about the extent to which stock markets in very diverse economies tend to move together. Thus, we referred market integration to the co-movement or correlation between stock markets but not in terms of similarity of stock markets due to the removal of restrictions on cross-border financial flows and foreign entry. We therefore used market integration and market co-movement interchangeably. However, where the link between market integration and market efficiency is determined, we defined the former in terms of the law of one price, suggesting that in an integrated market, security prices with similar risk profiles must equalise across markets. Also, we define *investor herd behaviour* in terms of the tendency of stock market participants to imitate the market consensus, ignoring their private information and evaluation in the process. Thus in this study, investor herd behaviour is used interchangeably with herding, investor herding, and herd behaviour. In addition, *market Efficiency or informational efficiency* is defined in this study in terms of price delay, and measured the speed with which the aggregate stock market reacts to common information.

Furthermore, we followed the classification by S&P/IFC in defining *emerging markets and frontier markets.* Accordingly, *emerging markets* refer to economies that are progressing toward becoming developed markets, in terms of market liquidity and regulatory framework. However, market efficiency, accounting standards and regulation in emerging markets are lower than their developed market counterparts. Also, *frontier markets*, as used in this study, refer to economies that are at the early stages of their development, characterised by small market size, low liquidity, limited investibility and slow informational flows and at the same time are smaller than their emerging market counterparts. Moreover, *developing stock markets* refer to stock markets in developing countries, which are similar in characteristics to frontier market economies, as shown in normally market size, liquidity, investibility and informational flows.

CHAPTER 2

The African Stock Markets: A Brief Overview

"Stock exchanges had become the 1990s equivalent of National Anthems and Flags in Africa." Ducker (1996)

African stock markets are as diverse as their economies and continue to grow in numbers and importance on an almost annual basis. Efforts are being considered to make these stock markets more relevant to the continent and the world as a whole. The regional locations of the stock markets explored in the present study are East Africa (Kenya, Tanzania and Uganda), North Africa (Egypt, Morocco and Tunisia), Southern Africa (Botswana, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe), and West Africa (Cote D'Ivoire, Ghana and Nigeria). In spite of the progress of African stock markets, however, a review of existing development literature suggests that the African continent is still classified as perhaps the most underdeveloped continent in the world. Thus African markets would require a structural transformation drive that focuses on increasing the share of manufacturing and innovative services especially in both public and financial sectors and anchored in an effective and efficient modernised agricultural sector. This approach should enhance the economies of African countries and consequently help to deepen their financial markets.

2.1 The State of Development of African Stock Markets

In general, stock markets in Africa have experienced substantial development since the beginning of the 21st Century. The market capitalisation of African stock markets has more than doubled in nearly two decades from about US$23.6 billion in 1995 to US$34.6 billion in 2004, reaching almost US$56 billion by 2012 (WDI, 2015). Market capitalisation as a percentage of GDP has recorded some impressive growth (see Figure 2.1). From Figure 2.1, market capitalisation as a percentage of GDP has increased from 29 percent in 1995 to 40 percent in 2002, falling marginally to 37 percent in 2012, perhaps due to the upshot of the global financial crisis in 2008.

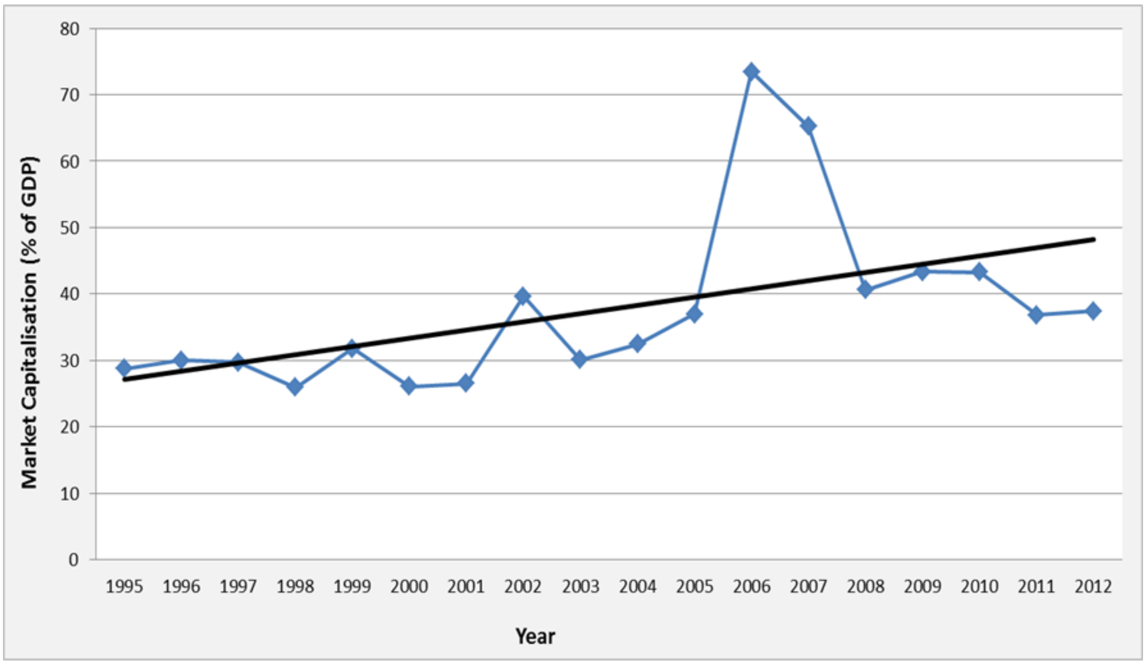

Figure 2.1: Stock Market Development in Africa (1995-2012)
Notes: Data Source is the World Bank, WDI (2015). Percentages are averages of the sample of 16 African stock markets, 3 of which are emerging markets and 9 frontier markets.

However, the development of African stock markets becomes unimpressive when compared with stock market development elsewhere. For instance, total world market capitalisation in 2012 was about US$53 trillion. Sub-Saharan African total market capitalisation was merely US$732 billion, representing only 1.38 percent of world market capitalisation (WDI, 2015). Also, over a decade (2002-2011), world total market capitalisation almost doubled from US$23 trillion in 2002 to US45 trillion in 2011. Emerging market total capitalisation increased nearly five times, from US$2.4 trillion in 2002 to 11.9 trillion in 2011 (Standard and Poor's, 2012), accounting for 10.43 percent in 2002 and 26.44 percent in 2011 of world total market capitalisation. In contrast, around the same period, African stock market capitalisation increased from about 250.5 billion in 2002 (representing 1.09 percent) to nearly 738.8 billion in 2011, representing 1.64 percent of world market capitalisation (WDI, 2015).

At present, there are 29 stock exchanges in Africa of which 24 are members of the African Securities Exchanges Association (ASEA). These stock exchanges delineate the various stock markets in Africa. A useful classification of the stock markets in Africa categorises them into four main categories based on their level of development. First, is South Africa, the dominant and most advanced stock market in terms of market size and sophistication in the African financial markets. South Africa's dominance in Africa's stock markets is visible over preponderance of the indicators of stock market development such as market capitalisation, market liquidity, and total number of listings. Figure 2.2 presents a comparison of African markets using market capitalisation as a percentage of GDP, a measure of the size of stock markets. Figure 2.2 clearly exhibits South Africa's dominance in terms of development. South Africa market capitalisation ratio constantly lies above 150 percent of GDP. Egypt and Morocco also recorded some appreciable levels in some years. The other markets however depict generally low levels of stock market development as measured by the market capitalisation ratio. Zimbabwe exhibits some high but erratic development. Overall, African stock markets are mostly small relative to their economies as the market capitalisation as a percentage of GDP for most of them is constantly below 50 percent of GDP over the 1995-2013 period.

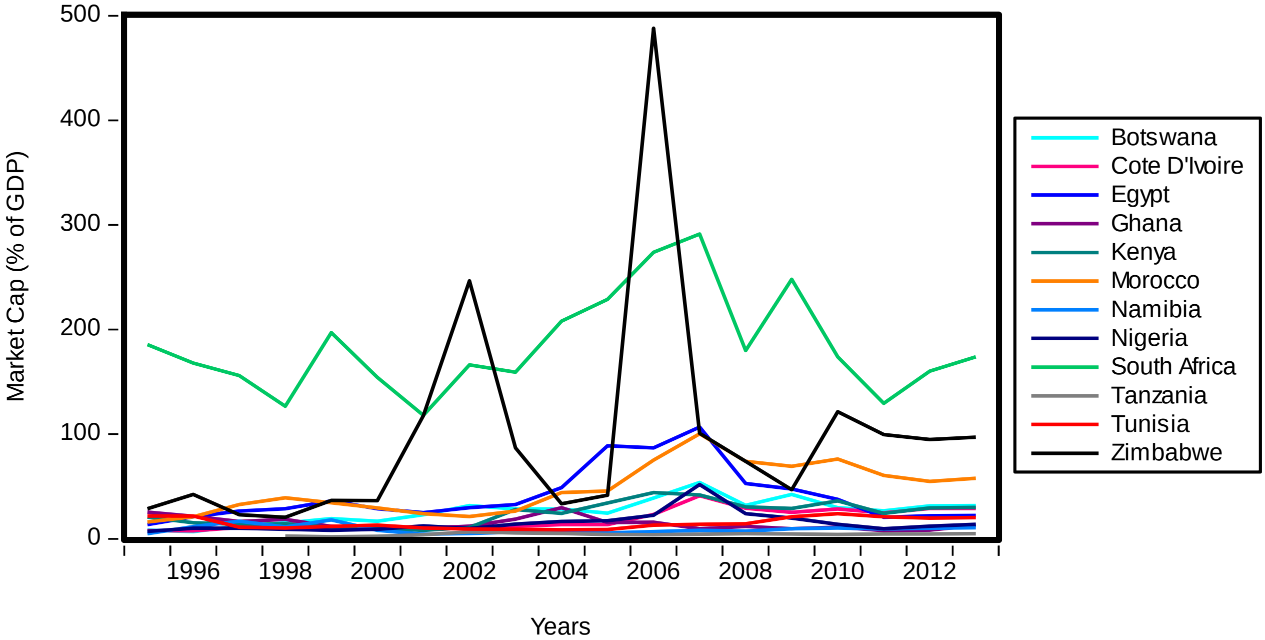

Figure 2.2: Comparison of Development of African Stock Markets (Market Cap. Ratio: 1995-2013)

The second category of stock markets in Africa refers to medium sized and older stock markets including Egypt, Kenya, Morocco, Nigeria, and Zimbabwe, all of which have been operational for over 50 years. Egypt and Morocco are categorised as emerging markets, Kenya and Nigeria are categorised as frontier markets, while Zimbabwe is considered as a standalone market (IFC/S&P Emerging Markets Database, EMDB, 2015). The third category contains small-sized and relatively new stock markets with demonstrated impressive and rapid growth potentials, including Botswana, Cote D'Ivoire, Ghana, Mauritius, Namibia, Tunisia, and Zambia, all of which have been categorised as frontier markets by IFC/S&P index classification. All the above markets, except Tunisia, have been established for less than 30 years. A fourth group of African stock markets consist of a number of smaller and newer stock markets, such as Algeria, Cameroon, Malawi, Mozambique, Rwanda, Seychelles, Sudan, Swaziland, and Tanzania, which are still in the early stages of their development, and most of which are relatively inactive.

2.2 Some Stylised Facts of African Stock Markets

We explore the market microstructural characteristics of African stock markets in relation to regulatory environment, market structure, and trading environment. In particular, Table 2.1a presents evidence on market regulation; trading, clearing and settlement; foreign investor participation; settlement cycles of markets; and trading days per week. In Table 2.1b we extend the information on market microstructure and trading environment to issues relating to instruments traded in the exchanges, trading mechanisms, listing by foreign domicile companies as well as tax structure. A glance at Table 2.1a indicates that the well-established African stock markets have independent market regulators as well as clearing and settlement procedures that are significantly enhanced by upgraded automation and electronic trading facilities. Most markets are now fairly opened to foreign investments and participations. For example, the South African stock market is self-regulated and supervised by the Financial Service Board; the Egyptian Financial Supervisory Authority regulates the Egyptian stock market; the CDVM (Conseil Deontologique des Valeurs Mobilieres) regulates the Moroccan stock market, the Capital Markets Authority regulates the Kenya stock market, while the Securities and Exchange Commission of Ghana and of Nigeria regulates those stock markets.

Clearing and settlement procedures in most African stock markets are now executed electronically by centralised depository systems and trading is conducted on electronic platforms as exchanges are fast moving away from the open-outcry approach. The global requirement on the clearing and settlement cycle of T+3 is now being achieved in most African stock markets, although evidence shows that implementation is weak and inefficient in most cases. Trading days have been extended throughout the week in all active and well-functioning markets, although some exchanges still trade for only a few hours daily. The evidence suggests that it is only Malawi, Namibia, South Africa, Uganda, and Zimbabwe that currently do not meet the global requirement on clearing and settlement, though South Africa is presently on the second-to-last phase of a project to reduce from T+5 to T+3. Electronic trading environments have further boosted trading mechanisms in most African stock markets. Apart from Kenya, Uganda and Zimbabwe which currently observe only intraday trading, all other markets now operate via margin and online trading alongside the traditional intraday trading mechanism. The frequency of trade and trading environment play a crucial role in the price discovery process, in ensuring an efficient market, in encouraging investments and in improving the indicators of stock market development. In particular, market efficiency can be undermined by factors including infrequent trading, bid-ask-spread bounce, and market over or under reaction (See Lang and Lee, 1999).

It is important to recognise that the microstructure of emerging and frontier stock markets plays an influential role in promoting their levels of development. With improved microstructure markets are able to meet the growing demands of sophisticated global investors. The regulatory environment directly affects the functioning and activities of stock markets, their efficiency, and the level of development attainable. Differences in regulatory environments among stock markets are seen as indicators of discrepancies in the levels of stock market development among countries (Revia, 2014).

Table 2.1a: Snapshot of Microstructure of African Stock Markets

Stock Market	Market Regulator	Trading, Clearing and Settlement	Foreign Investor Participation	Settlement Cycle	Trading Days per week
Uganda	Available	Manual, Central Depo.	Fairly open	T+5	5
Tanzania	Available	Electronic, Central Depo.	Fairly open	T+3	5
Kenya	Available	Electronic, Central Depo.	Unrestricted	T+3	5
Cote D'Ivoire	Available	Electronic, Central Depo.	Fairly open	T+3	5
Ghana	Available	Electronic, Central Depo.	Unrestricted	T+3	5
Nigeria	Available	Electronic, Central Depo.	Fairly open	T+3	5
Morocco	Available	Electronic, Central Depo.	Unrestricted	T+3	5
Tunisia	Available	Electronic, Central Depo.	Fairly open	T+3	5
Egypt	Available	Electronic, Central Depo.	Fairly open	T+2	5
Botswana	Available	Electronic, Central Depo.	Fairly open	T+3	5
Malawi	Available	Manual, Central Depo.	Fairly open	T+5	5
Mauritius	Available	Electronic, Central Depo.	Fairly open	T+3	5
Mozambique	Available	Electronic, Central Depo.	Fairly open	T+3	5
Namibia	Available	Electronic, Central Depo.	Fairly open	T+5	5
Zambia	Available	Electronic, Central Depo.	Fairly open	T+3	5
Zimbabwe	Available	Electronic, Central Depo.	Fairly open	T+7	5
S. Africa	Available	Electronic, Central Depo.	Fairly open	T+5	5

Sources: Authors' Survey (2015); ASEA Yearbook (2014), and National Stock Exchanges.
Central Depo. denotes the presence of Central Depository System in the stock market.

Also, the evidence reported in Table 2.1b indicates that African stock markets are quite behind their counterparts elsewhere in the world in terms of advancement in financial market product development and offering. With the exception of South Africa, Africa's most advanced and sophisticated stock market, where there are thriving markets for equity market, equity derivatives, bonds and other interest rate derivatives, commodity derivatives, and currency derivatives, most African stock markets trade mainly in stocks and bonds. The listed companies are largely formerly state-owned enterprises, and a few large domestic and multinational businesses as well as minimal cross-border listings. The bond market is very underdeveloped in most African markets and bond issuance is heavily dominated by central and local government authorities, the exception being South Africa, Mauritius, and Morocco. For example, in 2013 the value traded on governmental bonds as a percentage of bond total value traded was 100 percent in Botswana, Ghana, Namibia, and Nigeria, 99.9 percent in Egypt, 99.7 percent in Tanzania, 99 percent in Kenya, 80 percent in Cote D'Ivoire and other members of the BRVM exchange, and 62 percent in Tunisia. Some markets such as Kenya, Ghana, Nigeria and others are making fervent efforts and preparations to establish commodities and some derivatives markets on their exchanges.

Table 2.1b: Snapshot of Microstructure of African Stock Markets Cont'd.

Country	Securities Traded	Trading Mechanism	Foreign Domiciled Companies Listing	Tax Structure
Uganda	Stocks Bonds	Intraday Trading	Permissible	DD = 10%(15%), INT = 15%, and 0% tax on CG
Tanzania	Stocks Bonds	Online Trading	Permissible	DD = 5%, and 0% tax on INT and CG
Kenya	Stocks Bonds	Intraday Trading	Permissible	DD = 5%(10%), INT = 15%, and CG = 0%
Cote D'Ivoire	Stocks Rights, Bonds	Intraday Trading	Fairly Permissible	DD = 10%, and 0% on INT and CG
Ghana	Stocks Bonds	Margin Trading, Online Trading	Permissible	DD = 8%, and 0% on INT and CG
Nigeria	Stocks Bonds, ETFs	Margin, Intraday, & Online Trading	Permissible	DD = 10%, INT = 10%, CG = 0%
Morocco	Stocks Bonds	Intraday Trading, Online Trading	Permissible	DD = 15%, CG = 30%(Co.), & CG = 15% (individuals)
Tunisia	Stocks Bonds	Online Trading	Permissible	DD = 5%, INT = 20%, CG = ranges from 2.5% - 30%
Egypt	Stocks, Bonds EDRs, ETFs, Mutual Funds	Margin, intraday, Online Trading	Permissible	No taxes on CG
Botswana	Stocks Bonds, ETFs	Intraday Trading, Online Trading	Permissible	DD = 7.5%, INT = 10%
Malawi	Stocks	Margin, Intraday & Online Trading	Permissible	DD = 10%, CG = 30%
Mauritius	Stocks, Bonds ETFs, Funds	Intraday Trading, Online Trading	Permissible	DD = 0%, INT = 0%, and CG = 0%
Mozam-Bique	Stocks Bonds	Intraday Trading, Online Trading	Permissible	DD = 10%, INT = 10%, and CG = 0%
Namibia	Stocks Bonds, ETFs	Margin Trading, Intraday Trading	Permissible	DD = 10% for Non-resident Shareholders
Zambia	Stocks Bonds	Intraday Trading, Online Trading	Permissible	DD = 15%, INT = 15% and CG = 0%
Zimbabwe	Stocks, Debt Instruments	Intraday Trading	Permissible	DD = 10%, INT = 15% CG = 1%
South Africa	Stocks, Bonds Funds, ETFs, Derivatives, Warrants, etc.	Margin Trading, Intraday Trading, Online Trading	Permissible	DD = 15%, INT = 0%, CG = 10%

Source: Authors' Survey (2015); ASEA Yearbook (2014), and National Stock Exchanges.
Notes: DD denotes dividend tax rate, INT denotes tax on interest income, and CG denotes capital gains tax. Also, ETFs signifies exchange traded funds, EDRs is Egyptian Depository Receipts.

A lot is being done in stock markets in Africa with regard to improving market regulatory infrastructure. It is important to note that improvement in regulatory infrastructure of stock markets can lead to increased investor confidence and renewed credibility of domestic markets to foreign investors, which are necessary for their efficient functioning and development. Even though there has been significant progress in the accounting procedures on account of adoption of global reporting standards by some African countries, accounting standards are still generally poor and investment protection quite marginal in these markets. Nonetheless, a number of leading stock markets in Africa such as South Africa, Egypt, Nigeria, Kenya, and Mauritius have relatively effective and efficient regulatory structures, including tax structures with ingenious tax incentives for foreign investments and domestic listings. For example, as evidenced in Table 2.1b, Mauritius has a number of incentives for foreign investors in particular, including zero withholding tax on dividends, no taxes on interest income and capital gains, and allows revenues from sale of shares to be repatriated unrestrictedly. Similarly, Botswana, Egypt, Ghana, Nigeria, and Tanzania apply zero tax on interest and capital gains as incentive packages to encourage investments. Capital gains are also non-taxable in Uganda and Zambia.

Moreover, stock markets in Africa have made some progress in terms of enhancing their regulatory, monitory and supervisory environment as well as accounting and reporting standards. In fact, the World Bank Group's (WBG) Doing Business report (2013-2014) underscored that "Sub-Saharan Africa has benefited more than other regions from regulatory improvement" worldwide (February 2015 Issue of Fortune). Figure 2.3 presents evidence on investor protection in stock markets in Africa in comparison with some developed and emerging stock markets around the world. The 'strength of minority investor protection index is measured as the average of the extent of conflict of interest regulation index and the extent of shareholder governance index' (WBG, Doing Business report, 2015). The value of the index ranges between 0 and 10 (inclusive), with higher values signifying evidence of strong minority interest protection.

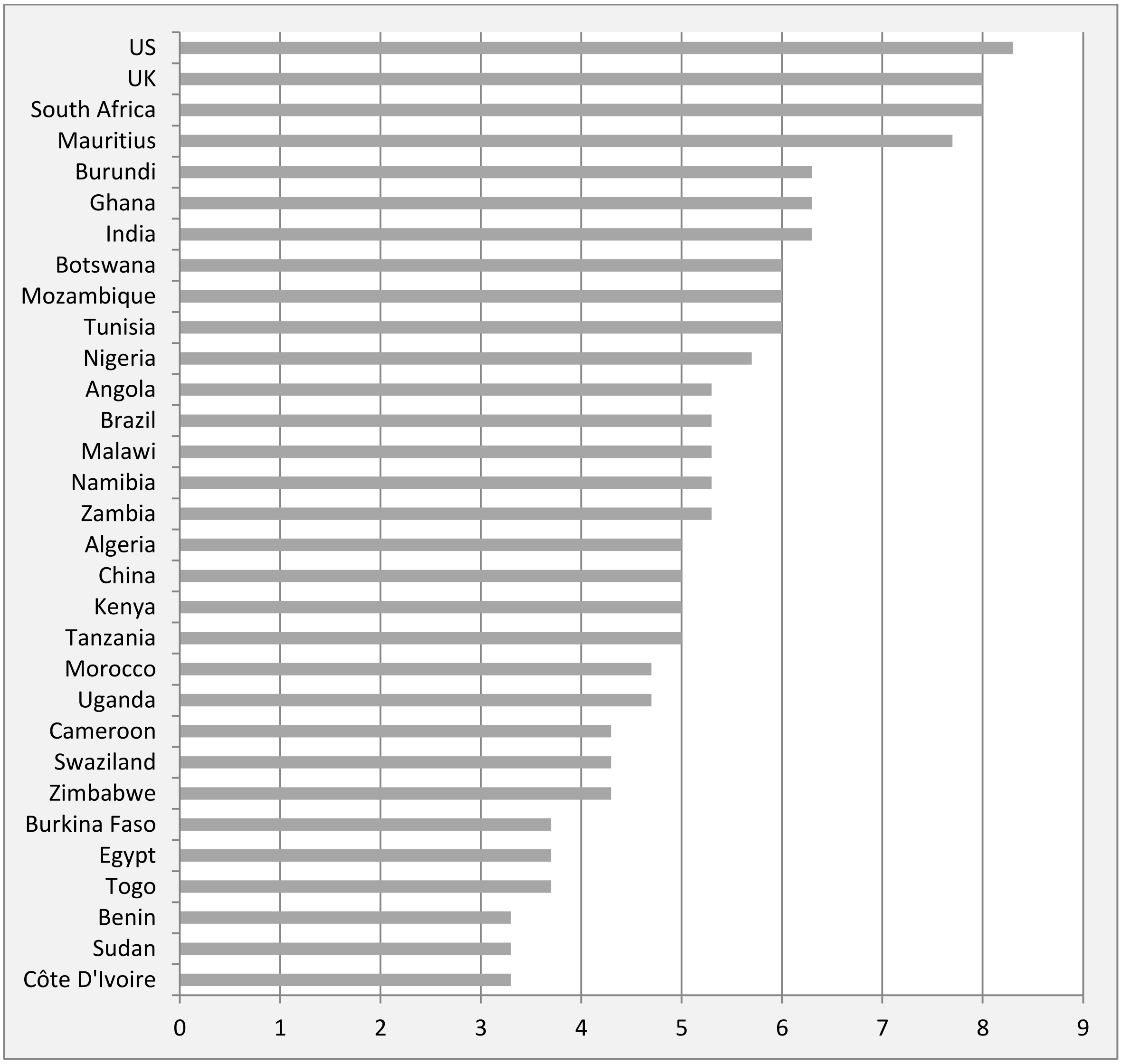

Figure 2.3: Investor Protection in African Markets
Notes: China, Malaysia, and the United States are included in order to respectively provide an emerging market and a developed market comparison to the investor protection in African markets. Source: The World Bank Group, Doing Business Database (2014).

In Figure 2.3 the preponderance of African economies are observed to provide strong investor protection as most of the values are higher than 5 index value. In particular, investor protection in South Africa is very strong and compares favourably with the developed countries of the UK and the US. The survey evidence further suggests that African economies such as Botswana, Ghana, Mauritius, Nigeria and Tunisia are doing relatively better than the emerging markets of Brazil, China and India in terms of investor protection. However, investor protection in economies such as Egypt and Cote D’Ivoire and other smaller countries are quite weak with values observed below 5 index value. Table 2.2 further exemplifies the position of foreign investment in the African markets. While some restrictions to foreign investments still exist in African markets, most markets present relatively generous regulations toward foreign investments (see Table 2.2).

Table 2.2: Foreign Investment Regulations in African Stock Markets

Botswana	Foreigners may not collectively own more than 49% of a publicly quoted company's share capital. No foreign individual may own more than 5% of a company's shares.
Cote d'Ivoire	Foreign portfolio investments are restricted.
Egypt	No restrictions.
Ghana	Foreign investors may not collectively own more than 74% of the shares in a quoted company. A non-resident portfolio investor may not own more than 11% of the shares in a company. Resident foreigners may invest without any limit.
Kenya	Foreign investors as a group may not own more than 40% of the shares in a company. Individual foreign investors may not own more than 5% of the shares in a single company.
Malawi	N/A
Mauritius	Not more than 15% in a sugar company may be owned by foreign investors. Foreign investors may participate in unit trusts and mutual funds within approved limits.
Morocco	No restrictions.
Namibia	N/A
Nigeria	Foreigners may not own more than 40% of the shares of companies in some industrial sectors which were incorporated before 1990. Since the Industrial Policy Act of 1989, foreigners can incorporate companies as sole owners if they so wish.
South Africa	Total foreign ownership is limited to 15% for banks and 25% for insurance companies. There are no restrictions on foreign investors in other areas.
Swaziland	Prior approval of the central bank is required before investment is undertaken if the investor wishes to buy 20% or more of a company.
Tunisia	N/A
Zimbabwe	Foreign investors collectively may not own more than 40% of the shares in a company. Individual foreign investors may not own more than 5% of the shares in a company.

Source: Survey Evidence from African Stock Exchanges (2015).

Moreover, like most other developing economies, there are still serious concerns about information and disclosure inadequacies in most African stock markets, which might deny investors sufficient information on markets as well as on the financial health of listed companies.

2.3 Indicators of Stock Market Development in Africa

Table 2.3 presents a summary of some of the key features that characterise the performance of African stock markets including age, number of listed companies, market capitalisation, value traded and turnover ratio. A conspicuous feature about African stock markets is that they are fairly young compared to stock markets in other countries such as Brazil, India, the UK and the US. Apart from the stock markets in Egypt and South Africa, which are over 100 years old, and perhaps those in Kenya, Morocco, Nigeria, and Zimbabwe which have been established since 1960, and Tunisia in 1969, all other African stock markets surveyed were established in the late 1980s, and 1990s. Specifically, nine of the fifteen stock markets surveyed in Table 2.3 were established in the 1990s. Most of these young stock markets such as Botswana, Cameroon, Ghana, Malawi, Mozambique, and Sudan and others were established on account of a recommendation and support from the Bretton Woods Institutions. A key motivation for the World Bank and IMF-sponsored structural adjustment programme in the 1990s was to enable African economies to realise the advantages potentially available from privatisation for economic growth and capital market development.

The youthfulness of African stock markets has a direct influence on the number of listings in these markets. The number of listed companies is as low as 4 in Mozambique, 6 in Swaziland, 14 in Malawi, 16 in Uganda, 18 in Tanzania, 21 in Zambia, 34 in Ghana and Namibia, and 35 in Botswana. Also, Kenya, Zimbabwe, Tunisia and Morocco have 61, 67, 71 and 76 listed companies respectively. The well-established stock markets are however different and pretty much comparable to other emerging markets around the world. There are currently 386 listed companies in South Africa, 212 in Egypt, 190 in Nigeria, and 91 in Mauritius. Evidence further indicates that the total number of listed companies on African stock markets at the end of 2012 stood at 1,373, but 987 excluding South Africa, suggesting that South Africa alone accounts for 28 percent of overall listings in Africa. The overall listings in African markets becomes insignificant when compared with other markets such as Malaysia, China, and India which have 904, 1070, and 5689 listed companies, respectively. Clearly, the level of development of stock markets as measured by market capitalisation as percentage of GDP is lower for the majority of stock markets in Africa compared with others (see Table 2.3). For example, total market capitalisation as percentage of GDP is below 50 percent for nearly 90 percent of African countries.

However, the level stock market development as indicated by market capitalisation as percentage of GDP is very impressive in South Africa (160.15 percent), Zimbabwe (94.74 percent), Mauritius (61.99 percent), and Morocco (54.88 percent).

These levels of development are comparable to many emerging and developed stock markets around the world. Specifically, the market capitalisation ratio for South Africa and Zimbabwe is higher than those recorded by the BRIC countries with the South Africa’s record outstripping those of the UK and US. Moreover, the performance of stock markets in Africa averaged over nearly a two-decade period suggests an analogous picture of the current level of stock market development in Africa.

Table 2.3: Indicators of Stock Market Development in Africa (2015)

Country	IFC/S&P Category	Date Est.	No. of Listed Firms	Market Cap. (% of GDP)	Value Traded (% of GDP)	Turnover Ratio (%)
East Africa:						
Uganda	None	1997	16	30.74	0.057	0.15
Tanzania	None	1998	18	4.65	0.095	1.60
Kenya	Frontier	1954	61	9.38	2.00	8.07
West Africa:						
Cote D'Ivoire	Frontier	1998	37	28.89	0.602	2.31
Ghana	Frontier	1990	34	8.30	0.129	1.64
Nigeria	Frontier	1960	190	12.18	0.908	8.79
North Africa:						
Morocco	Emerging	1929	76	54.88	3.65	6.21
Tunisia	Frontier	1969	71	19.64	2.77	13.49
Egypt	Emerging	1883	212	22.07	7.67	37.79
Southern Africa						
Botswana	Frontier	1989	35	31.56	0.779	2.60
Malawi	None	1995	14	17.77	0.380	1.51
Mauritius	Frontier	1988	91	61.99	2.59	4.01
Mozambique	None	1999	04	n/a	n/a	n/a
Namibia	Frontier	1992	34	10.01	0.161	1.71
Zambia	Frontier	1994	21	12.04	0.784	5.58
Zimbabwe	Standalone	1946	67	94.74	12.91	14.17
Swaziland	None	1990	06	n/a	n/a	n/a
S. Africa	Emerging	1887	386	160.15	81.55	54.93
Total			1373	598.99	116.93	164.56
Excluding SA			987	438.84	35.38	109.63
SA as % of Total			28	26.74	69.74	33.38
Average Africa			72	73.26	30.26	66.67
Brazil	Emerging	1890	359	54.69	37.11	67.88
China	Emerging	1990	1070	44.93	70.80	164.44
India	Emerging	1875	5689	68.82	33.49	54.63
Malaysia	Emerging	1960	904	156.04	40.78	28.57
UK	Developed	1801	2406	115.47	95.17	84.04
US	Developed	1792	2464	115.50	132.25	124.60

Source: Column 2 is based on S&P (2006), Columns 3 and 4 are from ASEA Yearbook (2014), and Columns 5-7 are from World Bank World Development Indicators (2015). Columns 3 and 4 of international stock exchanges are based on Authors' Survey (2015) and WFE (2015). Market capitalisation as percentage of GDP, value traded as percentage of GDP, and turnover ratio are all end-of-year values in 2012. Percentages are Author's calculations.

Another striking feature in Table 2.3 is the generally very low liquidity (as measured by total value traded as percentage of GDP) in African stock markets (except South Africa) in relation to other stock markets in the world. In fact, this feature is reinforced by the presence of the limited number of instruments in African markets indicated previously (see Table 2.1b column 2), a feature which is largely due to limited innovation potential. Institutions such as insurance companies, pension schemes and mutual funds are not resilient enough to provide a strong institutional base in African markets. As a consequence, the sources crucial for vigorous market participation required to keep African stock markets active and liquid are lacking. A common trading practice in African stock markets is merely “buy and hold”, which does not create the desirable liquidity and turnover needed for robust stock market activities and development. From Table 2.3, the total value traded as percentage of GDP is in fact lower than 5 percent in 13 of the 16 countries surveyed. The market liquidity indicator is 7.67 percent in Egypt, and 12.91 percent in Zimbabwe. The total value traded as a percentage of GDP for South Africa (81.55 percent) suggests that South Africa is the only African stock market with the level of liquidity comparable to those in other developed and emerging markets worldwide. By far, South Africa is more liquid than any of the BRIC countries and actually compares favourably with the UK stock market.

Also, the turnover ratio is below 10 percent for 14 out of the 18 stock markets in Table 2.3, ranging from a value as insignificant as 0.15 percent in Uganda to 8.79 percent in Nigeria. In the context of Africa, Egypt (37.79 percent) and South Africa (54.93 percent) are faring quite well in terms of the number of times shares on their markets change hands. The evidence of widespread low liquidity in African stock markets is further supported by the evidence of turnover ratio. The turnover ratio in the Chinese stock market alone (164.44 percent) was equivalent to the total turnover ratio of all African stock markets put together (164.56 percent) at the end of 2012.

2.4 Policy Interventions toward Promoting Stock Market Development in Africa

Stock markets in Africa (except South Africa) are largely constrained by factors such as a high degree of fragmentation, thin trading, illiquidity, shallow product offering due to weak technological innovativeness, and global marginalisation all of which constrain resource mobilisation. However, frantic steps are being taken to reverse the trend and ensure the growth and development of stock markets in Africa through financial liberalisation and regional integration. Indeed, regional and global integration of stock markets will create synergies in terms of competition, informational efficiency, innovative instruments, and overall market size. In particular, regional integration of capital markets is associated with reduction or removal of physical infrastructure, and legal and regulatory barriers. The process of regional integration of markets also requires the harmonisation of the laws, regulations and standards of individual stock markets. The African Securities Exchanges Association (ASEA) has also been very instrumental in promoting member exchanges and ensuring greater integration regionally and with the rest of the world. A long-term plan of ASEA is to consolidate different national stock exchanges into regional stock hubs based in Johannesburg, Cairo, Nairobi, Lagos and Abidjan (Mlambo and Biekpe, 2007). A number of initiatives have gone on to ensure the creation of regional stock exchanges and hopefully eventually a Pan African stock exchange. Perhaps, the most successful regional initiative to date is the conversion of Cote d'Ivoire's national exchange in 1998 into the Bourse Regionale des Valeurs Mobilieres (BRVM). Regional exchanges are also being considered in the Central African franc zone by members of the Southern African Development Community (SADC) and the East Africa Community (EAC). Listing requirements and trading rules in most countries are being harmonised to further ease cross-border listings. Moreover, a number of bilateral and multilateral agreements have been signed between national stock exchanges to cooperate on various schemes. While the driving force behind most of these initiatives is the Pan-Africanist ideology, they are normally intended to enlarge markets, enhance efficiency, improve liquidity and ensure greater stock market development.

2.5 Chapter Summary and Concluding Remark

This Chapter provided an overview of African stock markets in relation to the state of their development and the stylised facts of these stock markets. Also explored in the chapter was how the performance of African stock markets compared with those of other stock markets around the world. The chapter further explored the indicators of development of stock markets in Africa as well as the institutional setups and various policy interventions being considered to improve their development, efficiency and integration with the rest of the world. Overall, the survey evidence showed that the stock markets in Africa are as diverse as the 53 economies that constitute the African continent. It is also observed that, although a number of challenges still persist, stock markets in Africa have made significant progress since the beginning of the century. The next chapter examines domestic and global determinants of stock market development in Africa.

CHAPTER 3

Domestic and Global Determinants of Stock Market Development in Africa

"Symbolically, however, Africa's stock exchanges are likely to remain important icons. Whether they will come to symbolize pockets of an emerging modern economy in Africa or merely reflect further economic stagnation and failed policy reform clearly depends on wider factors than the markets themselves." Todd J. Moss (2003)

This chapter focuses on the factors driving the development of African stocks markets and thus accomplishes objective one of the study i.e. *(to examine domestic and global determinants of stock market development in Africa).* The chapter is organised in seven main sections. Section one introduces the theoretical link between finance and growth and discusses the functions of stock markets. The theories of stock market development are explored in section two. Section three surveys the sources of stock market development suggested by economic theory or provided in empirical studies. A survey of empirical literature on stock market development is presented in section four. Section five discusses the theoretical framework and methodology used in the present chapter as well as the data and their panel properties. The empirical results are presented and analysed in section six, while a summary and concluding remarks of the chapter are provided in section seven.

3.1 Background on Stock Markets and their Financial Aspects

The importance of Stock market development as a source of economic growth and national prosperity has long been recognised. Economic agents including investors, businesses, and governments use the stock market to achieve their respective objectives. In effect, the health of the stock market is a barometer of the conditions and wellbeing of the economy. Despite their importance, however, the determinants of stock market development have been under-researched, particularly in Africa. Yet, African stock markets have certainly contributed to the surge in world stock markets being witnessed globally. There were only 6 stock exchanges in Africa during the 1990s; however, there are currently 29, representing a more than 380 percent increase over the period. Also, 3 of the 20 emerging markets and 9 of the 36 frontier markets worldwide are African (S&P/Dow Jones Indices, 2014).

A key policy question thus arises: what domestic and global determinants drive stock market development in Africa? Studies on this all important question are unmeritoriously small worldwide and very scanty in Africa. Yet, there is a need for a firm understanding of the determinants of stock market development because of its link with economic growth. Also, existing empirical works on the determinants of stock market development have largely concentrated on macroeconomic and institutional factors (see for example Afful and Okeahalam, 2006; Yartey and Adjasi, 2007; Yartey, 2007, 2008; Cherif and Gadzar, 2010; Standley, 2010; and Afful and Asiedu, 2014). While a sound macroeconomic environment and strong institutions are certainly required for stock market development, they may present a partial picture given the current relationships in the global economy and financial markets.

In the present study, a broader opinion is held on the subject. We examine the stock market development effect of global factors alongside domestic factors in Africa. Evidence suggests that an open and integrated market becomes more sensitive to global information, and that global rather than domestic factors largely influence its performance (Bae et al., 2012; Hooy and Lim, 2013). Africa's integration with the rest of the world economy and financial market has seen remarkable improvement in recent times (Giovannetti and Velucchi, 2013). For example, the 2007-2009 global financial crisis has been reported to have caused the stock market indexes of South Africa and Egypt to drop by some 40 and 50 percent, respectively. Also, the Ghanaian economy has worsened ever since the aftermath of the financial crisis and is currently under a three-year IMF bailout programme. In fact, global factors that commonly affect all countries (such as world commodity prices, the influence of developed and emerging economies, and the global economic and financial conditions) could thus play a leading role in the development of African stock markets. We are therefore motivated to study the stock market development effect of global factors alongside institutional and macroeconomic factors in Africa.

In the light of this, two questions are key for the attainment of the goals of this chapter and for the attention of policy makers, practitioners, and the academic community in Africa in particular and the world at large: (1) what domestic factors determine stock market development in Africa? (2) Do global factors such as financial market conditions of leading stock markets, growth of leading economies, and the macroeconomic stability of major trading partners have significant influence on the development of African stock markets? By classifying the underlying determinants into domestic and global factors, a comprehensive view about what drives stock market development will be contributed to the literature.

This study thus differs significantly from previous studies and contributes to the literature in a number of unique ways. An augmented Calderon-Rossell behavioural structural model is applied to comprehensively analyse domestic and global factors influencing stock market development in Africa. This study is perhaps the first to take such a broad view in analysing the determinants of stock market development. As indicated earlier, the integration of African stock markets with global financial markets have been found to improve over time, thus making them more global in outlook and thus possibly being significantly influenced by global factors as well. Also, the fact that African economies are largely import-led, donor-dependent, and less developed make them more exposed and vulnerable, and with their increasing importance in global financial markets, global factors are expected to play an important role in explaining their levels of development.

3.1.1 Theoretical Link between Finance and Economic Growth

In the 1980s and early 1990s, many emerging markets, following the advice of the World Bank and International Monetary Fund, had liberalised their financial markets to various extents. The liberalisation means opening up their financial markets for foreign participation, intended to attract trade, capital and portfolio flows from the developed and other higher-income economies. Many African countries, like their emerging market counterparts, responded to the call by deregulating their markets, removing restrictions and making them relatively more accessible to diverse investors. Theoretically, liberalisation should lead to increased stock market integration, improve informational efficiency of domestic share prices (Bae et al., 2012), increase real investment (Bae and Goyal, 2010; Chari and Henry, 2008; Mitton, 2006; Henry, 2000a), reduce cost of capital (Bekaert and Harvey, 2000; Henry, 2000b), and promote productivity and economic growth (Bekaert et al., 2005, 2009,). Indeed, the liberalisation process has increased the integration and interactions among stock markets. Proponents of liberalisation assert it is very beneficial to open domestic markets to foreign participation. For instance, liberalising restrictions on international capital and portfolio flows will most likely enhance domestic stock market liquidity, which in turn boosts total factor productivity and ultimately results in long-term economic growth (Levine, 2001). However, the frequency and impact of financial crises have impelled many to question the growth-enhancing effects of the stock market liberalisation process. Critics argue that the liberalisation will cause more harm than good to domestic financial markets in emerging countries. In effect, there is a lack of definite evidence with regard to the positive effect of financial openness (Kose et al., 2009; Henry, 2007; Edison et al., 2004) advocated.

An enormous and growing literature exists on the link between financial development and economic growth. Theoretical works have suggested that financial development (which includes stock market development) promotes economic growth (see Caporale et al., 2004; Levine, 1997; Demetriade and Hussein, 1996; Demirguc-Kunt and Levine, 1996; Dow and Gorton, 1995; Levine and Zervors, 1998; King and Levine, 1993; Bencivenga and Smith, 1991; Levine 1991). Nevertheless, economists have largely held divergent views regarding the role of the financial system in growth. In particular, there are varying opinions about the mechanisms through which financial markets impact on the economic growth process. Consequently, three views have emerged in the literature: (1) the supply-leading view which believes that financial development precedes and hence promotes economic growth; (2) the demand-following view which believes that financial development follows economic growth; and (3) the view that finance does not matter in economic development and that the two are really not related. Schumpeter (1911) and subsequent studies supporting the supply-leading view (Miller, 1998; McKinnon, 1973; Shaw, 1973; Hicks, 1969; Goldsmith, 1969; Gurley and Shaw; 1967) have argued that financial services provided by financial intermediaries and markets create advances in technological innovation and promote economic growth in the long run. Even prior to Joseph Schumpeter's assertion which has become known as the supply-leading view, Bagehot (1873) had argued that the financial system in England played a crucial role in promoting industrialisation there by facilitating capital mobilisation for massive real economic activities. The implication of Schumpeter's supply-leading view is that the financial sector takes proactive steps to provide enterprises with requisite financial services by mobilising savings, evaluating investment projects, managing risks associated with those projects and monitoring corporate managers as well as enabling transactions (King and Levine, 1993).

Conversely, some economists (Robinson, 1952) known as the demand-following view assert that "where enterprise leads finance follows", implying that economic growth precedes financial development and that the latter is only a by-product of the former. According to the demand-following view as a nation experiences economic growth where enterprises expand with increasing real economic activities, there is corresponding increase in fresh demands for some financial services and the financial system responds naturally to the resulting new demands by providing appropriate financial products and services to finance them (Levine, 1997).

A third view held by some economists is that the debate is unimportant and unmeritorious. In particular, Lucas (1988) has asserted that the role of finance in economic growth has been "badly over-stressed" suggesting that finance is inconsequential for economic growth. In fact, development economists (Chandavarkar, 1992) have been very cynical about finance and its relevance to economic growth to the extent that finance is often ignored in matters relating to the subject (Meier and Seers, 1984); and indeed Stern (1989) utterly ignores it in a review of development economics (Levine, 1997).

Notwithstanding these disagreements, Keynesian economists, and endogenous growth models in particular, have shown that economic growth and financial development are inextricably linked and that financial development is a crucial determinant of economic growth (Levine, 2005; Caporale et al., 2004). Theoretically, the financial system, which ameliorates market imperfections relating to information and transaction costs and through various channels, engenders economic growth in the long run. In Bencivenga and Smith (1991), an endogenous growth model with multiple assets is constructed showing the impact of the emergence of competitive financial intermediaries (i.e. banks) on steady state growth rates. Prior to the emergence of banks, the model shows that capital accumulated by economic agents facing "random future liquidity needs" merely represents "liquid" security that is unproductive. Financial intermediaries, in performing their fundamental functions of accepting demand deposits and providing lending facilities to enterprises and individual investors automatically increase the availability of and accessibility to productive investment opportunities. Thus the presence of banks mitigates liquidity risk, promotes efficient resource allocation, enhances saving rates and investments, thereby preventing premature liquidation of investments on account of liquidity problems and for that matter causes the economy to grow. In Greenwood and Jovanovic (1990) both the extent of financial intermediary development and the rates of economic growth are shown to be endogenously determined. According to their endogenous growth model and in line with the view of McKinnon (1973), Shaw (1973) and Goldsmith (1969), the financial superstructure and the real infrastructure of an economy are linked in such a way that economic growth stimulates investments in businesses and that in turns accelerates further growth of the economy. According to Greenwood and Jovanovic (1990) the endogenous emergence of institutions in the model leads to enhanced trade in the economy; first, by enabling higher expected rates of return on investments to be earned; and second, by promoting risk sharing among investors. The model shows that resource allocation efficiency is improved through the activities of the financial intermediaries, which ensure that market frictions and information asymmetries are lessened and that investors can access a wealth of information to ameliorate their investment profitability. Greenwood and Jovanovic's (1990) endogenous growth model further demonstrates the dynamics of the development process during the lifetime of an economy that is essentially evocative and in accord with the spirit of Kuznet's (1955) hypothesis[2]. An economy has virtually no financial markets during the initial stages of development; but these emerge and grow gradually as the economy attains intermediate growth. At the intermediate stage, while both the growth and saving rates are increasing, there is a widening gap in the distribution of wealth between the rich and the poor in the economy. Distribution of income among members however stabilises during the latter parts of the intermediate stage. At the maturity stage in the development process when the economy achieves growth, a widespread financial superstructure develops at the same time and financial intermediaries become visibly important in the economy. The final stage in the development process of an economy according to Greenwood and Jovanovic sees stable distribution of income among agents, falling saving rates and convergence of economic growth rates at a relatively higher level compared to rates during the early stages. However, models involving financial intermediaries or banks are incapable of demonstrating a complete analysis of the link between finance and growth since the financial system comprises both banks and markets. As such banks' monopoly over savings may not promote investor confidence in long-term investment.

In an endogenous growth model that connects the financial system and the steady-state growth rate of per capita output, Levine (1991) shows how the emergence of stock markets allocates risk and works to change investment incentives that propel the economy towards growth. In keeping with earlier models by Bencivenga and Smith (1991) and Greenwood and Jovanovic (1990), Levine extends and links two strands of literature: the endogenous growth literature[3] which relates to the work of Romer (1990, 1989) and Lucas (1988) and the financial structures literature[4] which is associated with the work of Diamond (1984); Diamond and Dybvig (1983); and Townsend (1979). The model shows that economic

[2] Kuznets (1955) hypothesis is based on the premise that economic growth and the distribution of income are strongly related such that income distribution in the economy widens during the initial stages of economic development, becomes flatter at intermediate stage of development and eventually declines during the advanced stage in the economic growth process.
[3] In the endogenous growth literature, models are constructed to show how steady state growth rates are influenced by the decisions of economic agents.
[4] Under the financial structures literature, models are constructed to indicate how the emergence of financial contracts serves as optimal responses to the informational and risk characteristics of an economy.

growth only occurs when investment decisions of agents result in significantly high rates in human capital accumulation and technological progress. Importantly, premature removal of capital from firms imposes an externality and reduces the rate of human capital accumulation of others. Premature liquidation of capital hinders economic growth and to mitigate such events calls for financial contraction. Financial contracts are needed because of the presence of productivity risk and liquidity risk in the system. Productivity risk is due to productivity shocks that firms are subject to and can discourage risk averse investors from investing altogether. Levine's (1991) endogenous growth model thus suggests that stock markets enable investment in a large number of firms which effectively diversifies away potential idiosyncratic productivity shocks.

Also, liquidity risk is the second feature of the Levine's (1991) model that necessitates financial contraction. Liquidity risk influences agents' decisions regarding the amount of money to invest in firms that take a long time to produce and assets that are less profitable but liquid with prompt pay off. An important implication of the model is that human capital enhancement and economic growth will be greatly retarded when risk averse investors fail to invest or when economic agents invest in liquid assets. Some of the agents who initially decide to invest in firms may experience liquidity shocks privately afterwards and may choose to withdraw their investments prematurely before the creation of new technologies, sale of goods and distribution of profits by the firms. Ultimately, the risk of getting liquidity shocks and extremely low return from premature liquidation discourages investment in firms.

Levine (1991) suggests that liquidity risk facing individuals would be eliminated if liquidity shocks were publicly observable. Since liquidity shocks are not publicly verifiable, alternative financial contracts may be required to mitigate liquidity risk. Thus the emergence of stock markets in the model enables investors to (1) eliminate productivity risks associated with idiosyncratic productivity shocks by simultaneously investing in a large number of firms; and (2) effectively manage liquidity risk through stock market trading so that entrepreneurs who have encountered liquidity shocks will be able to sell their shares to other investors with excess liquid assets. Essentially, premature liquidation for short-term liquidity needs is completely circumvented in the system allowing firms to focus more on their investments and core activities.

Also, the impersonal and competitive nature of stock markets enables information and transaction costs minimisation with individual investors focusing more on trades informed largely by their private information and away from worrying over which investors have received liquidity shocks. Ultimately, the stock market moderates risk and improves welfare more effectively. Nevertheless, stock market related policies and regulations can impose constraints and adversely affect the market, limiting its ability to enable risk reduction and welfare-enhancing activities. Indeed, Levine's (1991) model further shows that consumption, income, corporate, and capital gain taxes on stock market related transactions can lower the proportion of firm resources and incite investors to withdraw capital prematurely from firms. Possible consequences of these situations include declining rates of both human capital accumulation and growth in per capita output.

From the aforementioned discussions, the balance of the literature strongly suggests the existence of an intricate link between finance and growth. The two (finance and growth) can best be described as complementing and reinforcing each other. Also, the role of stock markets in stimulating economic growth has been widely studied and well recognised. Relevant to finance, banks and stock markets should be regarded as complement rather than substitute in the economic growth process.

3.1.2 The Functions of Stock Markets

A growing body of literature suggests that financial development, and as such stock market development, matters significantly in economic growth and development. Information transaction costs and frictions associated with economic activities serve to incentivise the creation of financial markets and intermediaries as their presence mitigates problems and risks associated with market frictions and imperfections. In the absence of information and transaction costs similar to the form described in the state-contingent claim framework by Arrow (1964) and Debreu (1959), the financial system comprising financial instruments, intermediaries and markets as well as their associated arrangements will be absolutely irrelevant in the economy (Levine, 1997). Thus financial markets and intermediaries remain absolutely crucial in the process of economic progress. Essentially, financial development creates effective financial intermediaries and markets alongside their respective instruments, products and services which fundamentally ameliorate the effects of market frictions and imperfections associated largely with the costs of acquiring information, enforcing contracts and making transactions (Levine, 2005). The financial system which consists of financial intermediaries and markets perform at least five primary financial functions across both space and time and within an uncertain environment (Levine, 2005; Levine 1997) including: providing information and allocating capital for investments; mobilising savings and enhancing capital accumulation; enabling exchange of goods, financial products and services among market participants; ameliorating and managing risks associated with market imperfections; and monitoring of firms and investments and exerting corporate control (see Levine 1997; 2005 for a detailed explanation of these functions of the financial system).

Specific to stock markets, a well-functioning stock market plays a crucial role in an economy. Firstly, economic theory postulates that stock markets, like their bank counterparts, facilitate information and transaction costs reduction (Demirguc-Kunt and Levine, 2001; Beck and Levine, 2004). As a secondary market, the stock market provides and facilitates a formal trading arrangement for financial securities (Jalloh, 2009) and ensures that the price discovery process is efficient. Indeed, the mere establishment of a stock market in the economy is not sufficient unless it promotes market liquidity (i.e. making it easy to exchange or trade stocks). Thus the central function and value of stock markets is the provision of liquidity as well as accurate and timely information to its stakeholders. By promoting the generation and dissemination of relevant company-specific and market information, stock markets make it possible for companies to access and obtain external finance at lower costs. Also, investors spend less time and resources to have the same information for investment decision making, which would otherwise have been very costly to obtain or non-existent without stock markets. To put this function in perspective, assume a company or an individual who has a need for extra finance to expend on a project. If this individual or company has to go asking everywhere in order to find another individual or company with idle money, the whole time could be used to do the search. But with several financial institutions intermediating between these financial markets and the public, the hypothetical individual or company knows beforehand where exactly to go for which type of finance and for what type of investments.

Secondly, the value of stock markets to an economy is based also on their role in resource allocation. Stock markets help in allocating resources for productive activities which, through various channels, promotes economic growth. By promoting easy access to information at lower costs and improving the allocation efficiency of scarce resources, stock markets help to increase the average productivity of capital (Holmestrom and Tirole 1993). According to Kenny and Moss (1998) stock markets can also enhance the operations of the entire domestic financial system and in particular the domestic capital market. A well-functioning stock market can stimulate domestic saving mobilisation, improve the saving rate and enhance both the quantity and quality of investments (Greenwood and Smith, 1997; Singh 1997). It is important to add that, the saving mobilisation function of stock markets relates to long-term debt and equity finance for investments in long-term projects. Stock markets also help to strengthen corporate financial structure and to improve the general solvency of the financial system in the economy. Thus, stock markets play a complementary role with the banking and other lending institutions by providing risk capital in the form of equity and loan capital in the form of debt instruments.

Thirdly, another function performed by stock markets is the provision of alternative long-term capital to companies and the fact that it helps to reduce the burden and pressure on bank financing. High demand for long-term finance from banks alone by firms can potentially cause a credit crunch in the financial system which can destabilise the economy and impede growth. However, by offering alternative long-term finance, stock markets help to mitigate and potentially eliminate the risk of a credit crunch and its associated consequences for the economy. Indeed, stock markets also potentially perform an "act of magic" (Baumol 1965; Yartey, 2008). That is, long-term investment is adeptly financed by funds provided by short-term individual investors. These short-term investors may even demand their funds at short notice, yet the stock market enables the conversion of such short-term investments to long-term investments for firms. The effect of all this is to increase outputs and promote long-run economic growth.

Fourthly, stock markets further facilitate risk allocation and risk sharing among investors. A fundamental principle of finance is that risk and return are positively related, implying that high risk projects should offer high return in compensation to induce investments in them. By their nature and functioning, stock markets are able to determine the risk of investment opportunities and price projects according to their risk levels and further ensure that such risks are shared to promote investments even in very risky projects. In the absence of well-functioning stock markets, projects perceived to be too risky would be rationed out of the economy and completely ignored leading to value destruction. Consequently, aggregate growth might perform poorly and the economy might stagnate as potentially high return projects are ignored by investors.

Fifthly, another important function that stock markets are expected to perform relates to corporate governance, in that the market serves to discipline the management of companies through the takeover mechanism in an environment with imperfect information and incentive problems. Corporate management is expected to effectively manage assets and guarantee the most efficient utilisation of past investments. Theoretically, the presumption is that management's failure to maximise shareholder wealth and the value of the firm, may encourage another investor to takeover and control the firm, replace its existing management and reap the resulting gains thereof. Stock markets also play a crucial role in the international financial liberalisation process. A country's competitiveness in markets for international capital is strengthened when there is a well-functioning stock market (Jalloh, 2009). The country is able to interact with the rest of the world markets. Consequently, the dependence of the economy on foreign aid and other forms of external support is significantly reduced.

Notwithstanding the number of important functions stock markets perform, they have been heavily criticised. In fact, critics of stock markets have always questioned and doubted the real functions or role of the stock market in the growth process of modern economies. Economic theory posits that higher savings (which also increases the saving rate) leads to more capital accumulation or capital formation and greater investments which ultimately results in higher growth of the economy. However, stock market liquidity and its ability to reduce market uncertainty (volatility) may cause the saving rate of the economy to fall so much so that the rate of economic growth is adversely affected (Bencivenga and Smith, 1991). Accordingly, even within a well-functioning stock market, the actual operation of the pricing and takeover mechanism does not enhance economic growth, but only results in short-term investments in the stock market and lower rates of long-term investment in firm specific human capital.

Stock markets are further panned for creating unpopular incentives for managers who succeed by doing financial engineering but at the expense of wealth creation through organic growth (Singh, 1997). Singh (1997) points out that, the takeover mechanism which is expected to serve as a disciplinary measure to check corporate management is weak in practice as competitive selection in the market is based more on size than on performance. The implication of this practice therefore is that, bigger firms that are inefficient are likely to get selected while relatively efficient but smaller companies are likely to be ignored.

A further criticism is that, stock market liquidity may also influence corporate governance unfavourably due to the fact that very liquid stock markets may induce investor bigotry (Yartey, 2008). Stock market liquidity can lead to low investor commitment to long-term investment in the company whose shares they hold. Investors may become more short-term in their investment preferences since securities they hold can be sold easily in a very liquid market and this can adversely affect corporate governance (Bhide, 1994). The issues, as pointed out in Yartey (2008), are aggravated in emerging markets which are already bedevilled by weaker institutions and greater macroeconomic volatility. In view of the aforementioned limitations of the stock market, many critics doubt the role of stock markets in enhancing and stimulating the growth of emerging economies.

3.2 Theories of Stock Market Development

By 1913, around the same time of the First World War, lower levels of stock market development were being generally observed in relatively poorer countries, especially in developing countries (Battilossi and Morys, 2011). The implication of this was that, the extent of stock market development, measured by the stock market capitalisation ratio, the normalised number of listed stocks, or the liquidity or depth of the market was found to correlate with per capita income of the economy. In particular, stock market development is said to be mainly determined by economic growth and stock market liquidity in a classical model (Calderon-Rossell, 1991). Studies however show that the levels of stock market development differ between countries even with similar levels of per capita income; suggesting that some other factors could be significantly driving their respective development. A bi-directional relation between stock market development and economic growth has also been reported (Calderon and Liu, 200). The literature on factors that can potentially constrain stock market development points to different sources. At least, five different hypotheses or schools of thought provide explanations as to why financial development, for that matter, stock Market development differs from one country to another even when the two countries have achieved comparable economic progress. They are the initial endowment hypothesis, the law and finance theory, the politics and finance theory, the multiple equilibria theory or path-dependence model, and the interest group theory, discussed in the ensuing subsections.

3.2.1 The Initial Endowment Hypothesis

The initial endowment theory about stock market development postulates that the initial endowment of a country in terms of colonisation, geography, land, topology, and disease environment, shapes the development of all institutions including that of the financial system (Beck et al. 2001; Andrianaivo and Yartey, 2009). The development of the financial system (financial markets and institutions) is dependent on whether these initial endowment factors are growth enhancing or growth retarding. Three channels emerge from the literature on the initial endowment view. One channel of the endowment view suggests that environments or lands with high rates of diseases and poor quality of agricultural yields have weak financial system (Gallup et al., 1998). According to this channel, poor agricultural yields implies lack of large-scale farming which is necessary for specialisation, innovation, financial development and hence economic growth (Beck et al., 2001). The flipside of this, as noted by Engerman and Sokoloff (1997) about southern North America and South America is that, financial development is enhanced in environments free of diseases and rich in fertility for large-scale farming. The authors noted that, whereas long-lasting institutions emerged in South America to protect minority landlords from majority peasant farmers, more egalitarian institutions developed in North America as small farm owners were promoted. Such differences in initial endowment, in the view of Engerman and Sokoloff, shaped various institutions including government approaches, political institutions and consequently development of their financial systems.

In another channel of the initial endowment hypothesis described as the settler mortality hypothesis, Acemoglu et al. (2001a, b) underscore the role geography and disease conditions of colonies played and how that affected the development of various institutions including the present financial systems. According to the authors, the Europeans settled in colonies they found to be hospitable and free of diseases and established institutions to develop those colonies, but only set up extractive institutions to extract natural resources in colonies where prevailing environmental conditions were found to be unfavourable with various diseases and related high mortality rates. The initial environment endowment of colonies thus profoundly affected the colonisation strategies of the colonial masters, resulting in the interminable international differences in institutional and financial development.

A third channel of the endowment view relates to a country's endowment in terms of its institutional quality, macroeconomic policies, and cultural characteristics (Huang, 2005) as well as other country-specific characteristics including the extent of ethnic fractionalisation, language and religious differences (Stulz and Williamson, 2003). In agreement with earlier authors' assertions (North and Thomas, 1973; Jones, 1981), Acemoglu et al. (2001) state that economies with better institutions, more secure property rights and less distortion in government policies will invest more in physical and human capital and will utilise them more resourcefully to achieve economic growth.

3.2.2 The Law and Finance Theory

Cross-country differences in financial (or stock market) development, according to the law and finance theory, are due to differences in legal traditions. That is the origin of a country's laws influences its financial development. Legal theories identify two channels through which legal systems can influence financial development: (1) the political channel of the law and finance theory, and (2) the legal adaptability channel of the law and finance theory. The political channel of the law and finance theory emphasises that (a) legal traditions concerning the priority given to private property rights and the rights of investors differ between countries, and (b) the protection of investors and private property rights are the basis for financial development. Essentially, present international differences in financial development are the result of historically determined differences in legal tradition (Battilossi and Morys, 2011, Beck et al., 2001; La Porta et al., 1997, 1998).

According to comparative law literature, English common law is more inclined towards protecting private property owners against the crown, so that private contracts are facilitated (North and Weingast, 1989), while French and German civil law codified in the 19th Century approved government dominance over the judiciary and as such provided few rights and little protection to property owners. Through conquest, colonisation and imitation, these legal systems spread to other countries across the world (Beck et al., 2001). Thus, in the view of the political channel of the law and finance theory, common law legal traditions enhance financial development more than civil law legal systems and this helps explain international differences in financial development even today (Battilossi and Morys, 2011; Beck et al., 2001).

On the other hand, the legal-adaptation channel of the law and finance theory stresses that (a) the ability of legal traditions to adapt to changing commercial and financial conditions differs, and (b) legal systems that adapt rapidly to changing economic conditions are more effective at promoting contracting and financial development (Johnson et al., 2000). According to comparative law literature, the common law system is intrinsically dynamic, while French civil law tradition is inherently static. In common law, Judges decide cases on their own merits with regard to changing commercial and financial transactions. On the other hand, French civil law was thought of as “a complete, unambiguous, internally consistent, and immutable legal doctrine,” with monopoly rights of law making vested in the legislature and since laws are not quickly made to suit changing conditions, the French civil law tradition is rigid. Again, while the English legal system promotes financial development, the rigidity of the typical French law tradition inhibits financial development (Battilossi and Morys, 2011, Beck et al., 2001; Mahoney, 2001; La Porta et al., 1998; Merryman, 1985). However, due to the fact that financial development is dynamic and constantly changing, the law and finance theory which involves static legal traditions is often rejected in favour of the politics and finance theory.

3.2.3 The Politics and Finance Theory

The argument in support of the politics and finance theory is that financial and market development keeps evolving over time, but the legal traditions in countries have remained fixed (Beck et al., 2001; Ragan and Zingales, 2001). The fundamental idea of the politics and finance theory is that political leaders influence policies and institutions that favour them (North, 1990; Olson, 1993). Therefore, if the government in power believes free financial markets will enhance its interests, then the appropriate laws and institutions will be created to enhance financial development (Beck et al., 2001). Conversely, political leadership may thwart financial development with unpopular policies and institutions if those in power feel that such development is injurious to their course. Besides, the politics and finance view further predicts that political systems with centralised governments are more effective at implementing the will of the few elites than those with decentralised, open and competitive political systems. Essentially, financial development can be heavily influenced by the political system in operation in an economy.

3.2.4 Multiple Equilibria – Path Dependence Models

Another theoretical explanation for the large differences in international stock market development may be due to multiple equilibria resulting from “thick market externalities” among actual or potential market participants (Pagano, 1993). Market participation by some investors motivates others to participate, so that the decisions of investors to participate in the market are correlated in equilibrium. If this happens, then in a situation where every participant expects low participation and such expectation is confirmed in equilibrium, a stock market could be trapped into what Pagano (1993) refers to as persistent stagnation. Conversely, high participation equilibria could possibly exist as well. Similarly, in the stock market, risk-sharing opportunities and the portfolio diversification ability of investors are enhanced by the number of listings in the market. Also, the demand for shares of companies is dependent on the quantity and variety of shares supplied. Therefore, a stock market will generate low demand expectations when few shares are expected to be listed, and this has the tendency to discourage entrepreneurs from going public and incurring listing related costs such as takeover risk and loss of benefits from private control. According to Pagano (1993), re-echoed in Battilossi and Morys (2011), a stock market facing such a "contagion mechanism" can again be trapped in a low level equilibrium regardless of the magnitude of probable market participation.

3.2.5 The Interest Group Theory

In what is described as the interest group theory of financial development, Rajan and Zingales (2003) propose that financial development and for that matter stock market development is closely and directly related to globalisation. Rajan and Zingales explain that incumbents in the financial sector and industry are against equality with financial markets and fear the latter will fiercely establish competition with them. Accordingly, incumbents feel that financial markets disrespect their incumbency, have lower entry barriers, heighten competition and therefore will eliminate their dominance within the financial system. According to Rajan and Zingales, there are instances however, where the ability or incentive of incumbents' opposition to financial market development is disabled. When a country decides to liberalise its borders for international trade and capital flows, incumbents' opposition is weakened and financial market development is accomplished. The decision of an economy to open its borders to international trade and finance can also be politically motivated. However, politics is not the only reason why an economy may liberalise its borders to international trade and capital flows. The size of the economy may limit its choices and compels it to open its borders; its proximity to other countries that have already opened up their borders may force it to liberalise; and it may also open its borders as a strategy to complement large economies that are already open (Rajan and Zingales, 2003). In addition, groups like exporters who are strongly in support of openness because of the potential benefits associated are likely to press hard and succeed in getting their country's borders open (Becker, 1983). In fact, the interest group theory of financial development converges, to some extent, with the law and finance theory, as the latter's assertion about the civil legal system is that small interest groups can easily influence public policy and tilt the legal system to their advantage (Battilossi and Morys, 2011).

3.3 Sources of Stock Market Development

Even though there are conflicting theoretical predictions and empirical evidence of finance-growth link on the one hand, and banks versus markets on the other hand, the balance of evidence seems to suggest that both the banking sector and stock markets play crucial roles in the growth process of an economy. However, a matter of growing interest relates to resolving the most crucial policy questions: what accounts for cross-border or international differences in stock market or financial development? And if the stock markets are such an important driver of economic growth and prosperity, why have some countries developed their markets and general financial systems and achieved resulting economic prosperity and others have not developed theirs? These questions are relevant to every economy irrespective of their level of development.

In fact, the relative size of stock markets differs considerably among nations. Even countries that have achieved a comparably high level of economic development still experience large variance in stock market development indicators (Pagano, 1993). Certainly, resolving the issues surrounding these pertinent policy questions is paramount for emerging markets and more particularly African countries. Africa economies, in diverse ways including stock market development, seem to lag far behind their peers around the world. Growing literature has identified at least three broad factors that explain the cross-border differences in the levels of stock market development: economic factors, governance and institutional factors, and financial globalisation and liberalisation.

3.3.1 Economic Fundamentals

Theoretically, there is broad consensus that stock market development is a positive function of the level of income (Garcia and Liu, 1999). According to demand driven hypotheses, when income levels are high, fresh demand for financial services is induced in the economy and that should lead to stock market development. The positive relation between real income growth and stock market development is based on the assumption that increased income levels usually go hand in hand with better education, better defined property rights, and a generally healthier business environment (La Porta et al., 1997). Other theoretical predictions however argue that the level of income does not directly affect stock markets, rather, a higher volume of intermediation through the stock market leads to higher growth in real income and the increased income levels in turn stimulate stock market development. The cyclical component of the increased income levels should affect the stock market price index and size (Garcia and Liu, 1999).

Also, liquidity ensures the channelling of savings and investments through the stock market, so that more market liquidity facilitates greater stock market development. Higher liquidity in the stock market enables investors to easily and cheaply modify their investment portfolios as well as venture into less risky investments (Levine 1991; Bencivenga et al., 1996). Therefore, whether stock market liquidity is calculated to measure equity transaction relative to the size of the economy (Levine and Zervos, 1998) or it is measured as equity transaction relative to the size of the stock market (Ben Naceur et al., 2007), theory suggests it has a positive impact on stock market development. Despite the protracted debate on the relative importance of bank-based economies (Rajan and Zingales, 1998) versus market-based economies (Holmstrom and Tirole, 1993), Levine (2002) has advised that the two must complement each other. Certainly, both banks and markets intermediate savings to investment projects within the economy and are thus closely related.

In addition, macroeconomic stability (inflation rate and real interest rate) affect stock market development. Macroeconomic instability corresponds to higher inflationary periods, higher interest rates, volatile trade balances, and high volatility in stock markets. High volatility of the macroeconomic environment is a disincentive to investment and can potentially reduce investor participation in the market. Again, there is very little guarantee of corporate profitability as changes in monetary, fiscal, exchange rate, and trade policies become more volatile during unstable macroeconomic conditions. The prediction of economic theory therefore is that stable macroeconomic conditions are a prerequisite for stock market development, so that countries with stable macroeconomic conditions also have well developed stock markets (Huybens and Smith, 1999).

Moreover, fiscal policies and the type of fiscal consolidation and initial conditions that exist in an economy are a source of cross-country differences in stock market development. During a fiscal expansion, aggregate demand is stimulated either directly as government increases its spending while keeping taxes constant, or indirectly as government cuts taxes or increases transfer payments (Weil, 2008). The resulting increase in household disposable income increases aggregate demand encouraging households to increase their consumption of goods and services (including demand for stocks). Theory however suggests that a fiscal deficit in an economy could lead to rising interest rates and crowding out of some investments in the private sector as government is likely to raise additional funds through bonds issue (Weil, 2008). In an open economy, fiscal policy impacts on exchange rate and merchandise trade balance. Depending on the fiscal policy stance of the economy, exchange rate fluctuations can seriously thwart stock market development.

3.3.2 Governance and Institutional Factors

Theory has long underscored the indispensable role of good governance and quality of institutions in the financial development and economic performance of countries (Avellaneda, 2006). Adam Smith in the 18th Century aptly described it as follows:

> *"Commerce and manufactures can seldom flourish long in any state which does not enjoy a regular administration of justice, in which the people do not feel themselves secure in the possession of their property, in which the faith of contracts is not supported by law, and in which the authority of the state is not supposed to be regularly employed in enforcing the payment of debts from all those who are able to pay. Commerce and manufactures, in short, can seldom flourish in any state in which there is not a certain degree of confidence in the justice of government"(Smith, 1776: 240).*

There seems to be a consensus among development economists and policymakers on the notion that good governance and institutions are prerequisite for sustainable financial development and economic growth (Kaufmann et al., 2000; Olson, 2003; Knack, 2003; Avellaneda, 2006). Kaufmann et al. (2000) aptly put it as "governance matters" in economic development and broadly define governance as the "traditions and institutions that determine how authority is exercised in a particular country" (Kaufmann et al., 2000). In their "Governance Matters", Worldwide Governance Indicators (WGI) project, the authors identified six dimensions of governance: regulatory quality, voice and accountability, political stability and absence of violence, government effectiveness, rule of law, and control of corruption. Good governance is thus characterised by the existence of the right institutional environment which Davis and North (1971) describe as "the set of fundamental, political, social and legal ground rules that establish the basis for production, exchange and distribution" as necessary incentives for well-functioning markets. Similarly, North (1990) broadly defines institutions as the human constraints (formal and informal) designed to coordinate and shape economic, political, and social interactions among societal members. The essence of institutions and the particular way they are structured, in the view of North (1990), is mainly to ensure order, reduce uncertainty, and subsequently determine economic agents' choices, activities, costs, feasibility and profitability within certain economic constraints. For Edison (2003), institutions should be delineated in terms of the extent of property rights protection, fairness in the enforcement of laws and regulations, and the level of corruption in the country.

Moreover, Olson et al. (2000) have argued that neither the neoclassical nor the endogenous growth theorists have been able to explain what accounts for differences in cross-border financial development. In their view, international differences in the levels of development are due to differences in the quality of governance and institutions. Their argument is based on the striking fact observed during the 1985-1995 period, that developing countries had experienced further decline in growth, while a subset of them (China, Korea and Thailand) became the fastest growing economies worldwide. These second type of developing economies had actually outgrown, on average, the three largest economies with the highest per capita income globally (i.e. Canada, Switzerland and the United States). If the assumption of diminishing returns to investment in human and physical capital by the neoclassical growth model was accommodative of such differences, then the expectation of the world would have been that "the capital-poor low income countries should have grown more rapidly than the well-endowed rich countries" (Olson et al., 2000).

3.3.3 Financial Globalisation and Liberalisation

Financial globalisation is an aggregate concept referring to the rising global linkages through cross-country financial flows (Prasad et al., 2003). Also, financial liberalisation is the process of opening up a country's borders to the rest of the world and the removal of restrictions on foreign participation in the domestic financial markets. Theoretically, such steps should promote capital and portfolio flows into the country, as was actually the case in most developing economies in the 1990s when they liberalised their markets. Financial globalisation can be augmented by liberalisation policies leading to financially integrated markets. A financially integrated market refers to an individual country's linkage with capital markets worldwide, or the extent to which a country's borders are open to international capital and portfolio flows.

Theory suggests that financial globalisation or financial integration can promote stock market development and economic growth through a number of direct and indirect channels. In terms of the direct channels, financial globalisation enhances domestic stock prices, augments domestic savings and investments, lowers cost of capital through better risk allocation and risk sharing, transfers appropriate and relevant technology from industrialised economies to developing countries, and improves the financial sector in general (Prasad et al., 2003). Through financial globalisation and integration, capital-poor countries can have greater investments from industrial economies, while at the same time higher returns are realisable by capital-rich economies which hitherto would have been absent without such linkage.

Predictions from international asset pricing theory suggest that liberalised markets improve risk allocation (Henry, 2000a; Stulz, 1999) and enable domestic and foreign investors to share risk which ultimately helps them to diversify potential risks of investment portfolios. Consequently, risk diversification opportunities and ability embolden and fortify firms to invest more, increase productivity and enhance stock markets and growth. Also, since financial integration is characterised by increased capital flows, domestic stock markets may become more liquid, reducing their equity risk premia and eventually lowering their cost of raising capital to finance investments. By intensifying competition and transferring well-functioning financial systems in the domestic economy, financial liberalisation enhances the functioning and development of domestic stock markets (Levine, 2001). Accordingly, a financially integrated country is better able to attract foreign direct investments which potentially can lead to the spill-over of more efficient and effective technology and management practices. Moreover, financial integration, through indirect channels such as promotion of production specialisation, stimulation of better economic policies, and enhancement of capital inflows according to the neoclassical growth model, promotes stock market development and economic growth (Prasad et al., 2003).

In principle, however, financial globalisation and liberalisation are effective only under certain prevailing economic, financial, institutional, and policy regimes and domestic economic conditions. Pre-existing market distortions such as weak institutions and policies could distort and retard growth both in stock markets and the general economy. International financial integration may lead to capital flowing out from already capital-poor countries to capital-rich countries with better institutions and policies (Boyd and Smith, 1992). Edison et al. (2002) prescribe a number of pre-existing conditions as prerequisites for a country to benefit from international financial integration: (1) good governance, (2) a well-functioning legal system with effective enforcement of laws and regulations, (3) absence of or less corruption, and (4) sound macroeconomic conditions. This prescription thus supports the ‘sequencing’ literature which advocates that domestic systems must be developed to an appreciable level prior to capital account liberalisation (Eichengreen et al. 1999).

3.4 Survey of Empirical Literature on Stock Market Development

Not until two decades ago, studies involving stock market development had been conducted mainly along two lines; analysing the relationship between economic growth and financial development (Robinson, 1952; McKinnon, 1973; Levine and Zervos, 1998; Rousseau and Wachtel, 2000), and assessing the relative importance of bank-based versus market-based financial systems[5] and whether stock markets and financial intermediaries are complements or substitutes (Demirguc-Kunt and Maksimovic, 1998b; Beck and Levine, 2004).

Subsequently, a new path of empirical research has emerged with a focus on analysing the determinants of stock market development in order to understand the sources of economic growth and national prosperity. In this strand of literature, macroeconomic and institutional factors have been suggested as the major sources of stock market development. Stock market development is multi-dimensional in nature as evidenced in the varied measures used in the literature to proxy it. All things being equal, a resilient macroeconomic environment can enhance the performance of businesses, improve investor confidence, boost resource mobilisation, capital flows and foreign investments and can increase stock market efficiency and development. Also, the importance of institutions in financial development has been widely acknowledged (La Porta et al., 1997, 1998; Rajan and Zingales, 2003; Acemoglu et al., 2004; Djankov et al., 2007; Roe and Siegel, 2008; Demetriades and Fielding, 2009).

Garcia and Liu (1999) pioneered this strand of the literature by examining the macroeconomic determinants of stock market development using pooled annual data from 1980 to 1995 for fifteen countries around the world. The results showed that real income, saving rate, financial intermediary development and stock market liquidity are the main determinants of stock market development. Inflation however was found to have a positive and insignificant effect on stock market development. Testing the hypothesised relationship between banks and stock markets, the study found financial intermediary development to be a complement rather than a substitute of stock market development. Garcia and Liu (1999) however did not consider institutional factors as determinants of stock market development, although they acknowledged the important role institutions

[5] Theoretically, a bank-based financial system focuses on and prioritises financial intermediaries as the ultimate approach for attaining economic growth, whereas a market-based financial system regards financial markets as more important in the growth process of an economy.

play. The evidence in Garcia and Liu (1999) is corroborated by the findings of Boyd et al. (2001) and Naceur and Ghazouani (2007), except the finding in respect of inflation rate. The two studies respectively found evidence consistent with economic intuition as inflation showed a significant negative relationship with stock market development.

In another study, Ben Naceur et al. (2007) built on the work of Garcia and Liu (1999) and similarly examined the macroeconomic variables. Using an unbalanced panel of twelve (12) MENA region countries in both fixed and random effects model specifications for the time period from 1979 to 1999, the authors found evidence largely consistent with the results of Garcia and Liu (1999) with the exception of macroeconomic stability. The study also upheld the hypothesis that financial intermediaries and capital markets play complementary instead of competitive roles in the economic growth process.

Yartey (2008) examined the institutional and macroeconomic factors determining stock market development using a panel of 42 emerging countries for the period from 1990 to 2004. In an augmented Calderon-Rossell partial equilibrium model, the authors applied panel data techniques using the generalised method of moments (GMM) estimation. The results showed that banking sector development, private capital flows and stock market liquidity are significant determinants. Institutional quality measures comprising bureaucratic quality, law and order and political risk have been found to play an important role in stock market development in emerging markets. The presence of quality institutions ensures that the rights of creditors and investors are generally well protected.

In a similar study, Andrianaivo and Yartey (2009) examined separately, the determinants of banking sector development, and the determinants of stock market development in Africa. The panel data techniques including GMM estimation methods were applied to 53 African countries for the period 1990 to 2006. The study found, in particular, that market liquidity, domestic savings, banking sector development and political risk are the main determinants of stock market development in Africa. While both Yartey (2008) and Andrianaivo and Yartey (2009) have made significant contributions to the literature, their studies, like all other prior studies on the determinants of stock market development did not explicitly consider the potential effects that global factors could have on stock market development in Africa.

Cherif and Gazdar (2010) used a panel of 14 Middle East and North African (MENA) countries and applied both panel and instrumental variable techniques for the period 1990 to 2007. The results reported concurred with the view that stock market development (and financial system) is crucial and largely depends on the adoption of appropriate macroeconomic policies, promotion of competition within the financial system, and the development of strong and transparent institutions. The authors, however, could support the importance of institutions as a significant determinant of stock market development in the MENA region based on their findings. Also cointegration techniques applied by Kemboi and Tarus (2012) showed that income level, banking sector development and stock market liquidity determine Kenyan stock market development. Macroeconomic stability is however not a significant determinant of Kenyan stock market development.

Studies have also analysed the determinants of financial development (including stock markets) in line with the views that advocate the importance of institutions, financial liberalisation and openness. Unlike the previous studies which examined the macroeconomic determinants of stock market development, this group of empirical studies have investigated the influence of institutions and governance quality on stock market development as well, though largely in developed and non-African emerging markets. Good governance, quality of institutions and ultimately efficient legal systems which guarantee transparency, contract enforcement and protection of creditor and property rights are crucial for the development of the financial system in general (Billmeier and Massa, 2009).

Chinn and Ito (2005) applied panel data analysis to 108 countries using data spanning the period from 1980 to 2000 to examine the influence of capital account liberalisation, legal and institutional development on stock market development. The study documented evidence which affirms earlier studies (Pagano, 1993; La Porta et al., 1997, 1998; Pistor et. al., 2000) that effective legal systems and quality of institutions are important determinants, the absence of which weakens the influence of financial openness on stock market development. In a similar study but in respect of 37 SSA countries, McDonald and Schumacher (2007) suggested that macroeconomic stability and financial liberalisation are necessary but not sufficient conditions for financial deepening. Countries with stronger legal institutions and information-sharing are found to exhibit greater financial development.

Law and Habibuliah (2009) also shed light on the influence of financial liberalisation, openness and quality of institutions on financial development. In a panel of 27 countries, the authors applied dynamic panel techniques in GMM estimation. The evidence revealed per capita real income and quality institutions as significant determinants of both banking sector and capital market development. The results further indicated that trade openness is more relevant to capital market development, while financial liberalisation significantly influences the development of both the banking sector (when liberalisation leads to financial sector reforms) and stock markets (when liberalisation programmes centre on liberalising the stock market). Results of sub-sample analysis showed that developed countries are more responsive to financial liberalisation programmes than emerging markets, implying that the impact of financial liberalisation could depend on the level of economic development. Indeed, studies suggest that countries with well-developed financial systems gain more exports share and international capital and portfolio flows (Levine, 2001; Beck, 2003).

The role of international remittances and resource endowment has been studied alongside the institutional and macroeconomic determinants of stock market development in the literature. Increased remittances can enhance disposable income, smooth consumption and possibly boost saving and investment in the stock markets of the recipient countries. Also, hydrocarbon exportation can enhance domestic foreign exchange, income, saving and investment, and ultimately stimulate stock market development. This line of enquiry was examined initially in relation to economic growth (Sachs and Warner, 1999; Sala-i-Martin and Subramanian, 2003) but has recently been extended to stock market development.

Billmeier and Massa (2009) analysed macroeconomic factors, institutions, natural resources and remittances as determinants of stock market development using data from 17 emerging economies. Applying fixed-effect panel analysis, the results largely support the importance of institutions and macroeconomic factors in explaining stock market development. Also, remittances exert significant positive influence on stock market development. The influence of both institutions and remittances is greater in countries without significant natural resources or hydrocarbon sectors. Additionally, oil price movements appear to significantly drive stock market development in countries that are endowed with substantial natural resources. Billmeier and Massa (2009) thus suggest that oil price movements do have strong explanatory power on stock market development in resource-rich countries but weak influence in countries without significant resource endowment.[6]

In another recent study of the macroeconomic determinants of stock market development, El-Nader and Alraimony (2013) investigated the sources of stock market development in Jordan using monthly data from 1990 to 2011. The Johansen and Juselius (1990) multivariate cointegration and variance decomposition analysis was applied. The findings indicated that banking sector development, stock market liquidity, investment rate, macroeconomic stability and money supply relative to GDP have positive effects on the development of the Jordanian stock market, while nominal GDP and net remittance relative to GDP exert negative influence. Their findings further showed evidence of a long-run and short-run dynamic relationship between stock market development and selected macroeconomic factors in Jordan.

More recently, Afful and Asiedu (2014) also examined the effectiveness of business regulations, fiscal policy, governance quality, and stock market liquidity in stimulating stock market development. In a dynamic panel data technique using annual data from six Sub-Saharan countries, the authors found that governance quality, fiscal policy and business regulations are significant determinants of stock market development. But none of these studies considered the influence of global factors on stock market development.The results of Afful and Asiedu (2014) are consistent with an earlier study (Revia, 2014) which sought to examine the influence of regulatory environment on stock market performance in 71 countries over the period from 2004 to 2009. Revia (2014) used the difference and system GMM estimation techniques and documented a positive and robust link between the quality of existing institutions and the level of stock market development and sophistication. However, like most previous studies reviewed in this paper, Afful and Asiedu (2014) only partially examined the determinants of stock market development, focusing solely on internal factors for that matter. Specific global factors like commodity prices movements and influential economies like China and the United States have gained

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[6] A number of recent studies have documented evidence suggesting a link between oil price movements and stock market performance (Cunado and Perez de Gracia, 2003; Kilian and Park, 2009; Miller and Ratti, 2009; Mohanty et al., 2011). For example, Sadorsky (1999) found that both oil price changes and oil price volatility significantly influence stock returns in the United States; Basher and Sadorsky (2006) used data from 21 emerging stock markets and found that oil price shocks significantly affect stock price returns in emerging markets; Park and Ratti (2008) used data from the US and 13 European countries and concluded that oil price shocks have a significant influence on stock returns; and Mohanty et al. (2011) used data from the GCC countries and documented evidence which suggests that stock markets are exposed to oil price shocks and that 12 out of 20 industry-specific returns responded significantly to oil price shocks.

prominence under current global developments in financial markets and could thus play a significant role in determining stock market performance in Africa.

However, the extant literature seems to have paid unmeritoriously little attention to or have ignored entirely the crucial role of global factors in the determination of stock market development. In a world that has been likened to “a global village” and markets are increasingly becoming linked on account of financial liberalisation and advancements in telecommunications and technology, global events such as crude oil price movements and the influences of global economies may have become significant sources of stock market development in developing and emerging markets in particular.

3.5 Theoretical Framework, Methodology and Data

This section seeks to examine the domestic determinants (institutional quality and macroeconomic factors) and global determinants (international macroeconomic and financial market conditions) of stock market development in Africa. To this end, an empirical model is specified using the most current data and theoretically grounded variables for the estimation. In particular, a dynamic panel data modelling technique within the framework of the GMM estimation approach is executed for the analysis.

3.5.1 The Classical Calderon-Rossell Model

In investigating the domestic and global factors determining stock market development in Africa, the specification of the empirical model is based on the theoretical foundation established in Calderon-Rossell’s (1991) behavioural structural model, modified in the spirit of Yartey (2008). The key assumption of the Calderon-Rossell model is that stock market development is mainly determined by the level of economic growth (proxied by output growth or income per capita) and stock market liquidity (measured by turnover ratio). Calderon-Rossell suggested that as the economy expands, income per capita grows, increasing the saving rates, capital accumulation and investments, and consequently leading to increasing stock market activities and development. The model further suggests that stock market capitalisation is a function of the number and value of listed companies. The price of listed companies is also a function of the number of listed companies and the annual output of the economy measured by gross domestic product; and the number of listed companies in turn depends on the output of the economy and market liquidity. The basic classical Calderon-Rossell behavioural structural model is formally presented mathematically as follows:

$$Y = PV \quad (4.1)$$

$$Y = PV = Y(G, T) \quad (4.2)$$

$$V = V(G, P) \quad (4.3)$$

$$P = P(T, V) \quad (4.4)$$

where:

Y = stock market capitalisation (in local currency)

P = number of listed companies on the stock market

V = price of listed companies in local currency

T = market liquidity proxied by the turnover ratio (the total value of traded stock as a percentage of the stock market capitalisation)

G = measure of the annual output of the economy (proxied by gross domestic product, gross national product, or income per capita).

The output per annum or per capita income measure (G) and the market liquidity measure (T) are exogenously determined, while the number of listed companies (P) and the price of listed companies (V) are endogenously determined. The model thus represents a set of interrelated functions. Based on the above structural equations, the reduced behavioural model can be expressed in the following equation:

$$\mathrm{LogY} = \beta_1 \mathrm{LogG} + \beta_2 \mathrm{LogT} \quad (4.5)$$

The components of the reduced behavioural model in equation (4.5) can be expressed as follows:

$$\mathrm{LogV} = \alpha_1 \mathrm{LogG} + \alpha_2 \mathrm{LogT} \quad (4.6)$$

$$\mathrm{LogP} = \omega_1 \mathrm{LogG} + \omega_2 \mathrm{LogT} \quad (4.7)$$

Also, combining equations (4.6) and (4.7) together with equation (4.2) would yield equation (4.8); and factorising subsequently would yield equation (4.9) as follows:

$$\mathrm{LogY} = \mathrm{LogPV} = \alpha_1 \mathrm{LogG} + \alpha_2 \mathrm{LogT} + \omega_1 \mathrm{LogG} + \omega_2 \mathrm{LogT} \quad (4.8)$$

$$\mathrm{LogY} = (\alpha_1 + \omega_1)\mathrm{LogG} + (\alpha_2 + \omega_2)\mathrm{LogT} \quad (4.9)$$

where:

$\beta_1 = (\alpha_1 + \omega_1)$

$\beta_2 = (\alpha_2 + \omega_2)$

Equation (4.9) depicts the fundamental hypothesis of the classical Calderon-Rossell behavioural structural model in which the level of stock market development is the result of the combined effects of the level of economic growth (G) and the liquidity of the stock market (T) on both the number of listed companies and stock prices. More specifically, the effect of economic growth on stock market development through its influences on stock prices and the number of listings is measured by $\beta_1 = (\alpha_1 + \omega_1)$ and the effect of stock market liquidity on stock market development through its influences on stock prices and the number of listings is measured by $\beta_2 = (\alpha_2 + \omega_2)$. It however takes the combination of these effects, according to the model, in order to determine the influence of the two variables on stock market development.

The validity of this model was subsequently tested by Calderon-Rossell using data from the most actively traded stock markets in some 42 countries spanning the period from 1980-1987. Consequently, the results affirmed conclusively that economic growth and stock market liquidity are significant factors determining stock market development. The validity of the model was further examined by Yartey (2008) in a modified Calderon-Rossell model to broaden the determinants of stock market development. The study supported convincingly not only the validity of the Calderon-Rossell model, but also the importance of institutions and macroeconomic factors as determinants of stock market development. Yartey's (2008) specification however only considers institutional and macroeconomic factors and does not explicitly consider the influence of global factors. The present study classifies the factors in Yartey (2008) as domestic factors and introduces possible global factors that can affect stock market development in Africa.

3.5.2 The Augmented Calderon-Rossell Model

The present study modifies the classical Calderon-Rossell model to classify possible determinants of stock market development into two broad categories: domestic factors (i.e. institutional and macroeconomic indicators) and global factors (global economic and financial market conditions as well as influential world economies) potentially affecting stock market development in Africa. In the context of financial globalisation amidst increasing levels of integration among financial markets around the world, global factors may have gained prominence and such factors as crude oil price movements, global financial market conditions and influential global economies could be significant sources of stock market development in developing and emerging countries (see for example, Bae et al., 2012; Hooy and Lim, 2013). The response of stock markets to global factors and the long-run link between the two has been documented (see for instance, Park and Ratti, 2008; Arouri et al., 2011, 2012; Arouri, 2013). However, no study in this strand of the literature to date has simultaneously investigated domestic institutional and macroeconomic determinants alongside controlling for the influence of global factors such as international financial market conditions, world commodity price movements, and the economic growth of leading global economies on African stock market development.

The modified Calderon-Rossell's (1991) model in the spirit of Yartey (2008) is specified as follows;

$$S_{it} = \alpha_i + \delta S_{it-1} + \Omega M_{it} + \lambda I_{it} + \psi G_{it} + \varepsilon_{it}, \quad i = 1, \ldots N, \quad t = 1, \ldots, \qquad (4.10)$$

where S is stock market development proxied by stock market capitalisation as a percentage of GDP, the subscripts it represent both the cross-sectional units (i individual countries or stock markets up to N markets) and the time series dimension (time period in years), α_i is the unobserved country-specific or stock-market-specific effect and ε_{it} is the usual error term. Also S_{it-1} is a one period lag of stock market capitalisation ratio indicating that stock market capitalisation is a dynamic concept and an important determinant of the current period market capitalisation for that matter, M is a matrix of macroeconomic variables comprising income level, banking sector development, stock market value traded as a percentage of GDP, foreign direct investment as a percentage of GDP, macroeconomic stability measured by inflation rate and real interest rate, gross domestic investment as a percentage of GDP, and gross domestic savings as a percentage of GDP. I in the equation is an index of institutional quality measures comprising bureaucratic quality, corruption index, democratic accountability, law and order, and political risk; G is a matrix of global factors affecting stock market activities and development including growth of the G-8 economies including Switzerland as well as the largest emerging markets of China, India, and Brazil, growth of the economies of major trading partners, world commodity prices movements, global equity indices performance, and the 2008-2009 economic and financial crisis; while δ, Ω, λ, and ψ are all coefficients to be estimated. The rationale for the inclusion of variables is discussed in the next section.

It should be noted that the approach in this chapter is to model domestic and global factors affecting stock market development in Africa. A number of macroeconomic and institutional factors based on economic theory and existing literature are selected to investigate the domestic determinants of African stock market development. Macroeconomic factors of the domestic determinants included in the model are *income level, banking sector development, stock market liquidity, savings and investment, macroeconomic stability, and private capital flows.* Governance and institutional quality factors of the domestic determinants examined in the model are *bureaucratic quality, corruption, democratic accountability, law and order, and political risk.* Global economic and financial market conditions indicators are proxied and used to assess the effects of global factors on stock market development in Africa. Specifically, the following international macroeconomic and financial conditions variables are examined: *performance of leading global equity indices proxied by the S&P equity indices of G-8 nations including China, India, Brazil, and Switzerland; the growth of influential global economies measured by the annual growth rate of gross domestic product of the major trading and investment partners of the African markets; world commodity prices for which Africa is a major exporter, international macroeconomic stability proxied by the current inflation of major trading and investment partners to Africa, and a dummy explanatory variable for the recent global economic and financial crisis in the United States.*

The sources of data include the World Bank World Development Indicators Database, WDI (2015) for macroeconomic variables and some global factors, the International Country Risk Guide (ICRG) for governance and institutional quality variables, and the International Monetary Fund (IMF), S&P Equity Indices, and the US Department of Labour for other global variables. National authorities' and institutional publications of individual countries were used to gather missing data in a few cases. All datasets are annual, spanning the period from 1998 to 2013. The top twelve stock markets in Africa based on stock market capitalisation and whose exchanges have existed since 1998 with available data are included in the sample[7]. The start date is influenced by Tanzania, for which market capitalisation data are available only after 1997. The stock exchanges and markets examined are Botswana Stock Exchange (Botswana), BRVM (Cote d'Ivoire), Dar es Salaam Stock Exchange (Tanzania), Egyptian Stock Exchange (Egypt), Ghana Stock Exchange (Ghana), Nairobi Securities Exchange (Kenya), Casablanca Stock Exchange (Morocco), Stock Exchange of Namibia (Namibia), Nigerian Stock Exchange (Nigeria), Johannesburg Stock Exchange (South Africa), Tunis Stock Exchange, BVMT (Tunisia), and Zimbabwe Stock Exchange (Zimbabwe). These stock markets account for up to 95%

[7] The Stock Exchange of Mauritius, even though has existed since 1988, was excluded because of lack of data on institutional variables from ICRG database.

of the share of the African stock markets and can thus serve as a plausible proxy for them. The ensuing discussions provide motivation for the inclusion of the variables in the modified Calderon Rossell (1991) model in this study.

3.5.2.1 Dependent Variable: Stock Market Development (S)

The dependent variable in this study is stock market development (S) proxied by stock market capitalisation as a percentage of GDP. In the literature, stock market development is measured variously including changes in the stock market indexes, market liquidity, market concentration, market efficiency, integration with world capital markets, institutional and infrastructural development, number of listed companies, and market volatility[8]. However, most of these measures are not only difficult to obtain for developing countries, but can be very arbitrary (Yartey, 2008). Besides, Demirguc-Kunt and Levine (1996) have demonstrated that there is high correlation among different measures of stock market development. In addition, the stock market capitalisation indicator, which also measures the size of the stock market in an economy-wide basis, is the most widely used measure for stock market development. Therefore, the findings in this study can be properly situated within the literature and can facilitate comparisons with previous studies. The average value of two consecutive years' market capitalisation provides a mid-year market capitalisation value to circumvent a stock flow problem with GDP (Yartey, 2008).

3.5.2.2 Macroeconomic Variables (M)

The income level of an economy is an important factor that influences almost all other development indicators including stock market capitalisation. Real income and stock market size are highly correlated (Garcia and Liu, 1999). Indeed, the demand-following hypothesis suggests that economic growth promotes financial development as fresh demand for financial services among others accompanies high income levels. Also, higher income level is associated with better education, better defined property rights, and a sound general business environment. Thus the income level of countries is expected to positively and significantly affect the level of stock market development. The annual growth rate of GDP per capita is used to measure income level in this study.[9] Real GDP, GDP growth rate and real GDP per capita could not be used due to a unit root problem.

[8] A similar line of argument is presented in Demirguc-Kunt and Levine (1996), Yartey (2008), Bayraktar (2014).

[9] A number of other measures of income level are also used in the literature including real GDP, real GDP growth, GDP per capita, nominal GDP and GNI, etc.

Financial markets in an economy are closely related so that the growth in one can have implications for the growth in another. Besides, channelling savings toward investment projects is intermediated by both financial institutions and stock markets and the two could be complements or substitutes. Increased activities and development levels of banks and bond markets have potential consequences for stock market development. However debt and equity capital can become substitutes when the banking sector experiences phenomenally high levels of development. Given that bond markets are almost non-existent or very underdeveloped in most African countries (except for South Africa, Nigeria and few others) the study measures the effect of banking sector development on stock market development. The value of domestic credit provided by the banking system to the private sector as a percentage of GDP is used as an indicator of banking sector development. This measure is chosen ahead of measures such as broad money supply M2 indicator of liquid liabilities, and domestic credit provided relative to GDP because private credit correctly indicates the activities of commercial banks and how funds mobilised are channelled to investment projects. Besides, the measure effectively discriminates between private sector credit and credit issued to government and other public institutions. Though M2 is a popular measure of financial intermediary development, it has a limitation because difficulty arises as to whether the liabilities are created by the central bank, commercial banks or other depository institutions (Yartey, 2008). The sign of the value of domestic credit to the private sector is expected to be positive, showing that banking sector development promotes stock market development.

A fundamental requirement of a well-functioning stock market is that, it should be easy and speedy to buy and sell securities. In other words, liquidity is essential for the very existence of stock markets. Stock market liquidity enables greater saving mobilisation, increased volume of trades, enhanced investment in the long-term on profitable projects, and ultimately leads to improved capital allocation efficiency and growth of the stock market. In effect, the level of stock market liquidity can be a good measure of the level of stock market development. Two indicators, the value traded ratio and the turnover ratio are commonly used in the literature as indicators of stock market liquidity, even though neither of them directly measures the level of stock market liquidity. The value traded ratio is the total value of traded stocks in the economy as a percentage of GDP, while the turnover ratio is the total value of traded domestic stocks as a percentage of stock market capitalisation. Thus value traded ratio measures the value of transacted stocks relative to the size of the economy, while turnover ratio measures the value of traded stocks relative to the size of the stock market. In this study, the value traded ratio is chosen ahead of the turnover ratio because it measures stock market liquidity on an economy-wide basis (Levine and Zervos, 1998). This variable is expected to have a positive sign because the more liquid the stock market, the higher the stock market capitalisation and development.

The main function of stock markets perhaps is to intermediate between savers and investors and to ensure that funds are transferred between borrowers and savers. Savings and investment are thus expected to influence stock market development. Three indicators are used in this study to measure private capital flows and supply of funds in an economy: gross domestic savings, and gross domestic investment (for domestic sources) and foreign direct investment (for foreign sources). The higher the levels of savings and investments in the economy, the higher the amount of capital flows and the higher the level of stock market capitalisation and development. In this study, savings is measured by the ratio of gross domestic savings to GDP, while investment is measured by the ratio of domestic investment to GDP. Due to unit root problem with gross domestic investment however, an interactive term between the two domestic sources of private capital flows replaces the former. A positive sign of the coefficients is expected between savings and stock market capitalisation and also between the interaction variable of savings and investment and market capitalisation; signifying that higher savings and investment in the economy leads to higher stock market development.

Following the deregulation and liberalisation policy reforms implemented by most developing and emerging countries in the last three decades, foreign investor participation in domestic financial markets has increased tremendously. This increasing participation is associated with growing foreign private capital inflows, which have been suggested as an important determinant of emerging stock market development (Errunza, 1982; Yartey, 2008). Private capital inflows in the form of foreign direct investment are a form of foreign savings and investment and can be a significant determinant of domestic financial development. In this paper, foreign direct investment as a percentage of GDP is used to measure the effect of foreign private capital flows on stock market development. A positive sign of the coefficient is expected since higher private capital flow engenders stock market capitalisation and countries with higher foreign capital inflows are likely to experience more stock market development.

Macroeconomic stability is an important factor that affects the entirety of the economy including stock markets. A stable macroeconomic environment signals economic resilience and increases financial market activities as investor confidence soars. It is thus anticipated that countries with more stable macroeconomic environments would experience increased stock market activities and development, while countries that experience frequent macroeconomic instability would also experience lower levels of stock market development. In the literature, macroeconomic stability of countries is measured by two indicators: CPI inflation rates and real interest rates (see for example, Garcia and Liu, 1999; Yartey 2008; Bayraktar, 2014). Higher inflationary periods are associated with low market confidence, distortion in saving and investment decisions, and low firm investments and profitability among others. Inflation is therefore expected to affect stock market development negatively (McCarthy et al., 1990). Also, higher real interest rates are associated with higher risk. Even though risk is essential for investment due to its positive relation with returns, higher risk negatively influences stock markets. It is thus anticipated that the coefficient of real interest rate would be negative, indicating that countries with higher real interest rates experience lower stock market capitalisation than countries with relatively lower real interest rates.

3.5.2.3 Institutional Quality Variables

Participation in financial markets is highly dependent on the quality of governance and institutions, and how these institutions guarantee protection of investor interests and property rights through effective accountability and enforcement of laws. These are essentially political risk indicators which dominate the factors considered by foreign investors in deciding whether or not to participate in emerging financial markets. Specifically, countries with demonstrably good quality institutions with effective legal protection of investor and property rights, and low political risk should experience greater stock market development. Conversely, countries with weak institutions are likely to lag behind. The influential role that governance and institutional quality play in the development of financial markets has been noted in empirical studies: Erb et al. (1996), La Porta et al. (1997, 1998), Demirguc-Kunt and Maksimovic (1998a), Kaufman et al. (1999), Perotti and Van Oijen (2001), Edison (2003), Yartey (2004 and 2008), Billmeier and Massa (2009), Cherif and Gazdar (2010), and Bayraktar (2014).

Even though different indicators are used in the literature to measure governance and institutional quality, the political risk composite index constructed by the Political Risk

Service (PRS) Group of the International Country Risk Guide (ICRG) has gained prominent application in recent times, with discretely categorised and uniquely measured political risk ratings of countries (Yartey, 2008). The composite political risk index used in this study is thus based on ICRG's categorisation and measurement of the following indicators: bureaucratic quality, corruption, democratic accountability, law and order, and political risk. Table 3.1 below provides a succinct description of these indicators according to the data source. On an a priori basis, in all of these governance and institutional quality indicators, a positive sign is anticipated as higher values are an indication of good quality governance and institutions.

Table 3.1: Description and Measurement of Institutional Variables

Indicator	Description of Indicator	Measurement
Bureaucratic Quality	Bureaucratic quality index measures institutional strength and quality of the bureaucracy in a country. It serves as a shock absorber which tends to minimise reversal of policy in the event of change in government and political leadership. Higher scores are given to countries where bureaucracy is autonomous from political pressure.	Risk ratings range from 1 (lowest bureaucracy quality) to 6 (highest bureaucracy quality).
Corruption	The corruption index measures corruption within the political system of a country which is injurious to foreign investment. Corruption distorts the economic and financial environment, deteriorates business and government efficiency, promotes favouritism and mediocre political workforce, and enhances instability within the political process.	Risk ratings range from 1 (highly corrupt political system) to 6 (least corrupt political system).
Democratic Accountability	The democratic accountability index is a measure of how freely and fairly elections are conducted, and more importantly how responsive the government is to its people. It is more likely that the government will fall if it appears to be less sensitive and less responsive to the people and their needs.	Risk ratings range from 0 (no democratic accountability) to 6 (complete democratic accountability).
Law and Order	The law and order index involves two measures combined to indicate one risk component: the "law" sub-component assesses the strength and impartiality of the legal system, while the "order" sub-component assesses the popular observance of the law.	Risk ratings range from 0 (very weak and highly partial legal system) to 6 (very strong and highly impartial legal system).
Political Risk	The political risk indicator is a composite index which assesses political stability or the likelihood of a country experiencing unconstitutional or violent means to govern. The political risk composite index comprises all the above four risk components as well as factors such as external conflict, ethnic tensions, government stability, investment profile, internal conflict, military strives in politics, religious tensions, and socio-economic conditions.	Risk ratings range from 0 (very high political risk) to 100 (no potential risk). The risk is further classified as: 0-49.9 (very high risk); 50-59.9 (high risk); 60-69.9 (moderate risk); 70-79.9 (low risk); and 80 or above is very low risk.

Source: Author's compilation based on ICRG Risk Rating System of The PRS Group (2015)

3.5.2.4 Global Factors Determining Stock Market Development (G)

Economic theory and evidence underscore the influence of international factors on national economies and financial markets. For example, except for some noteworthy objections such as Rodriguez and Rodrik (1999, 2001: 326), the general consensus in the literature suggests that trade openness or outward-looking policies have a positive effect on economic growth. Arora and Vamvakidis (2004) have found that the growth of a country is affected positively by the relative income level and growth rate of its trading partners. It is also a commonly held view that increasing integration of economies and financial markets has made developments abroad a significant determinant of the development of countries (Arora and Vamvakidis, 2002, 2004). The positive finance-growth link hypothesis of the demand-following view means that, favourable economic and financial conditions of trading partner economies should promote stock market development in the domestic economy. Besides, it has been documented that an open and globally integrated market is more responsive to global events and information, suggesting that global factors play significant role in explaining its progress (Hou and Moskowitz, 2005; Hammoudeh and Li, 2008; Bae et al., 2012; Hooy and Lim, 2013). The experiences of countries such as South Africa, Egypt, Nigeria and other African countries and around the world following the economic and financial crisis in 2008-2009 further lend credence to the above assertion. Improved trade and investment relations between Africa and leading global economies are expected to boost economic and financial development generally in the continent.

The influence of global factors or international macroeconomic and financial conditions such as the growth of trading partner economies, performance of global equity indices, world commodity prices, international macroeconomic stability in the form macroeconomic stability of trading partner countries, and instability in the global financial markets on stock market development in Africa are examined in this study. There are at least two possible channels through which domestic stock market development can be determined by the economic and financial conditions of trade partner economies and leading global stock markets (Arora and Vamvakidis, 2001). One channel is through trade linkages, through which higher income and growth in a trading partner economy contributes to raise import demand and a corresponding rise in net exports, growth and stock market development in the domestic economy. Besides, trade linkages could bring about spillover effects and technology transfers which can improve both the domestic economy and markets. Another channel is through financial linkages which could result in higher flow of foreign direct and portfolio investments from trading partner countries and leading global economies in favour of domestic economies and stock markets in particular. Thus the growth of trading partner economies is expected to have positive and significant influence on domestic stock market development. In this study, growth of trading partner economies is measured by the annual growth rates of the major trading partners of the considered stock markets.

Also, the up and down swings in the global equity index send global information and signals investors the direction of global financial markets. Given that national stock markets are interlinked through various investment instruments including cross-listing, ADRs and other derivative instruments, events in the global markets can be easily transmitted to national stock markets. African stock markets are thus anticipated to directly reflect the movements in the S&P equity indices of influential markets so that a significant positive effect is expected on their development. Instability in the global financial environment in the form of global financial crises will however have an adverse effect on domestic stock market development. The effect of the performance of global equity indices is measured by the S&P equity indices of the G-8 economies, including China, India, Brazil and Switzerland, whereas a dummy variable proxies the effect of instability in the global financial markets.

Also, the stability and instability of the international macroeconomic environment has serious ramification for national economies in general and stock markets in particular. A stable international macroeconomic environment should stimulate investor confidence and participation in stock market activities worldwide. Conversely, international macroeconomic instability will likely induce panic among global investors, lower investor confidence, reduce stock market activities, and possibly retard stock market progress. Due to Africa's global and import dependence and vulnerability, African stock markets can be greatly affected by the macroeconomic environment of global economies and major trading partners. International macroeconomic stability is proxied by the current inflation of major trading partner economies. It is expected to have a negative effect on stock market development, because higher world inflation can inhibit domestic stock market growth through its negative effect on market confidence, savings and investments, income, corporate profitability, and foreign direct investment inflows.

Commodity prices have far-reaching implications for economic growth in general and stock market development in particular. For example, commodity price booms coupled with high price volatility has both positive and adverse effects on both commodity exporters and importers. A number of African countries are dependent on the export of some strategic and global commodities such as gold from South Africa, Ghana and Tanzania, crude petroleum from Nigeria and Egypt, Cocoa from Cote D'Ivoire and Ghana, precious metals from South Africa, Botswana, Morocco, and Namibia, and tea and other beverages from Kenya. These exporters stand to gain from rising foreign exchange and income due to higher commodity prices, but are also adversely affected by higher price volatility which can cause instability in the economy and financial markets.

Table 3.2: A Summary of the Variables in the Modified Calderon-Rossell Model for Africa

Variables	**Description**	**Source(s)**
Stock market capitalisation	The mid-year value of market capitalisation (% of GDP)	WDI 2015
Lagged dependent variable	The one-period lag of market capitalisation	WDI 2015
GDP per capita growth	The annual growth rate of GDP per capita	WDI 2015
Bank credit/Private credit	Bank credit to the private sector (% of GDP)	WDI 2015
Total value traded	Stock market total value traded (% of GDP)	WDI 2015
Gross domestic savings	Gross domestic credit as a percentage of GDP	WDI 2015
Savings and investment	Interaction between gross domestic savings and gross domestic investment	Authors' Calculation
Inflation	Annual inflation rates based on CPI (%)	WDI 2015
Real interest rate	Annual real interest rate (%)	WDI 2015
FDI	Foreign direct investment, net inflows (% of GDP)	WDI 2015
Bureaucratic accountability	A measure of institutional strength and administrative quality in a country	ICRG
Corruption	A measure of corruption in the political system	ICRG
Democratic quality	A measure of adherence to democratic values	ICRG
Law and order	A measure of the strength and impartiality of the legal system and respect for the rule of law.	ICRG
Political risk	A composite index comprising the four above and other risk measures.	ICRG
GEINDEX	The US dollar price change in the stock markets covered by S&P/IFCI and S&P/Frontier indices	S&P, Global Stock Markets Factbook
MTP economic growth	The annual GDP growth rate of trading partner countries	WDI 2015
WCOMP	Annual world prices of global commodities (in US dollars)	IMF, World Bank, World Gold Council
MTP inflation	Annual inflation rates of trading partner countries	WDI 2015
Financial crisis dummy	A dummy variable for global financial crisis, taking the value 1 for 2008-2009 and 0 otherwise.	Authors' calculation

Source: Author's own compilation based own the various sources provided (2015)

Also, as many African countries are import-led economies, rising commodity prices have direct consequences on food and energy security, income and savings, economic growth, and stock market development (Spatafora and Tytell, 2008; Staritz, 2012; Staritz et al., 2013). It is thus anticipated that world commodity prices would be a significant determinant of African stock market development. We measure commodity prices by first determining the major commodity exported by each of the countries involved in the study. The annual world prices (in US dollars) of the following commodities are used: gold prices, oil prices, cocoa prices, precious metals prices, and tobacco prices. The sources of these data are the International Monetary Fund database and World Bank primary commodity prices pink sheets. Table 3.2 provides a summary of the variables used in this study and their sources.

In addition, Table 3.3 summarises the expected signs of the regressors on the basis of economic theory and empirical studies discussed in this section.

Table 3.3: A Priori Sign of Regressors in the Modified Calderon-Rossell Model for Africa

Variable	**Expected Sign**
One period lag of Stock Market Capitalisation	Positive
Real GDP per capita growth	Positive
Domestic Credit to Private Sector by Banks/GDP	Positive
Stock Total Value Traded/GDP	Positive
Gross Domestic Savings	Positive
Inflation, CPI	Negative
Real Interest Rate	Negative
Interaction domestic savings-domestic investments	Positive
Foreign Direct Investment/GDP	Positive
Bureaucratic Quality	Positive
Corruption	Positive
Democratic Accountability	Positive
Law and Order	Positive
Political Risk	Positive
GDP growth rate of world’s leading economies	Positive
S&P Equity Indices of influential global economies	Positive
World primary commodity prices (export commodities)	Positive
International macroeconomic stability indicator	Negative
Dummy for 2008-2009 financial crisis	Negative

Source: Authors’ compilation from the extant literature

3.5.3 Panel Unit Root Implementation

Empirical analysis using panel data requires that the underlying panel series are stationary. Establishing stationarity or non-stationarity of the panel data is achieved by testing for the presence or otherwise of panel unit root. The presence of panel unit root renders the panel series non-stationary which will require some data transformation, such as differencing in order to achieve stationarity. Working with a non-stationary panel can lead to spurious results with false economic relationships overall. The concern for non-stationarity and its associated spurious regressions is more worrying with large N (number of stock markets) and large T (length of the time series) macro panels (Baltagi, 2005: 237). A successful rejection of the presence of panel unit root is considered as evidence that the panel is stationary and suitable for econometric estimation. In this study, the failure to successfully reject the presence of panel unit root leads to either the exclusion of the particular variable or taking its first difference.

A number of methods exist for testing for the presence of stationarity in panel data including Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003), augmented Dickey-Fuller Fisher-type tests developed by Maddala and Wu (1999) and Choi (2001), Harris and Tzavalis (1999), Breitung (2000), and the Hadri (1999) LM stationarity test. These panel unit root tests formulate the null hypothesis as "all panels contain unit root" against the alternative hypothesis that "all panels are stationary". The Hadri Lagrange Multiplier (LM) stationarity test however states the reverse condition for the null hypothesis where all panels are said to be stationary against the alternative that some panels contain unit root.

The Levin, Lin and Chu (2002)[10], hereafter referred to as the LLC test, the Im-Pesaran-Shin, hereafter referred to as the IPS test and the augmented Dickey-Fuller Fisher-type unit root test are implemented in the present study to determine the stationarity or otherwise of the panel series. The LLC test requires a strongly balanced panel. The LLC procedure is most appropriate for moderate-sized panels containing between 10 and 250 individuals with observations ranging between 25 and 250 per individual (Levin, Lin and Chu, 2002). The procedure assumes variable time periods, T which is allowed to tend to infinity but at a rate slower than the number of cross-sectional units, N. The LLC procedure is similar to the Harris and Tzavalis test procedure in relation to the assumption of a common autoregressive parameter for all panels so that the alternative hypothesis is simply rho < 1. The Harris and Tzavalis test however differs from the LLC procedure by the assumption of

[10] The Levin-Lin-Chu test is regarded as the baseline or benchmark panel unit root test in this study.

a fixed number of time periods, T. In particular, the LLC procedure involves examining the null hypothesis ($H_n : \rho_i \equiv \rho = 0 \ \forall \, i$) that each individual time series has a unit root against the alternative hypothesis ($H_a : \rho < 0 \ \forall \, i$) that each series is stationary (i.e. has no unit root) represented as follows:

$$\Delta y_{it} = \alpha_i + \beta_t + \gamma_i t + \rho y_{i,t-1} + \sum_{k=1}^{\rho_i} \delta_i L \Delta y_{it-k} + v_{it} \quad i = 1, 2, .., N; \ t = 1, 2, \dots, T \tag{4.11}$$

with α_i and β_t capturing the effects of both the cross-sectional and time dimensions of the data, respectively. Also $\gamma_i t$ captures discrete deterministic trends in the individual series and Δy as a lag structure to mop up autocorrelation in the model. Given that the lag order ρ_i is unknown, LLC proposes a three-step procedure to perform the test: step 1 involves performing separate ADF regressions for each cross-section based on equation (4.11); step 2 involves estimating the ratio of long-run to short-run standard deviation; and step 3 involves computing the panel test statistic by running pooled regression (Baltagi, 2005: 240). In particular, once the unknown and variable lag order is determined in the first step, two auxiliary regressions are performed to correct the effect of possible disturbance in the asymptotic distribution of the test statistics. First, Δy_{it} is regressed on its lags, Δy_{it-k}, k = 1,…. ρ_i as well as on the exogenous regressors accounting for α_i, β_t and $\gamma_i t$ as preferred and to obtain the residuals e_{1it}. The second regression is then run by regressing the y lagged levels, y_{it-1} on the same variables as previously done and the residuals e_{2it} obtained. The two sets of residuals are then standardised to control for cross-sectional variance differentials using the regression standard error $\hat{\sigma}_{\varepsilon i}$ obtained from each ADF regression equation in (4.11) as in the following equations:

$$\tilde{e}_{1it} = {}^{e_{1it}}/_{\hat{\sigma}_{\varepsilon i}} \tag{4.12}$$

$$\tilde{e}_{2it} = {}^{e_{2it}}/_{\hat{\sigma}_{\varepsilon i}} \tag{4.13}$$

In this case, $\tilde{e}_{1it}$ is comparable to Δy_{it}but this time without the effect of the deterministic components, and $\tilde{e}_{2it}$ being equivalent to y_{it-1}but also without the effect of deterministic components. In the final part, $\tilde{e}_{1it}$ is regressed on $\tilde{e}_{2it}$ and the resulting slope estimate is applied to construct an asymptotically distributed test statistic as a standard normal variant (Brooks, 2014:548).

The Im, Pesaran and Shin (2003) or IPS test relaxes the assumption of a common rho allowing a unique rho for individual panels. The IPS procedure is proposed to rectify a limitation of the LLC approach, where evidence against the non-stationary null in only one series is enough for rejection of the joint null. Given equation 4.11 above, the null and hypotheses under the IPS procedure are then stated as $H_0: \rho_i = 0 \; \forall \; i$ and $H_1: \rho_i < 0, i = 1, 2, \dots \dots, N_1; \; \rho_i = 0, i = N_1 + 1, \; N_1 + 2, \dots, N$. In that case, while the null hypothesis still specifies that "all series in the panel are non-stationary", the alternative hypothesis now specifies two situations; a proportion of the panel series (N_1/N) are stationary, while the remaining proportion $\left((N - N_1)/N\right)$ are not stationary.

The results of the ADF Fisher-type test procedure developed by Maddala and Wu (1999) and Choi (2001) are also reported. Like the IPS procedure, the ADF Fisher-type tests relax the assumption of a common autoregressive parameter (rho) and allow each panel to take on its own parameter. The Fisher-type tests however differ slightly from the IPS procedure. The Fisher-type procedure approaches panel unit root testing from a meta-analysis viewpoint in which unit root tests are conducted on each panel separately and producing eventually an overall test by combining the p-values from the individual tests. In the presence of unparameterised cross-sectional dependence the Fisher-type tests yield more robust results compared with the IPS procedure (Maddala and Wu, 1999). Using such differing panel unit root test procedures will likely yield robust results. The results from the three panel unit root tests are reported in Table 3.4.

Table 3.4: Results of Panel Unit Root Tests

Variable	Levin-Lin-Chu (LLC) Test	Im-Pesaran-Shin (IPS) Test	ADF Fisher-Type (ADF-F) Test
SMD	-7.9248***	-2.8262***	54.7802***
GDPPC growth	-9.7365***	-3.8981***	67.7318***
RGDP growth	-10.4116	-4.5303***	175.4063***
Private Credit	-4.6475**	-1.7536**	57.5407***
Market Value Traded	-7.9820***	-2.4849***	83.0117***
Domestic Savings	-6.7973**	-2.2862***	50.7039***
Investments	-4.6678*	-1.3340	18.5211
Savings-Investments	-5.4015*	-2.3883***	38.4916**
FDI	-7.5959***	-2.4166***	60.7078***
Inflation, CPI	-7.3296***	-3.2203***	56.4602***
Real Interest Rate	-5.6535**	-2.6799***	82.7176***
GEINDEX	-12.4491***	-4.3080***	194.5708***
WCOP	-4.0241**	-0.3880	4.9623
World Econ. Growth	-8.5176***	-2.5465***	67.0028***
MTP Inflation	-7.8873***	-3.0020***	94.9480***

*Notes: The null hypothesis is that panel contains unit root against the alternative hypothesis that all panel series are stationary. ***, ** and * indicate significance at 1, 5 and 10 percent level, respectively. GEINDEX is S&P Global Equity Indices of 12 the world's leading economies including* *the G8 nations; and MTP inflation is the inflation of Africa's major trading partner economies worldwide.*

The results generally support the hypothesis of stationarity at levels. Working with stationary series is very desirable in econometric studies because conclusions reached with such data are reliable.

3.5.4 Estimation Methodology

Generally, estimation of models under dynamic panel methodology can be quite problematic because of the possibility of the presence of a number of associated econometric and technical concerns including:

(i) The presence of time invariant, unobserved country specific effects $\mu_{it} = v_i + e_{it}$ can result in biased and inconsistent estimators (Yartey, 2008).

(ii) The likelihood of endogeneity of regressors, where the relationship between the error term and regressors may not fulfil the orthogonality condition and may lead to a situation where the dependent variable and regressors are jointly determined or exhibit dual-causality.

(iii) The inclusion of a lagged dependent variable, $\mathrm{S}_{\mathrm{i,t-1}}$ as an explanatory variable within a dynamic process and the associated autocorrelation renders the classical OLS method inappropriate as it is likely to yield biased and inferior estimators.

(iv) The Nickel bias where the time horizon, T of the data may be short thereby causing a shock to be carried over to the next period leading to biased results.

(v) The idiosyncratic disturbances may exhibit no correlation across individuals, but yet contain heteroscedasticity and autocorrelation.

(vi) The absence of perfect instrumental variables that can potentially address the requirement of strict endogeneity.

The classical approach to tackle the issue of country-specific fixed effects is to transform the data by first differencing. However, as suggested in Revia (2014), first differencing in the presence of endogeneity and lagged dependent variable will cause downward bias (Nickel, 1981) and produce inconsistent results. The endogeneity problem could be addressed using an instrumental variables (IV) approach and performing two stage least square estimations (2SLS). However, 2SLS estimation is not feasible considering the nature of the regressors involved and the fact that efficient and exogenous instrumental variables are not readily obtainable. The most appropriate and efficient contemporary approach to address the prevailing econometric concerns is to employ Generalised Method of Moments (GMM) estimation techniques (Arellano and Bond, 1991; Bond, 2002; Roodman, 2006; Yartey, 2008; Revia, 2014). The GMM methodology involves two stages in the transformation process. The first stage addresses the country-specific fixed effect by taking the first differences of the series as in the following:

$$\Delta y_{it} = \alpha \Delta y_{i,t-1} + \Delta x_{it}\beta + \Delta\varepsilon_{it} \tag{4.14}$$

Thus the regression model to be estimated can be rewritten in the following form:

$$\Delta \mathrm{S}_{\mathrm{it}} = \delta\Delta \mathrm{S}_{\mathrm{it-1}} + \Delta\Omega \mathrm{M}_{\mathrm{it}} + \Delta\lambda \mathrm{I}_{\mathrm{it}} + \Delta\psi \mathrm{G}_{\mathrm{it}} + \Delta\varepsilon_{\mathrm{it}} \quad \text{where } \Delta\varepsilon_{\mathrm{it}} = \varepsilon_{it} - \varepsilon_{i,t-1} \tag{4.15}$$

This transformation should successfully eliminate the problem associated with the country-specific effect. However, the problem of endogeneity and serial correlation (where regressors are highly correlated with error terms) might still exist. The second stage in the GMM estimation process addresses the possible endogeneity problem by using instruments generated out of lags of the variables. According to Newey and Rosen (1988) and Roodman (2006) the approach is an efficient way of generating instruments. In this approach, the instrumental variables are constructed from the second lag of the dependent variable for each t while missing observations are assumed to be zeros, with the so called "GMM-style incrementing" written in the following form:

$$E[\text{źĚ}] = 0 \rightarrow \sum y_{i,t-2}\hat{e}_{it} = 0\, for\ eact\ t \geq 3\ \ assuming\ that\ E[y_{i,t-2}\hat{e}_{it}] = 0 \tag{4.16}$$

It should be pointed out that two types of dynamic GMM estimations exist in the literature; the difference GMM estimator by Arellano and Bond (1991) and the system GMM estimator by Arellano and Bover (1995) and Blundell and Bond (1998). Whereas the difference GMM approach uses classical procedures in differencing the series and treating suitable lags of endogenous variables as appropriate exogenous variables, the system GMM approach estimates a system of two simultaneous equations. One equation is in levels with lagged first differences as instruments and the second equation is in first difference with lagged levels as instruments. The difference GMM estimator is used in this study as the system GMM estimation technique was not designed for small cross-sectional units and is said to be inappropriate (Andrianaivo and Yartey, 2009). The difference GMM estimation is executed using the equation 4.10 reproduced below as equation 4.17.

$$S_{it} = \alpha_i + \delta S_{it-1} + \Omega M_{it} + \lambda I_{it} + \psi G_{it} + \varepsilon_{it}, \quad i = 1, \ldots N, \quad t = 1, \ldots, \tag{4.17}$$

The dynamic GMM applied in the present study takes the following form:

$$\hat{\theta} = \left(\bar{X}' Z A_N Z' \bar{X} \right)^{-1} \bar{X}' Z A_N Z' \bar{Y} \tag{4.18}$$

where $\hat{\theta}$ equals vector of coefficient estimates on both the endogenous and exogenous regressors, $\bar{X}$ and $\bar{Y}$ denote the vectors of the first differences of all the regressors, Z is the vector of instruments and A_N is a vector that weights the instruments.

3.6 Empirical Results and Discussion

This section presents and discusses the findings of the empirical analysis. The GMM dynamic panel approach formulated in equation 4.17 is implemented in analysing the domestic and global determinants of stock market development in Africa. Prior to implementing the substantive estimation methodology, pooled OLS regression, fixed effect and random effect models were estimated. However, the results from these models were largely inappropriate.

3.6.1 Domestic Determinants of Stock Market Development

Domestic determinants of stock market development are classified into two categories: macroeconomic determinants and institutional determinants. The results of the two types of domestic determinants of stock market development are presented and discussed in subsections 3.6.1.1 and 3.6.1.2 respectively.

3.6.1.1 Macroeconomic Determinants of Stock Market Development

This subsection presents and discusses the results of macroeconomic determinants of stock market development in Africa. In all cases, stock market development is measured by market capitalisation as a percentage of GDP.

The results of GMM estimation are presented in Table 3.5A. Models 1 to 4 show various macroeconomic factors that influence stock market development. Model 1 is the baseline regression with variables such as the one period lagged of market capitalisation ratio, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, and current inflation. The results show that all regressors included in the model, including the lagged dependent variable, GDP per capital growth, bank credit to the private sector, total value traded, gross domestic savings, and current inflation are significant and positively affect stock market development. The Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond serial correlation test tend to support the appropriateness of the model estimated with the GMM technique. The results thus suggest that stock market development is a dynamic process that is influenced by income level, stock market liquidity, banking sector development or financial depth, supply of funds in the economy, and macroeconomic stability.

In particular, the past performance of the stock market significantly and positively affects current stock market performance. Current period stock market development increases by 0.293 percentage point when last year’s market capitalisation increases by a percentage point. Also, income level in the economy is an important determinant of national stock markets. Stock market development increases by 0.025 percentage point when income level (GDPPC growth) increases by a percentage point. In addition, stock market liquidity plays a crucial role in stock market development. A percentage point increase in total value traded (Stock value traded) increases stock market development by 0.314 percentage point. Higher liquidity represents enhanced participation in the stock market by firms and investors, or signals the occurrence of increased volume of active trading, or both. Liquidity improves market confidence and makes firms and investors more willing to commit the level of permanent investments necessary for growth and development of stock markets. Greater liquidity should therefore lead to stock market development.

Banking sector development or financial deepness is also a major determinant of stock market development. Specifically, a percentage point increase in the value of bank credit to the private sector (Private credit) increases stock market development by 0.194 percentage point. As the value of bank credits to the private sector increases, corporation investments in productive projects most likely increase, employment and corporate profitability are greater, the economy becomes more resilient and stock market activities are enhanced. Domestic fund supply is another important determinant of stock market development. In particular, a percentage point increase in gross domestic savings (Domestic savings) increases stock market development by 0.018 percentage point.

Table 3.5A: Domestic Determinants of Stock Market Development (1998-2013)

Difference GMM Estimation

Dependent Variable: Stock Market Capitalisation relative to GDP

Variable	Model 1	Model 2	Model 3	Model 4
Lagged dependent	0.293	0.294	0.282	0.317
	(4.99)***	(4.98)***	(4.64)***	(5.54)***
GDPPC growth	0.025	0.025	0.023	0.013
	(3.20)***	(3.18)***	(2.70)***	(1.99)**
Private Credit	0.194	0.179	0.156	0.179
	(2.18)***	(2.02)**	(1.74)*	(2.03)**
Stock value traded	0.314	0.314	0.315	0.315
	(11.97)***	(11.89)***	(11.70)***	(12.20)***
Domestic savings	0 .018			0.015
	(2.33)***			(2.04)**
Inflation	0.040	0.041	0.035	
	(2.81)***	(2.89)***	(2.43)**	
Saving-Investment		0.016		
		(2.16)**		
FDI			0.014	
			(0.76)	
Real interest rate				0.001
				(0.38)
Constant	1.314	1.317	1.516	1.372
	(5.43)***	(5.38)***	(6.38)***	(5.69)***
Wald Chi2	517.78	513.44	489.80	528.17
	[0.00]***	[0.00]***	[0.00]***	[0.00]***
Sargan Test	152.34	151.99	149.14	165.58
	[0.00]***	[0.00]***	[0.00]***	[0.00]***
1st order autocorre.	-1.852	-1.846	-1.942	-2.175
	[0.064]*	[0.065]*	[0.052]*	[0.030]**
2nd order autocorre.	-1.560	-1.544	-1.382	-1.559
	[0.119]	[0.123]	[0.167]	[0.119]

Notes: *t-statistics are presented in parentheses while p-values are recorded in squared brackets. ***, ** and * indicate significance at 1, 5 and 10 percent level, respectively. Sargan Test is the Sargan test of over-identifying restrictions with formulated null hypothesis as $H_{0:}$ over-identifying restrictions are valid. 1st and 2nd order autocorrelation represent the Arellano-Bond test for zero autocorrelation in first-differenced errors. The null hypothesis in each case is H0: no autocorrelation. In all models, the number of observations is 108.*

Current inflation also has a significant positive effect on stock market development; showing a percentage point increase in current inflation (inflation) increases stock market development by 0.04 percentage point. This result contradicts economic intuition and theory. Normally, rising inflation should have negative effect on stock market development because of its treacherous effect in the form of higher prices, lower consumer purchasing power, declining revenues and profits and sluggish economic activities. However, this unexpected result is not entirely surprising especially from the perspective of African macroeconomic environment. Africa has had a history of high and rising inflation; nevertheless the performance of its stock markets in terms of listings and returns has fared quite well over the years. In fact, high and increasing rates of inflation can be said to be part of African economies, making rising inflation a normal expectation. Under such conditions, businesses, consumers and investors become "acclimated" to higher steady state inflation so that higher expected inflation would have minimal or no effect on their investing and spending decisions. Besides, the positive-significant result in this study may also be an indication that current inflation and stock market development are unrelated in Africa, thus converging with evidence reported in Garcia and Liu (1999) for Latin American and East Asian economies and Yartey (2008) for emerging markets including some African countries.

In Model 2, the interaction of gross domestic savings and gross domestic investment (Saving-Investment)[11] replaces domestic savings to enable the combined effect of savings and investment on stock market development to be examined. The results indicate that lagged market capitalisation ratio, GDP per capita growth, bank credit to the private, total value traded, and current inflation are all significant with positive coefficients. The savings and investment interaction is significant and has the expected positive coefficient. In particular, a percentage point increase in savings and investment interaction (Saving-Investment) increases stock market development by 0.016 percentage point. The Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond test of autocorrelation tend to uphold the appropriateness of the model estimated with the GMM technique.

In model 3, the influence of foreign direct investment (supply of external funds) on stock market development is investigated. To this end, foreign direct investment as a percentage of GDP (FDI) replaces gross domestic savings in baseline Model 1 and savings-investment interaction in Model 2. The result shows that foreign direct investment (FDI) has a positive but statistically insignificant effect on the growth and development of African stock markets. All other variables included in this model, i.e. lagged market capitalisation ratio, GDP per capita growth, total value traded, bank credit to the private sector, and current

[11] The effect of gross domestic investment on stock market development could not be ascertained due to unit root problem (see data and variable description section).

inflation are positive and significant determinants of stock market development in Africa. The Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond test of autocorrelation tend to affirm the appropriateness of this model.

In Model 4, we examined the effect of real interest rate on stock market development by replacing current inflation with real interest rate. The result shows that real interest rate, which measures the impact of macroeconomic stability like current inflation, influences stock market development positively but statistically insignificantly. Again, the lagged dependent variable, GDP per capita growth, bank credit to the private sector, total value traded, and gross domestic savings are all positive and significant determinants of African stock market development. The Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond test of autocorrelation tend to uphold the appropriateness of this model.

3.6.1.2 Institutional Determinants of Stock Market Development

This subsection focuses on examining the effect of governance and institutional quality on stock market development in Africa. To achieve this goal, the GMM estimation procedure was used to analyse the influence of political risk on stock market development and subsequently decomposed the components of political risk to further examine which institutions require considerable policy attention for Africa's stock market development. The results of the GMM estimation are reported in Table 3.5B. In Model 5, we estimated our baseline regression model with the following as regressors: one period lagged of market capitalisation ratio (Lagged Dependent), GDP per capita growth (GDPPC growth), bank credit to the private sector (Private credit), total value traded (Stock value traded), gross domestic savings, (Domestic saving), current inflation (Inflation), and political risk. The results show that lagged market capitalisation ratio, GDP per capita growth, bank credit to private sector, total value traded, gross domestic savings, and inflation have a significant positive effect on stock market development. Political risk unexpectedly shows a negative but statistically insignificant effect on stock market development in Africa. The results thus suggest that previous period stock market performance (Lagged Dependent), income level (GDPPC growth), banking sector development (Private credit), stock market liquidity (Stock value traded), domestic supply of funds (Domestic savings), and macroeconomic stability (Inflation) play an important part in explaining stock market development in Africa. The model estimated by the GMM estimation procedure is supported by the Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond test of autocorrelation.

Table 3.5B: Domestic Determinants of Stock Market Development (1998-2013)

Difference GMM Estimation

Dependent Variable: Stock Market Capitalisation relative to GDP

Variable	Model 5	Model 6	Model 7	Model 8	Model 9
Lagged dependent	0.288	0.274	0.267	0.296	0.288
	(4.82)***	(4.80)***	(4.58)***	(5.03)***	(4.87)***
GDPPC growth	0.026	0.022	0.020	0.024	0.026
	(3.19)***	(2.93)***	(2.51)**	(2.87)***	(3.26)***
Private Credit	0.193	0.211	0.165	0.191	0.198
	(2.16)**	(2.44)**	(1.86)*	(2.15)**	(2.23)**
Stock value traded	0.315	0.328	0.300	0.315	0.314
	(11.95)***	(12.78)***	(11.31)***	(12.02)***	(11.95)***
Domestic savings	0.018	0.027	0.018	0.019	0.017
	(2.33)**	(3.57)***	(2.44)***	(2.47)**	(2.25)**
Inflation	0.040	0.040	0.038	0.039	0.040
	(2.82)***	(2.93)***	(2.74)***	(2.78)***	(2.79)***
Political risk	-0.019				
	(-0.39)				
Bureaucratic quality		-0.425			
		(-4.17)***			
Demo. accountability			0.081		
			(2.54)**		
Law and order				0.028	
				(0.69)	
Corruption					-0.029
					(-0.90)
Constant	1.452	2.000	1.233	1.215	1.377
	(2.63)***	(6.95)***	(5.13)***	(4.31)***	(5.46)***
Wald Chi2 Statistic	515.31	565.89	540.82	523.77	518.86
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Sargan Test	151.639	145.716	152.174	153.040	151.832
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
1st order autocorre.	-1.875	-2.035	-1.810	-1.858	-1.881
	[0.061]*	[0.042]*	[0.070]*	[0.063]*	[0.060]*
2nd order autocorre.	-1.594	-1.632	-1.651	-1.581	-1.540
	[0.111]	[0.103]	[0.101]	[0.114]	[0.124]

Notes: *t-statistics are provided in parentheses and p-values are recorded in squared brackets. ***, ** and * indicate significance at 1, 5 and 10 percent level, respectively. Sargan Test is the Sargan test of over-identifying restrictions with formulated null hypothesis as $H_{0:}$ over-identifying restrictions are valid. 1st and 2nd order autocorrelation represent the Arellano-Bond test for zero autocorrelation in first-differenced errors. The null hypothesis in each case is formulated as H0: no autocorrelation. There are 168 observations in each case.*

In particular, a percentage point increase in last year's market capitalisation ratio (Lagged dependent) increases current stock market development by 0.288 percentage point, while one percentage point increase in income level measured by GDP per capita growth (GDPPC growth) increases stock market development by 0.026 percentage point.

When bank credit to the private sector (Private credit) is increased by one percentage point, stock market development increases by 0.193 percentage point. Also, a percentage point increase in total value traded (stock value traded) increases stock market development by 0.315 percentage point. In addition, a percentage point increase in last year's gross domestic savings (Domestic savings) increases stock market development by 0.018 percentage point. Indeed, internal funds supply in the form of increased domestic savings can improve the availability of funds in the economy which can stimulate higher domestic investment and growth ultimately resulting in enhanced stock market activities, growth and development.

Inflation continues to show significant positive effect on stock market development in Africa, even when the influence of institutional quality such as lower political risk is accounted for in the model. A percentage point increase in inflation tends to increase stock market development by 0.04 percentage point. Even though contrary to economic theory, it suggests that economic agents such as businesses, consumers and investors in Africa appear to have become accustomed to higher steady state inflation and perhaps live in anticipation of higher inflation rates so that saving and investment decisions remain reasonably unaffected by higher inflation. In fact, many generations in Africa have only known higher inflationary periods and have lived with inflation almost throughout their lives, yet domestic savings and investments have improved over time with an associated effect on the growth and development of stock markets. For example, inflation rates for the past 20 years have averaged 17.59 percent in Nigeria, 10.10 in Kenya, 7.91 percent in Egypt, 6.34 percent in South Africa, and 20.30 percent in Ghana (World Bank, World Development Indicators, 2015). On the other hand, inflation has averaged 2.38 percent in the United States, 2.14 percent in the United Kingdom, and 4.12 percent in China within the same two-decade period.

Political risk is a composite measure of the quality of institutions and thus conveys little information regarding which aspect of institutions countries should focus on when providing policy interventions. Thus in Models 6 to 9 in Table 3.5B, we examine the influence of the different components of political risk in order to ascertain the institutional quality effect of stock market development in Africa. In model 6, bureaucratic quality replaces political risk with lagged market capitalisation, GDP per capita growth, bank credit to private sector, total value traded, gross domestic savings and inflation as regressors. The results show that bureaucratic quality negatively and significantly impacts on African stock market development. The implication is that, improvement in bureaucratic quality in Africa resulted in a fall in stock market capitalisation ratio and hence lowered stock market development. This negative influence of bureaucratic quality on stock market development is unanticipated. However, it may be a possibility in most African countries; a situation that is attributable to the strengthening of a weak regulatory environment and institutions. Improvement in bureaucratic quality symbolises enhanced institutional strength and autonomy of administrative institutions to enforce rules and procedures without political influence. Market capitalisation ratio may decline initially following the presence of strengthened institutions which may succeed in creating efficient markets. For example, a stock market that has been dominated by a few listed firms which under disclosed or misreported their losses, corporate governance structures, and unscrupulous business strategy could have operated inefficiently. Nonetheless, strengthened regulatory structures that ensure strict compliance to disclosure and delisting of nonperforming firms can lead to a fall in market capitalisation and lower stock market development for that matter. Such was the case in Nigeria when the Governor of the Central Bank of Nigeria imposed various sanctions on some ten large banks for non-compliance with various guidelines. News about these sanctions, coupled with a post-global financial crisis, may have heightened investor agitation and market panic, impacting negatively on market confidence and performance evidenced in a lower market capitalisation ratio in 2011, but which nevertheless rebounded after compliance reenergised market confidence.

In Model 7, we analyse the influence of democratic accountability on stock market development. Democratic accountability measures the responsiveness of governments to the needs of their people. While more responsive governments adhere to democratic principles such as openness, the rule of law and guarantee of rights and justice, less responsive governments are more susceptible to violence and all forms of political tensions and unrests. Superior democratic accountability stimulates investor and market confidence leading to greater availability of funds and longer term investments which should eventually result in enhanced market activities, market capitalisation and stock market development. The results show that democratic accountability has a positive and significant effect on African stock market development. In particular, a percentage point increase in democratic accountability (Demo. accountability) increases stock market development by 0.081. An implication of the result is that, adherence to democratic values by African countries would work to propagate stock market development and economic growth for that matter and should therefore become a priority issue in national discourses. Also, lagged market capitalisation ratio, GDP per capita growth, bank credit to the private, total value traded, gross domestic savings, and inflation are positive and significant determinants of stock market development. In particular, the dynamic nature of the stock market development process is again supported in Model 7 with the coefficient of lagged market capitalisation ratio indicating that an increase of 0.267 percentage point is realisable in stock market development due to a percentage point increase in the variable. Moreover, a percentage point increase in income level, bank credit to the private sector, or stock market liquidity increases stock market development by 0.02, 0.165, or 0.30 percentage point, respectively. Similarly, a percentage point increase in gross domestic savings increases stock market development by 0.018 percentage point.

The influence of law and order as an indicator of institutional quality on stock market development is examined in Model 8. This is achieved by substituting law and order for political risk in the baseline model. Of course, a good legal system, underscored by its strength, impartiality and respect for the law is important for investment decision making. The results show that law and order is positive but insignificant in explaining stock market development. All other regressors included in this model, such as the lagged dependent variable, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, and inflation imply a positive and significant effect on stock market development.

Subsequently, the effect of corruption within the political system on stock market development in Africa is analysed. This is implemented in Model 9 in which political risk is replaced by corruption. Corruption distorts the economic and financial environments of countries, reduces business and government efficiency, and naturally introduces instability into the political system. Thus corruption in Africa remains a major threat to investors, particularly foreign direct investments and curtails funds flow to productive areas of the economy. Improvement in the fight against corruption in the economy should therefore serve to increase investor and market confidence, improve foreign capital inflows in the form of FDI, and ultimately lead to greater market activities and stock market development. The results indicate that corruption has the expected negative but statistically insignificant influence on stock market development.

3.6.2 Global Determinants of Stock Market Development

In the previous section, it was established that lagged market capitalisation, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, inflation, democratic accountability, and bureaucratic quality are the main domestic determinants of stock market development in Africa. In this section, we examine global determinants of stock market development in Africa. To do this, we introduce global factors successively in the various models containing the domestic factors found to be significant in determining stock market development. The results are presented in Tables 3.6A and 3.6B. In Table 3.6A, democratic accountability measures domestic governance and institutional quality, while bureaucratic quality becomes the domestic governance and institutional quality indicator in Table 3.6B. The results in both cases and for all models tend to be supported by the Wald test, the Sargan test of over-identifying restrictions and the Arellano-Bond test of autocorrelation.

Table 3.6A presents Model 1 as the baseline model with variables such as lagged market capitalisation, GDP per capita growth, bank credit to the private sector, gross domestic savings, inflation, democratic accountability, and performance of global equity indices of leading international stock markets (GEINDEX). The results show that global financial conditions, measured by performance of the global equity indices of the world's influential stock markets (GEINDEX) has a positive and significant impact on stock market development. In particular, a percentage change in the performance of the equity indices of the world's major stock markets, on average, changes African stock market development in the same direction by 0.002 percentage point. Simply put, a percentage point increase in the performance of the global equity indices of the world's leading stock markets increases stock market development by 0.002 percentage point. Domestic factors such as the lagged of market capitalisation (Lagged dependent), income level (GDPPC growth), banking sector development (Private credit), stock market liquidity (Stock value traded), supply of funds in the form of savings (Domestic savings), macroeconomic stability (Inflation), and good quality institutions as measured by democratic accountability (Demo. accountability) continue to be positive and significant determinants of stock market development.

Table 3.6A: Global Determinants of Stock Market Development (1998-2013)

Difference GMM Estimation with Democratic Accountability

Dependent Variable: Stock Market Capitalisation relative to GDP

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged dependent	0.282 (4.82)***	0.281 (4.80)***	0.285 (4.86)***	0.270 (4.42)***	0.305 (5.08)***
GDPPC growth	0.021 (2.62)**	0.018 (2.16)**	0.019 (2.37)**	0.020 (2.51)**	0.018 (2.18)**
Private Credit	0.159 (1.81)*	0.181 (2.04)**	0.154 (1.74)*	0.167 (1.89)*	0.149 (1.69)*
Stock value traded	0.306 (11.55)***	0.300 (11.36)***	0.296 (11.14)***	0.301 (11.27)***	0.308 (11.56)***
Domestic savings	0.017 (2.24)**	0.018 (2.40)**	0.014 (2.46)**	0.018 (2.41)**	0.016 (2.09)**
Inflation	0.045 (3.15)***	0.030 (2.05)**	0.037 (2.65)***	0.038 (2.72)***	0.036 (2.57)***
Demo. Accountability	0.066 (2.04)**	0.082 (2.59)**	0.091 (2.82)***	0.083 (2.25)**	0.083 (2.62)***
GEINDEX	0.002 (2.63)***				
MTP Growth		0.033 (1.72)*			
MTP inflation			-0.053 (-2.19)**		
WCOP				-0.006 (-0.17)	
Financial crisis					-0.107 (-2.44)**
Constant	1.256 (5.24)***	1.102 (4.38)***	1.235 (5.14)***	1.241 (4.98)***	1.179 (4.90)***
Wald Chi2 Statistic	550.08 [0.000]***	548.95 [0.000]***	545.52 [0.000]***	537.03 [0.000]***	551.70 [0.000]***
Sargan Test	146.104 [0.002]***	150.396 [0.001]***	148.883 [0.000]***	151.292 [0.000]***	147.270 [0.002]***
1st order autocorre.	-1.899 [0.058]*	-1.860 [0.063]*	-1.855 [0.064]*	-1.857 [0.063]*	-1.755 [0.079]*
2nd order autocorre.	-1.602 [0.109]	-1.537 [0.124]	-1.683 [0.102]	-1.636 [0.106]	-1.682 [0.103]

Notes: *t-statistics are provided in parentheses and p-values are recorded in squared brackets. ***, ** and * indicate significance at 1, 5 and 10 percent level, respectively. Sargan Test is the Sargan test of over-identifying restrictions with formulated null hypothesis as $H_{0:}$ over-identifying restrictions are valid. 1st and 2nd order autocorrelation represent the Arellano-Bond test for zero autocorrelation in first-differenced errors. The null hypothesis in each case is formulated as H0: no autocorrelation. Number of observation is 168.*

In Model 2, we examine the influence of growth of the economies of major trading and investment partners (MTP Growth) on stock market development in Africa. To this end, performance of the global equity indices of the world's leading stock markets is replaced by the GDP growth rate of African major trading and investment partners. The results show that growth of the economies of Africa’s major trading and investment partners (MTP Growth) is a positive and significant factor affecting its stock market development. In particular, a percentage point increase in the growth of the economies of major trading and investment partners (MTP Growth) increases stock market development by 0.033 percentage point. Also, all domestic factors previously found to be important in explaining stock market development such as lagged market capitalisation, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, inflation and democratic accountability remain major determinants of stock market development. For example, a percentage point increase in the lagged dependent variable, income level (GDPPC growth), bank credit (Private credit), and market liquidity (stock value traded), respectively increases stock market development by 0.28, 0.018, 0.18, and 0.30 percentage point. Also, stock market development would increase by 0.018 percentage point following an initial percentage point increase in gross domestic savings, and 0.082 percentage point is attributable to a percentage point increase in democratic accountability.

The study also examines the influence of major trading partners’ inflation (MTP Inflation) on stock market development. Macroeconomic conditions of trading partners can be transmitted to the economies of their partners, and studies such as Barro and Sala-i-Martin (1995), Edwards (1998), Warner (2002), Arora and Vamvakidis (2002, 2004) have confirmed this positive relationship between trade openness and growth. Stock market development of countries is expected to be influenced positively by favourable macroeconomic conditions but negatively by the macroeconomic instability of trading partner countries. To this end, the inflation of Africa’s major trading and investment partners replaces performance of global equity indices of the world’s leading stock markets in Model 3. The results indicate that higher inflation of major trading and investment partners is a negative and significant factor explaining stock market development. In particular, a percentage point increase in the inflation rates of Africa’s major trading partner countries (MTP Inflation) decreases stock market development by 0.053 percentage point. All domestic determinants such as the lagged dependent variable, income level, banking sector development, stock market liquidity, supply of funds, macroeconomic stability, and good quality institutions as measured by the adherence to democratic values still remain positive and significant in explaining stock market development.

World commodity prices play crucial roles in the development of economies and financial markets. Spatafora and Tytell (2008), in a new IMF study, underscore the growing importance of rising commodity prices and steady good quality institutions and policy frameworks in furthering the integration of emerging and developing economies with the global economy. Commodity price booms and a corresponding surge in the value of exports can lead to economic growth and stock market development through investments, but at the same time can also bring about "resource curse" which has adverse effects on the economy in general and financial markets in particular. World commodity price movements can thus affect an economy and the stock market either positively or negatively. We investigate the effect of world commodity prices on stock market development in Model 4 by substituting world commodity prices (WCOP) for performance of global equity indices of world's leading stock markets. The results show that the effect of the commodity prices indicator (WCOP) is negative but statistically insignificant. The lagged market capitalisation ratio, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, inflation, and democratic accountability remain important in explaining stock market development.

In Model 5, we examine the effect of instability within the global financial markets by using a dummy for the recent global economic and financial crisis as an explanatory variable. Global financial crises and turbulence are expected to affect stock market development negatively because of their associated adverse effects on almost everything including income, savings and investments and economic growth. The dummy for the recent global financial crisis is significant with the correct intuitive sign, suggesting that global financial instabilities (financial crisis) do have an adverse effect on stock market development, and further tends to support the view that Africa's integration with the world may have improved.

In Table 3.6B, the study analyses the effects of these global factors with bureaucratic quality as indicator of good quality institutions. The results presented in Models 6 to 10 show that performance of global equity indices of the world's leading stock markets (GEINDEX), growth of trading partner economies (MTP Growth), and global financial market instability (financial crisis) are significant determinants global factors explaining stock market development.

In particular, a percentage point increase in the performance of leading global stock markets (GEINDEX) and the growth rate of trading partner economies (MTP Growth) increases stock market development by 0.003 and 0.021 percentage point, respectively.

Table 3.6B: Global Determinants of Stock Market Development (1998-2013)

Difference GMM Estimation with Bureaucratic Quality

Dependent Variable: Stock Market Capitalization relative to GDP

Variable	Model 6	Model 7	Model 8	Model 9	Model 10
Lagged dependent	0.287 (5.02)***	0.284 (4.89)***	0.288 (4.99)***	0.248 (4.14)***	0.311 (5.27)***
GDPPC growth	0.022 (2.94)***	0.021 (2.72)***	0.022 (2.90)***	0.020 (2.63)***	0.020 (2.63)***
Private Credit	0.199 (2.31)**	0.221 (2.54)**	0.207 (2.39)**	0.200 (2.32)**	0.197 (2.28)**
Stock value traded	0.331 (12.98)***	0.327 (12.76)***	0.326 (12.73)***	0.325 (12.73)***	0.335 (13.01)***
Domestic savings	0.026 (3.38)***	0.027 (3.46)***	0.025 (3.16)***	0.029 (3.75)***	0.025 (3.22)***
Inflation	0.047 (3.41)***	0.035 (2.42)**	0.040 (2.87)***	0.041 (3.00)***	0.038 (2.76)***
Bureaucratic Quality	-0.435 (-4.27)***	-0.407 (-3.91)***	-0.420 (-4.11)***	-0.432 (-4.32)***	-0.421 (-4.13)***
GEINDEX	0.003 (3.20)***				
MTP Growth		0.021 (1.80)*			
MTP Inflation			-0.036 (-1.54)		
WCOP				0.041 (1.36)	
Financial crisis					-0.101 (-2.34)**
Constant	2.022 (7.05)***	1.888 (6.15)***	2.000 (6.95)***	1.917 (6.56)***	1.945 (6.75)***
Wald Chi2 Statistic	580.01 [0.000]***	566.63 [0.000]***	569.01 [0.000]***	574.42 [0.000]***	575.68 [0.000]***
Sargan Test	136.459 [0.011]**	144.396 [0.003]***	144.858 [0.003]***	145.503 [0.003]***	141.029 [0.005]***
1st order autocorre.	-2.087 [0.037]**	-2.108 [0.035]**	-2.046 [0.041]*	-2.114 [0.035]*	-1.962 [0.079]*
2nd order autocorre.	-1.552 [0.121]	-1.482 [0.138]	-1.684 [0.100]	-1.582 [0.114]	-1.624 [0.104]

Notes: *t-statistics are provided in parentheses and p-values are recorded in squared brackets. ***, ** and * indicate significance at 1, 5 and 10 percent level, respectively. Sargan Test is the Sargan test of over-identifying restrictions with formulated null hypothesis as $H_{0:}$ over-identifying restrictions are valid. 1st and 2nd order autocorrelation represent the Arellano-Bond test for zero autocorrelation in first-differenced errors. The null hypothesis in each case is formulated as H0: no autocorrelation. Number of observation is 168.*

A percentage point rise in global financial instability (financial crisis) however lowers stock market development by 0.101 percentage point. The results further indicate that bureaucratic quality, lagged market capitalisation, GDP per capita growth, bank credit to the private sector, total value traded, gross domestic savings, and inflation continue to be significant domestic factors in explaining stock market development.

The empirical analyses in this study show a number of interesting results. First, the factors influencing stock market development can be classified into domestic determinants and global determinants. Second, income level, banking sector development or financial depth, stock market liquidity, private capital flows or supply of funds, macroeconomic stability, and good quality institutions, and particularly, adherence to democratic values and improvement in bureaucratic quality are important domestic determinants of stock market development in Africa. Specifically, all domestic determinants such as income level, banking sector development, stock market liquidity, and supply of funds or private capital flows have the intuitive positive sign according to economic theory, except inflation. The results further indicate that stock market development in Africa follows a dynamic process in which a market's previous performance highly significantly influences its performance during the next period. Third, important global determinants of African stock market development include international macroeconomic and financial conditions such as the performance of leading global stock markets, the growth of trading partner economies, international macroeconomic stability as measured by trading partners' inflation, and global financial instability in the form of global financial crises. Lastly, even though world commodity prices are crucial in domestic economic growth and stock market development theoretically and empirically, they are not a significant determinant in the present study.

Overall, the results in this chapter, barring some minor variances, are largely consistent with economic theory and empirical studies. On the empirical front, Garcia and Liu (1999) found real income, banking sector development, and saving rates to be positive and significant determinants of stock market development using data from a sample of East Asian and Latin American countries. Naceur and Ghazouani (2007), and Ben Naceur et al. (2007) documented results consistent with those of Garcia and Liu (1999) in studies of the MENA stock markets to the effect that real income, financial intermediary development, and stock market liquidity are significant determinants. They additionally found macroeconomic stability to be negative and significant which is rather inconsistent with the result in the present study. Our result about inflation shows positive significance which also contradicts the finding in Boyd et al. (2001). The significant positive effect of inflation is attributed to the possibility of Africa's uniqueness and the evidence that African economies and financial markets have improved over the years amidst persistently high inflation. The result in this study may also be an indication that current inflation and stock market development are unrelated as reported in Garcia and Liu (1999), and Yartey (2008). In a study of the determinants of stock market development in emerging markets, and in Africa, respectively, Yartey (2007, 2008), and Andrianaivo and Yartey (2009) documented findings which are generally consistent with the findings in this study. Specifically, income level, banking sector development, private capital flows, and good quality institutions were found to be positive and significant determinants of stock market development.

Moreover, the results in this study are largely in agreement with the theoretical view that good governance, quality institutions and effective and efficient legal systems which guarantee transparency, contract enforcement and protection of creditor and property rights are determinants of financial market development in general and stock market development in particular (see Pagano, 1993; La Porta et al., 1997, 1998; Billmeier and Massa, 2009). Baltagi et al. (2007) found that strong economic institutions, including bureaucratic quality, and rule of law, which is an important feature of democratic governance, are significant determinants of financial development. The results in this study are also consistent with Cherif and Gazdar (2010), who in a study of 14 MENA regional stock markets, found evidence that concurs with the view that financial market development largely depends on the adoption of appropriate macroeconomic policies, promotion of competition within the financial system, and the development of strong and transparent institutions and legal frameworks. Also, Revia (2014) in a study of the effect of regulatory environment on stock market development in a sample of 71 countries found positive and robust link between institutional quality and level of sophistication of stock markets. Our domestic determinants in this study are equally in agreement with previous studies such as Huang (2005), Billmeier and Massa (2009), and Afful and Asiedu (2014). In particular, Law and Habibullah (2009) found that real income per capita and quality of institutions are positive and significant determinants of capital market development.

The evidence adduced in the present chapter that stock market development is determined by global factors is both theoretically and empirically founded in the literature. In particular, the performance of leading global stock markets, growth of trading partner economies, macroeconomic stability of trading partner countries, and instability in the global financial markets in the form of financial crises have been found as significant global determinants of stock market development. The trade-growth literature suggests that economic and financial conditions abroad such as growth rates, income levels, and inflation, against the backdrop of increased globalisation and financial integration, can significantly influence domestic growth (Arora and Vamvakidis, 2001). In particular, a positive relationship between trade openness and economic growth has been documented (Greenaway et al., 1998; Arora and Vamvakidis, 2004). Since economic growth leads to stock market development, at least according to the demand following view of the finance-growth link, global factors that affect economic growth are expected to significantly influence stock market development. Besides, studies have documented that globally integrated stock markets are more responsive to global events, and that global factors largely influence their performance (Hou and Moskowitz, 2005; Hammoudeh and Li, 2008; Albuquerque et al., 2009; Bae et al., 2012; Hooy and Lim, 2013). Jouini (2013), in a pure time-series study, found that global factors, such as oil prices, the returns of global equity index, and the United States macroeconomic stability indicator, have significant effects on GCC stock markets. Mensi (2014) documented that global factors, such as the returns of global stock index, commodity prices, global stock market uncertainty, and the United States economic policy uncertainty are influential global factors with significant effect on the emerging stock markets of the BRICS countries. The findings in the present study are largely consistent with the conclusions in these previous studies.

There are policy implications for the findings of this study. First, stock market development is a positive function of economic growth, stock market liquidity, banking sector development, savings and investments. Thus appropriate policy formulation directed at promoting growth, market liquidity, savings and investments, and banking sector development is needed to achieving stock market development in Africa.

Second, good quality institutions are crucial for stock market development in Africa. Stock markets in Africa have had a history of global neglect largely on account of perceived high political risk and high volatility. Thus the adherence to and guarantee of democratic principles such as free and fair elections, respect for human and investor rights, and improvement in bureaucratic quality, targeted at resolving political risk are indispensable for improving capital flows and ensuring stock market development in Africa.

Finally, at the global level, reform packages that ameliorate the adverse effects of liberalisation and integration and safeguard the opportunities associated with greater linkage among stock markets are needed to promote stock market development. These policies and reform sets could emanate from summits of the world's greatest economies such as the G-20 and discussions among regulators of financial markets.

3.7 Chapter Summary and Concluding Remarks

This chapter sought to examine empirically the domestic and global determinants of stock market development in Africa. First, it introduced stock market development and explained the theoretical underpinnings of stock markets, their role in the economic growth process, and sources of differences in stock market development among different economies. Second, it surveyed the empirical literature on the drivers of stock market development which mainly focused on macroeconomic and institutional factors which are domestic in nature. The chapter then discussed the theoretical framework of Calderon-Rossell's (1991) model, specified the estimation methodology based on a dynamic panel modelling technique within GMM estimation, and explained the variables and data from the 12 African stock markets covering the period 1998-2013. Finally, the chapter presented and discussed the empirical results, which turned out to be largely consistent with economic theory and many previous studies. The chapter concluded that both domestic (macroeconomic and institutional) and global factors drive stock market development in Africa. The next chapter investigates the evolving integration among stock markets in African stock markets and between them and the world market.

CHAPTER 4

Evolving Integration of African Stock Markets with the World Market

"We live in a truly networked and interdependent world, united by a global economy…The global stage is in a state of perpetual motion." Kenichi Ohmae (2003:24)

The present chapter focuses on evolving co-movement or integration of African stock markets with the world and thus accomplishes objective two of the study *(i.e. to investigate the evolving co-movements or integration among African stock markets and between them and the world market).* The chapter is structured in nine main sections. Section one presents the introduction and background on stock market interactions. Section two explores the theories of stock market co-movement, while the sources of stock market co-movement are discussed in section three. Section four presents a taxonomy of methodologies used in empirical studies, while a survey of empirical findings relevant to current study is provided in section five. The empirical methodology of this study, the wavelet coherence analysis is specified in section six alongside the DCC-GARCH analytical approach. The data and their statistical properties are also examined in this section. The empirical results and discussion from the wavelet analysis are presented in section seven, while those of the DCC-GARCH analysis are provided in section eight. The chapter summary and concluding remarks are presented in section nine.

4.1 Introduction and Background

African stock markets have witnessed noteworthy growth since their establishment and continue to expand in size and relevance. Historically, stock markets in Africa had been perceived as being generally segmented from the rest of the world. However, evidence from recent studies (Boako and Alagidede, 2016) and media commentary suggest that these markets have become more dependent on other stock markets around the world. Some of these stock markets such as South Africa, Egypt, Morocco, Kenya and Nigeria appear to have established market leadership in their respective regions and may have developed the capacity to influence other stock markets in the African continent. This notion is fundamentally an empirical question relating to stock market integration and co-movement. While empirical studies on stock market integration are numerous in the developed markets and emerging stock markets in Asia, Europe and North America, market integration studies are very few in Africa. In fact, studies investigating the evolving integration or co-movements of Africa stock markets and the world market within a time-frequency framework are nearly non-existent. This obvious gap motivates the present study and in this chapter.

Stock market co-movement dynamics remain a central and continuous issue in economics and finance principally due to its practical implications for international investment strategies in general and portfolio diversification decisions in particular. When stock markets are integrated they become interdependent and tend to co-move and, hence, the advantages potentially available from international diversification may reduce. Concern about global integration of stock markets is a several decades old phenomenon and continues to attract priority attention globally and has in fact intensified since the 1980s. A widely held view currently is that the degree of integration among stock markets around the world has increased significantly over the years (Neaime, 2012; Giovannetti and Velucchi, 2013). A major factor underlying this phenomenal development relates to the decision by most developing countries to undertake various market-oriented reforms to liberalise their financial markets. Key among these reforms are the relaxation of controls on capital movements and foreign exchange transactions, deregulation of the financial sectors, and advancement in communication and technological innovation in financial products such as American Depository Receipts (ADRs) and Country Funds. As a result, there has been significant increase in cross-border activities and capital flows especially to developing and emerging countries, leading to a corresponding rising importance of these markets within the global financial markets. Yet, the increasing integration of the world's stock markets has considerable ramifications for economies and financial markets generally. Integration allows for international risk sharing, lowers cost of capital and promotes capital flows, enhances stock prices, encourages technology transfers, and improves financial systems and economic growth (Prasad et al., 2003); these advantages are non-existent in segmented markets.

Integration can however result in significant short-term costs to companies and markets as greater interdependence is closely associated with spillover effects. These concerns are triggered by the destructive effects of return and volatility spillovers on markets and market participants such as investors, fund managers, and hedge fund managers. In particular, the international portfolio diversification principle developed by Nobel Laureate Harry Markowitz in 1952 underlies the relevance of studies on market integration and co-movements (Graham et al., 2012). The benefits potentially available from sector and geographic diversification may be limited in the presence of greater co-movements or dependence. Overall, studies have reportedly compelling evidence of increasing interdependence and co-movements among stock markets worldwide (Forbes and Rigobon, 2002; Aggarwal et al., 2004; Lee, 2004; Goetzmann et al. 2005; Brooks and Del Negro, 2006; Aslanidis et al., 2010; Syllignakis and Kouretas, 2011; Gupta and Guidi, 2012).

In spite of the increased research interest in the topic, studies on African stock market integration and co-movement are relatively scanty (some of these studies include Alagidede, 2010; Agyei-Ampomah, 2011; Boako and Alagidede, 20116). In recent times however, a number of factors have combined to make the study of African stock markets a timely endeavour. Africa has witnessed significant strides in economic and financial development, albeit that its contribution to international trade and capital flows remains insignificant by global standards. Importantly, African stock markets have actively partaken in the surge in the world stock markets over the past few decades. Currently, 3 of the 29 stock exchanges are categorised as emerging markets (South Africa, Morocco, and Egypt) and 9 as frontier markets (Botswana, Cote d'Ivoire, Ghana, Kenya, Mauritius, Namibia, Nigeria, Tunisia, and Zambia)[12].

Also, recently implemented legislative and policy shifts have significantly improved the political and regulatory environment leading to rising foreign investments in most African countries. Moreover, African markets have mostly offered some of the highest returns around the world. Admittedly, some worrying institutional and regulatory conditions still remain in most African countries which sets them apart from stock markets elsewhere in the world. Nonetheless, given recent progress by most stock markets in Africa, empirical research about their interdependence is undoubtedly desirable.

This chapter contributes to the literature on international financial integration with specific reference to stock market co-movement (integration) by investigating the evolution and strength of global and regional integration or co-movement of stock markets in Africa. To this end, two important empirical questions in the literature are investigated and analysed: (1) has the co-movement dynamics of African stock markets with global markets evolved over time and in scale? (2) did intra-regionally and inter-regionally co-movements of African stock markets improve overtime time and in frequency? Specifically, this chapter is unique for a number of reasons. First, the eleven stock markets used in the study

[12] The classification is according to Standard and Poor's (S&P) Annual Country Classification (2014).

represent the largest stock markets in Africa with three of them classified as emerging markets and the remaining eight as frontier markets according to Standard and Poor's BMI country classification. The markets are active members of the African Securities Exchanges Association (ASEA) which are working in close collaboration to create a Pan-African stock exchange. The markets have undertaken various levels of market-oriented reforms, and have collaborated and fashioned a number of common policies to harmonise their trading practices, develop automated trading systems, encourage cross-border listing of shares, and promote inter and intra-regional trade in Africa. These efforts may have improved global confidence in African markets and impacted on investor confidence and participation, and for that matter market integration and co-movement may have evolved over time and space.

Second, the chapter is also unique because the study not only examines whether African stock markets are integrated or not with each other and with the rest of the world, but also, whether co-movements among African stock markets and between them and the world market have been evolving. It is important to note that, by their unique characteristics, African stock markets may exhibit low integration with world stock markets, but evidence of evolution of their integration would have important ramifications for policies of governments and portfolio diversification decisions. The study further explores intra-regional and inter-regional co-movements (i.e. co-movements within the various regional locations such as East Africa, Southern Africa, North Africa, and West Africa versus co-movements between markets in different regions). In essence, the study sheds light on the scope for portfolio diversification opportunities in Africa for continental and global investors, portfolio managers and hedge funds in African markets.

Third, compared with previous studies within the African context, this chapter also makes a major methodological contribution to the literature on African market integration. The empirical questions in the present study are addressed using wavelet coherence analysis and multivariate DCC-GARCH analysis. The vast literature on stock market integration is not limited only to investigating co-movements among leading global stock markets and emerging markets to the neglect of Africa, but has mostly applied only time-domain methods in the analysis. Stock markets are complex systems of constant interaction among sophisticated investing agents with divergent term objectives and investment horizons. The relevant time series from this intricate process are thus the result of a combination of different components operating at different frequencies (Uddin et al., 2014). Consequently, the standard time series econometric approaches, which are not capable of jointly analysing both frequency domain and time series components, tend to lose relevant information. Specifically, frequency-based analyses cannot capture the time series aspects of the data, and analyses based on pure time series methodology cannot capture the frequency domain aspects of information. Therefore, the implementation of wavelets analysis in this study has the rare utility of allowing both the frequency domain and time series aspects of data to be investigated contemporaneously. More importantly, the approach allows us to examine stock market co-movements at different frequencies over time without sacrificing the time series information of the interdependence. Essentially, it takes into account investors' investment horizons as it enables the simultaneous assessment of short-and long-term co-movements among stock markets and also detects changes in co-movements over time (Graham et al., 2013). Thus interactions among stock markets which otherwise would have been concealed using conventional econometric methods are uncovered. Besides, wavelets approach is essentially model-free, thereby allowing its robust procedures to be analysed in comparison to pure time series estimation methods such as the DCC-GARCH, which are essentially based on models and parameters. Such a fresh contribution in the context of African stock markets is more than enough to inform policies and provide extremely valuable information for risk management and investment decisions in the African region and beyond.

4.1.1 The Concept of Financial Market Integration

A general view that expresses that extent of financial market integration is that the world has become "one big integrated marketplace". However, no single approach exists in the literature to determine the extent of international financial market integration. Kearney and Lucey (2004) suggest three basic approaches, each of which is either a direct or an indirect measure of international financial integration. While the first approach is a direct measure, the last two approaches are indirect. The first measure defines financial market integration in terms of the equalisation of rates of return across different countries for financial assets with similar maturity and risk characteristics. This approach applies the law of one price which suggests that assets with identical risk characteristics should attract the same return. The conditions of covered interest parity (CIP), uncovered interest parity (UIP), and real interest parity (RIP) have been used as alternative measures to this approach. Allan Deardorffs' definition encapsulates this quite well by defining financial market integration as:

"freedom of participants in the financial markets of two countries to transact on markets in both countries, thereby causing returns on comparable assets in the two countries to be equalised through arbitrage."(Alan Deardorffs' Terms of Trade: Glossary of International Economics)[13]

Putting Allan Deardorffs' definition in perspective, in a context where cross-listing of shares exists; it is easier for investors across the globe to buy or sell stocks either from the domestic stock market or foreign equity market. But Vermeulen (2010) contends that market integration should not be construed as a static phenomenon but instead, should be defined as a process that evolves over time. This argument is in line with the definition by Tahari et al. (2007) who broadly describe financial market integration as follows:

"It is the process through which financial markets of several countries remove restrictions on cross-border financial flows and on foreign entry into the domestic financial system so that all potential participants, local and foreign, in a market are subject to the same rules and have equal access."

In a related description, Baele et al. (2004) define an integrated financial market in the following words:

"The market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide to deal with those financial instruments and/or services; (2) have equal access to the above-mentioned set of financial instruments and/or services; and (3) are treated equally when they are active in the market."

This definition has three important characteristics: (1) the definition is independent of the financial structures of countries; (2) frictions in the process of intermediation concerning whether capital should be accessed through or invested in financial markets or financial institutions can continue even after the completion of the financial integration process; and (3) full integration of financial markets requires that investors (demand side for investment opportunities) and firms (supply side of investment opportunities) have equal access to investment opportunities regardless of their origin and without any forms of discrimination. It thus presupposes that a stock market can be completely segmented, partially integrated or completely integrated with the rest of the world financial markets.

[13] This glossary is available and accessible online via: http://www- personal.umich.edu/~alandear/ glossary /f.html#FinancialMarketIntegrationn. Accessed on 15/07/2014.

The second approach defines financial market integration based on the concept of capital market completeness proposed by Stockman (1988), which is quite similar to the previous definitions. Accordingly,

> "*financial integration is perfect when there exists a complete set of international financial markets that allows economic and financial market participants to insure against the full set of anticipated states of nature.*"

A prerequisite for such a perfectly integrated financial market requires the efficient functioning of a more complete set of markets where security availability and volume ensure that investment outcomes are not constrained.

The third approach measures financial market integration in terms of the extent to which domestic investment is financed by borrowings abroad instead of using domestic sources of finance (Feldstein and Horioka, 1980). This view is known as the Feldstein-Horioka hypothesis of perfect capital mobility premised on the assumption that capital is perfectly mobile between countries and flows to those countries where returns are highest.

Consequently, there is no consensus regarding a generally accepted measure of financial market integration, even though the extant literature provides evidence of increasing integration of world stock markets (Pukthuanthong and Roll, 2009). For our purposes in this chapter, even though stock market co-movement is a specific dimension of stock market integration, we use the two interchangeably. We measure co-movement by the extent of correlation or interdependence between stock markets and how the interaction evolves over-time and in space. In this chapter therefore, stock market integration and stock market co-movement refer to the same thing.

4.2 Theories of Stock Market Co-movement[14]

Asset returns are said to exhibit several patterns of co-movement. Strong common factors exist among the returns of different assets such as stocks in the same industry, small-cap stocks, value stocks, closed-end funds, and bonds of same risk characteristics and maturity. Common movement also exists among individual stocks within national markets and international stock markets (Barberis et al., 2005). There are two broad theories of co-movement of stock markets; the traditional theory also known as the fundamental-based view, and the alternative view known as the friction-or sentiment-based theory of co-movement (Barberis et al., 2005). The traditional theory of co-movement, which assumes

[14] This review is based heavily on Barberis, Shleifer and Wurgler (2005) model.

the presence of frictionless economies with rational investors, holds that co-movement in stock prices and returns represents co-movement in asset fundamental values. According to this theory, assets are priced at their risk levels and as such co-movements in prices must be attributable to co-movements in economic fundamentals such as inflation and interest rates, among other macroeconomic variables. Thus under the fundamental-based theory of co-movement, the returns of two assets are correlated when changes in the fundamental values of the assets concerned are correlated. By implication, two stock markets may exhibit common movement if they share common economic fundamental factors so that correlated changes in these economic fundamentals will induce stock market co-movement. Economies may however not be in accordance with the prescription that motivates the fundamental-based view of the theory of stock market co-movement.

Economies that experience frictions or the presence of irrational investors and where arbitrage activities are limited, co-movement in stock prices is delinked from co-movement in fundamentals (Barberis et al., 2005). Such circumstances are the reason for the second broad class of "friction-based" and "sentiment-based" theories of co-movement. Three specific views describe the friction-or sentiment-based theories of co-movement; these are the category, habitat and information diffusion views.

The category view of the friction-or sentiment-based theory of stock market co-movement, according to Barberis and Shleifer (2003) is used by investors in making portfolio allocation decisions. Barberis and Shleifer (2003) contend that many investors, rather than allocating funds at the individual asset level in their portfolio allocation decision-making, would instead group assets into categories such as small-cap stocks, value stocks, mining industry stocks, etc. and then allocate funds at the level of these categories. This practice can induce stock price or stock return co-movement especially if some of the investors who are using the categories are noise traders with correlated sentiment and if prices can really be affected by their trading. As investors allocate funds between categories in a coordinated fashion, common factors are induced in the returns of the assets which are classified into the same category, resulting in co-movement.

The second view of co-movement, the habitat view, is based on the premise that many investors are observed to prefer trading only a subset of all available securities and such preferred habitat remains the sole holding of these investors (Barberis et al., 2005). International trading restrictions, lack of information, and high transaction costs are some of the factors suggested for motivating the creation of preferred habitat. A common factor in the returns of assets is induced eventually as investors modify their exposure to securities in the preferred habitat due to changes in their risk aversion, sentiment or liquidity needs. The prediction of the habitat view suggests that the returns of assets that are held and traded by a particular group of investors are likely to exhibit co-movement.

The third view of information diffusion of the friction-or sentiment-based theories of co-movement according to Barberis et al. (2005) holds that the incorporation of information on the prices of stocks is asymmetric. The arrival of new information is incorporated more rapidly in the prices of some stocks than others due to market frictions such as the presence of less costly stocks, or stocks which are held by investors with superior access to relevant news and requisite resources. An implication is that, the incorporation of information in the prices of stocks at comparable rates induces a common factor in the returns of assets. For example, the prices of some stocks will reflect the good news about an aggregate earnings announcement by rising together almost immediately, while the prices of other stocks will gradually incorporate the good news and eventually move up together, but only after some lagged period.

A reduced-form of the theoretical models of these three views of co-movement according to Barberis et al. (2005) can be formally presented. Consider an economy that has a riskless asset that faces a perfectly elastic supply with zero rate of return, and that also has 2n risky assets in perfectly inelastic supply. A risky asset i can be thought of as a claim on a single liquidating dividend $D_{i,T}$ which is payable at some time T in the future. The expectant dividend can be represented as follows:

$$D_{i,T} = D_{i,0} + v_{i,1} + \cdots + v_{i,T} \tag{4.1}$$

where $D_{i,0}$ and $v_{i,T}$ are announced at time 0 and time t, respectively, and

$$v_t = \left(v_{1,t}, \ldots, v_{2n,t}\right)^{\dagger} \sim N(0, \Sigma_D), i.i.d. \text{ over time.} \tag{4.2}$$

Assuming that asset return is simply denoted by the change in the price of the asset and that $P_{i,t}$ represents the price of risky asset i at time t, then the return on the asset between two successive periods (i.e. t – 1 and t) can be obtained as

$$\Delta P_{i,t} = P_{i,t} - P_{i,t-1} \tag{4.3}$$

On the basis of these assumptions, some investors, in making portfolio allocation decisions may group the 2n risky assets into two categories, such as A and B, and then allocate funds at the levels of these categories instead of allocating the funds at the levels of the individual assets. Specifically, category A may contain securities 1 through n, while category B could hold assets n + 1 through 2n. Barberis et al. (2005) suggest that the two categories could be thought of as representing "old economy" and 'new economy" securities. It can be shown that asset returns may be significantly influenced by additional factors if noise traders, who move funds between categories according to their sentiment, adopt these categories. Asset returns can then be represented as:

$$\Delta P_{i,t} = v_{i,t} + \Delta\vartheta_{A,t}, \qquad i \in A \tag{4.4}$$

$$\Delta P_{j,t} = v_{i,t} + \Delta\vartheta_{B,t}, \qquad j \in B \tag{4.5}$$

where

$$\begin{pmatrix}\vartheta_{A,t}\\ \vartheta_{B,t}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \sigma_{\vartheta}^2\begin{pmatrix}1 & P_{\vartheta}\\ P_{\vartheta} & 1\end{pmatrix}\right), \qquad \text{i.i.d. over time.} \tag{4.6}$$

In the above representations, $\vartheta_{A,t}$ and $\vartheta_{B,t}$ respectively denote noise traders' sentiment about the assets in categories A and B at time t which are independent and identically distributed (i.i.d) random variables. The sentiment level for all assets in a particular category is the same for all noise traders since these investors apportion funds by category. Specifically, equations (4.4) and (4.5) signify that the return on an asset in categories A and B is respectively influenced not only by news about fundamentals such as cash flows, $v_{i,t}$, but also by changes in investors' sentiment about category A, $\Delta\vartheta_{A,t}$ and category B, $\Delta\vartheta_{B,t}$. For example, the prices of stocks in a particular category plummet when these noise traders become more bearish in their trading. Thus stock prices, and stock returns for that matter, in the same category tend to move together in the same direction, induced by correlated behaviour and sentiment of investors.

The above explanations can be extended to model the habitat view of stock price co-movement. In that case, categories A and B in equations (2.4) and (2.5) now represent habitats instead, and for that matter, they no longer represent asset groups that some investors are indifferent about when allocating funds. Essentially, as habitats, they are groups of assets that must be held by some investors. In the view of Barberis et al. (2005) these two habitats could then be thought of as representing US stocks in the case of assets

1 through n and UK stocks in the case of assets 1 + n through 2n. In fact, several investors are reportedly holding and trading in only domestic stocks in the two countries. Under the habitat view of the friction-or sentiment-based co-movement, $\vartheta_{A,t}$ and $\vartheta_{B,t}$ are interpreted to track the risk aversion, liquidity needs, or sentiment of investors who invest or trade only in the assets in habitat A and habitat B, respectively. In effect, the return of a security in either habitat is not only affected by news about asset cash flows but also by changes in the investors' risk aversion, sentiment and liquidity needs.

Also, the information diffusion view of the friction-or sentiment-based view of co-movement can be similarly modelled in the following representations:

$$\Delta P_{i,t} = v_{i,t}, \quad i \in A \tag{4.7}$$

$$\Delta P_{j,t} = \vartheta v_{i,t} + (1 - \vartheta) v_{j,t-1}, \quad j \in B \tag{4.8}$$

Under the information diffusion view of co-movement, A and B represent groups of stocks which by some reasons exhibit different rates in the incorporation of new information in their prices. While securities in group A incorporate news arriving at time t immediately, stocks in group B incorporate only a fraction ϑ of time t news instantaneously with the remaining fraction $1 - \vartheta$ reflecting in the asset prices in the next period. It is argued in the literature that for stock prices to be affected by the flow of funds of category-based noise traders or investors with preferred habitats according to the predictions in equations (2.4)-(2.5), or for information to be incorporated into security prices with delay, as suggested in equations (2.7)-(2.8), there must be some limits to arbitrage somehow, perhaps due to the short-term nature of arbitrageurs (De Long et al., 1990; Shleifer and Vishny, 1992; and Barberis et al., 2005). For example, Barberis et al. (2002) demonstrated convincingly that stock returns follow the predictions according to equations (2.4)-(2.5) in an economy in which rational arbitrageurs interact either with category-based noise traders or investors with preferred habitats.

There is substantial growing evidence that lends support to the friction-or sentiment-based theories of co-movement. For example, in a pioneering study to examine changes in the market betas of stocks added to the S&P 500, Vijh (1994) reported that, contrary to the traditional view of co-movement which predicts no change in the correlation between the returns of stocks added to an index and the returns of other stocks, stocks added to NYSE and AMEX experience significant increase in their betas. Other studies confirming the alternative view of co-movement include Fama and French (1995) who found difficulty in relating the strong common factors in the returns of small stocks and value stocks to common factors in news about earnings, Froot and Dabora (1999) who reported delinked returns of Royal Dutch shares from the returns of Shell shares even though the two securities have the same fundamental value because they both are claims to the same cash-flow stream, and Wurgler and Zhuravskaya (2002) who reported strong price effects for stocks included in the S&P 500 while Greenwood (2004) documented comparable effects on stock prices following inclusion in the Nikkei 225 indices, respectively. Barberis et al. (2005) also revisited the return to additions to the S&P 500 and reported fresh evidence that support the friction-or sentiment-based theories of stock price co-movement.

4.3 Sources of Stock Market Co-movements or Integration

The interactions among international stock markets may have strengthened for various reasons. Frequently cited reasons why national stock markets may have become more integrated with each other and with the rest of the world include deregulation and financial liberalisation policies of countries relatively stable economic, political and more market-oriented environments, technological advancements in communications and computerised trading systems, rapid growth in innovative financial products, such as country funds and American Depository Receipts (ADRs), and increasing activities by multinational corporations (see for example, Jeon and Chiang, 1991; Longin and Solnik, 1995; Agenor, 2003; and Yu and Hassan, 2008). A firm understanding of the sources of stock market integration is important. The extant literature has discussed the sources of stock market integration mainly along the following divisions: economic integration, financial liberalisation, stock market characteristics, and financial crisis.

4.3.1 Economic Integration

Stock market integration is itself a part of the broader concept of economic integration Bracker and Kock (1999) posited that the degree of integration across international capital markets at any point in time depends on the degree of economic integration across the underlying countries. The notion is that the more the economies of a pair of countries are related, the more interdependent or integrated their stock markets are likely to be. These markets thus co-move, rising together during some periods and falling together during other periods. It has been argued that greater stock market integration is a natural consequence of greater economic integration (Eun and Shim, 1989). In fact, studies have shown that financial integration is significantly influenced by the extent of real economic integration, measured by the correlation of business cycles of the underlying economies (Fama and French, 1989; Ferson and Harvey, 1991; Jagannathan and Wang, 1996). Also, the degree of market co-movements usually peaks mostly during recessionary periods (Erb et al., 1994). Industry similarities or differences between countries also matter. Roll (1992) decomposed individual stock returns into country and industry components and finds that stocks from different national markets but in the same industry are highly correlated, suggesting that countries with similar industry composition in their stock markets are likely to experience greater co-movements. Studies have further shown that the stability of the correlation structure over time greatly depends on the real economic interactions among countries (Roll, 1992; Bracker and Kock, 1999). For example, Phylaktis and Ravazzolo (2002) examined the real and financial links for a group of Pacific-Basin countries and find overwhelming evidence at the regional and global levels that stock market integration is accompanied by economic integration. Economic integration does appear to provide a channel for stock market integration.

Economic integration takes many forms, but the two most important forms are macroeconomic variables (Bracker et al. 1999; and Dornbusch and Claessens, 2000) and the formation of trade and currency blocs (Kim et al. 2005; Hardouvelis et al., 2006; Kenourgios et al., 2009; Buttner and Hayo, 2011). Stock market integration can heavily depend on macroeconomic factors (Bracker et al., 1999). Also, Pretorius (2002) found the extent of bilateral trade to be significant in explaining cross-country correlations in emerging markets. Karim and Ning (2013) revealed that bilateral trade and volatility significantly influence market integration in the ASEAN region. On the formation of trade and currency blocs, Hardouvelis et al. (1999) found that the degree of integration is closely related to the probability of a country becoming a member of the European Union. Yang et al. (2003) also documented evidence of strengthened stock market integration among EU member countries. For Aggarwal et al. (2004) it was not until the establishment of the EMU and the ECB[15] that the notion of market integration became a reality among member countries. Buttner and Hayo (2011) reported that the introduction of the Euro led to greater stock market integration.

4.3.2 Financial Liberalisation

Financial liberalisation policies have inherent explanatory power regarding the strengthened and increased integration of world stock markets. Formal liberalisation

[15] ECB stands for European Currency Board.

initiatives towards integrating global markets began in the US in 1975 with the deregulation of stock brokerage commission rates. It was experienced in Europe with the abolition of the UK exchange controls on capital outflows and with the opening up of the German capital markets to foreign investors in 1979, and resonated in Asia by the 1980s with the removal of exchange controls on capital outflows in Japan. By the late 1980s and early 1990s many emerging and developing economies, on account of the advice of the Bretton Woods Institutions, had undertaken a number of liberalisation initiatives. Chinn and Ito (2007) confirmed that the world is moving steadily towards greater financial openness, which further points to the extent of financial liberalisation. Formerly segmented national markets, prior to initiating any liberalisation measures, are often found to have been greatly integrated after embarking on one market liberalisation policy or another. For example, Gultekin et al. (1989) found evidence to the effect that the US and Japan were initially segmented but subsequently became integrated following the liberalisation of the Japanese capital markets. Hence, capital account liberalisation is a major source of capital market integration. Taylor and Tonks (1989) found evidence suggesting that the abolition of the UK exchange controls regime has had significant influence on the integration of the UK and other leading stock markets. Ten years ago, Quinn and Voth (2006) reported convincing results of greater integration of world markets due to capital market liberalisation. In contrast, Byers and Peel (1993) and Chelley-Steeley et al. (1998) found evidence of falling cointegration relationships among markets, suggesting that the removal of exchange controls in many major European countries did not bring about increased integration among those markets or between them and the rest of the world.

In the emerging markets, Bekaert and Harvey (1995) reported evidence of major shifts in the degree of integration in some emerging markets after liberalising their stock markets. Phylaktis and Ravazzolo (2005) reported evidence of strengthened stock market integration among a group of pacific-Basin markets, Japan and the US following the relaxation of exchange control restrictions in the 1990s. Eizaguirre and Biscarri (2006) similarly noted significant effects of the liberalisation of emerging markets on volatility, while Phuan et al. (2009) revealed a significant increase in both short- and long-run relationships following deregulation in Thailand, Malaysia, Indonesia and the Philippines. Also, Arouri et al. (2010) investigated the stock market integration dynamics of the Philippines and Mexican markets to determine whether or not the integration dynamics are symmetric, complete, continuous, constant, or linear. The findings point to nonlinear integration with the world market.

Cross-listing of shares on foreign stock exchanges has further stimulated greater integration among national stock markets. Cross-listing is similar in spirit to liberalisation policies that open up the stock market, since foreign investors are able to invest in securities which otherwise would have been restricted by national borders. Cross-listed financial securities are assumed to be driven by long-term fundamental values which are the same as those in the domestic markets and should thus have identical prices irrespective of the trading location. Any prevailing price discrepancy between the two markets will induce arbitrage activities which should cause prices to realign and stock markets, where securities are cross-listed to be integrated. This view is supported by empirical evidence (see for example, Ng, 2000; Hansda and Ray, 2003; and Karolyi, 2004). In particular, Adelegan (2008) found evidence of significant positive effects in the indicators of stock market depth around regional cross-listing events in Sub-Saharan African (SSA) markets. The evidence further points to greater correlations among stock markets with cross-listings than between markets without cross-listings.

4.3.3 International Financial Crisis

Financial crisis has also been suggested as an important source of integration among international stock markets. Periods of financial crisis or market crashes are often characterised by falling asset prices, intense speculative runs, and widespread capital flight leading to greater instability in financial markets and with the tendency to stimulate greater stock market linkages. Financial "contagion effect"[16], defined as significant increases in cross-market correlations (Forbes and Rigobon, 2002) unexplained by macroeconomic factors, is often blamed for the increased linkages among stock markets during crisis periods. The contagion effect involves transmission of shocks among countries or financial markets. Reasons linked to this kind of behaviour include financial panic, investor herding, increased risk aversion and loss of confidence (Dornbusch et al., 2000). The financial contagion literature summarises four types of transmission channels through which the contagion effect spreads during financial crisis: the correlated information channel (Von Furstenberg and Jeon, 1989; King and Wadhwani, 1990; and Pritsker, 2000) or the work-up call hypothesis (Sachs et al., 1996; and Goldstein, 1998), the liquidity channel (Claessens et al., 2001; and Forbes and Chinn, 2004), the cross-market hedging channel

[16] Contagion occurs when there is significant comovement as measured by correlations among capital markets following a crisis period which comovements are unaccounted for by economic fundamentals. In contrast, interdependence occurs both during tranquil and crisis periods which comovements are explained by common fundamental factors. See Forbes and Rigobon (2000, 2001, and 2002) for extensive discussions on contagion effects.

(Kodres and Pritsker, 1999; and Calvo and Mendoza, 2000), and the wealth effect channel (Kyle and Xiong, 2001). The determination of contagion follows the hypothesis that the return on the ith stock market index, r_i, depends on a set of common macroeconomic factors, M traditionally, and an idiosyncratic residual component, μ (Pritsker, 2000) expressed in the following equations:

$$r_i = f(M) \tag{4.9}$$

$$r_i = \alpha_i + \beta_i M + \mu_i \tag{4.10}$$

Correlation of the residuals between any pair of countries or markets could be interpreted as an indication of contagion since it represents co-movement that is unexplained by macroeconomic variables. Despite the fact that financial contagion is still being debated by economic scholars and the contention around it intensifies, majority of the studies that attempted to test contagion effects reported the contagious nature of financial crises (see for example, Roll, 1989; King and Wadhwani, 1990). Studies that contend the existence of contagion during crisis however concur that there is often increased interdependence (see for instance, Forbes and Rigobon, 2002). For example, Arshanapalli and Doukas (1993) showed an increase in the linkage between the United States and France, Germany and the United Kingdom post 1987 crash; although Japan was the exception. Also, most Asian markets were said to have become more integrated with the US market in the same market crash (see for example Arshanapalli et al. 1995; and Hung and Cheung, 1995). Collins and Biekpe (2003) report evidence suggesting that some African stock markets such as South Africa and Egypt showed evidence of contagion from the Asian financial crisis, but Forbes and Rigobon (2002) reported otherwise.

With regard to the recent global financial crisis, Samarakoon (2011) reported evidence of contagion in frontier markets from the United States as well as contagion to the United States from emerging markets. The recent global financial crisis also induced contagion effects in the US and German stock markets and seven emerging Central and Eastern European markets (Syllignakis and Kouretas, 2011). Similarly, Dimitriou et al. (2013) provide evidence which initially supports the decoupling hypothesis for most of the BRICS markets at the early stages of the crisis; but it exhibits recoupling and the presence of the contagion effect for nearly all BRICS markets following the collapse of the Lehmann Brothers in the United States.

Morales and Andreosso-O'Callaghan (2012) however reported that there was no contagion effect emanating from the US markets to the Asian stock markets even though strong evidence of volatility transmission was detected. The findings in Morales and Andreosso-O'Callaghan (2012) lend support to earlier evidence in Pretorius (2002) whose argument suggests that contagion is actually smaller than thought, and Phylaktis and Ravazzolo (2005) who showed that there was minimal effect of the Asian financial crisis on the integration of stock markets in the Pacific-Basin region.

Nonetheless, researchers are still divided as to whether the strengthened international linkages induced by financial crisis are permanent or temporary. Malliaris and Urrutia (1992) reported the absence of any significant lead-lag relationships for the pre-and post-1987 crisis even though there was dramatic increase in contemporaneous causality in the month following the 1987 market crash. King et al. (1994) similarly argued that global stock markets are not integrated and that the perceived increase in market integration is only a transitory phenomenon brought about by the 1987 market crash. In contrast, Chan et al. (1997) reported evidence suggesting that the 1987 stock market crash has minimal lasting effect on the long-run relationship among the markets. Also, Brook and Del Negro (2004) explored whether the increased co-movement across national stock markets since the mid-1990s is a permanent or temporary phenomenon and report evidence that support the latter.

4.3.4 Stock Market Characteristics

The characteristics of a stock market play a major role in international market integration. Stock market size, similarities of industry composition, greater coordination across countries, and similarity in existing accounting and regulatory standards have been suggested as playing an influential part in integrating stock markets. For example, the size of a stock market may mirror its stage of development as well as the extent of market liquidity, information and trading related costs in the market. Thus stock markets with similar sizes, liquidity, and trading related costs may be at a comparable stage of development and may therefore exhibit greater integration and co-movement (Bekaert, 1995). Conversely, a large disparity in market characteristics may induce lower cross-correlation. Also, countries with similar industrial composition tend to experience greater co-movement (Roll, 1992; and Longin and Solnik, 1995). However, Heston and Rouwenhorst (1994) and subsequently Griffin and Karolyi (1998) contended that minimal changes in the returns of a stock market are due to similarities in industry composition. In a related study, Bekaert (1995) suggested that emerging stock markets are largely segmented due to poor credit rating, the lack of high-quality accounting and regulatory framework of the individual countries. In a recent study that accounted for risk-adjusted differences in industrial structure, Dutt and Mihov (2013) concluded that countries with similar industries exhibit higher market co-movement.

4.3.5 Other Sources of Market Integration and Co-movements

Other possible factors also influence co-movements among stock markets. Brooks and Negro (2004) suggested a number of sources of co-movement including the possible decline in home bias in investors' portfolio holdings, greater diversification in sales and financing of companies across different countries, and, perhaps, the declining importance of country-specific shocks. Reduction in home bias, for example, has given rise to higher demand for domestic securities by foreign investors, a phenomenon that renders country-specific investor sentiment less important in national stock markets. Also, advances in communication technology, enhanced financial innovations such as derivative instruments, and rising consolidation and merger of stock exchanges are major sources for greater stock market co-movements (Koch and Koch, 1991; Yang et al., 2003; Hasan and Schmiedel, 2004; Chen, 2011). Moreover, stock markets with overlapping trading hours tend to exhibit systematically greater co-movement than stock markets with non-overlapping trading hours; and countries in close geographic proximity tend to be more interdependent than countries that are far apart (Bracker et al., 1999).

4.4 Taxonomy of Methodologies in Market Integration and Co-movement Studies

Measuring stock market integration is a challenging task due to the wide range of definitions in the literature. No generally accepted single measure of integration exists (Pukthuanthong and Roll, 2009), and Ho (2009) admits the difficulty in developing such a standard measure of market integration. The theoretical literature measures international stock market integration along three main lines: (1) testing the integration or segmentation of stock markets using the international capital asset pricing model (CAPM); (2) analysing changes in the pattern of correlation and cointegration structure of stock markets; and (3) applying time-varying measures to examine the time-varying behaviour of integration and co-movement. The review in this section starts off with a discussion of the general case of financial market integration measures and then discusses the specific case of stock market integration.

Baele et al. (2004) identified three broad categories of financial integration measures. First, *price-based measures* essentially measure discrepancies in asset prices or asset returns due to the geographic origin of the assets. This measure constitutes a direct check of the law of one price, which must also hold under fully integrated financial markets. This measure is appropriate if asset characteristics are sufficiently similar, otherwise, differences in systematic risk factors and other relevant characteristics must be accounted for. The cross-sectional dispersion of interest rate spreads or asset return differentials depicts the extent of integration. Also, beta convergence (a measure used in the growth literature) indicates the speed at which markets are integrating. Second, *news-based measures* of financial integration are designed to separate the information effects from other barriers and frictions of integration. More specifically, in a financial integrated world with well diversified portfolio, the arrival of local news should carry little effect, while global news is more impactful. Essentially, systematic risk is identical across assets in different countries, otherwise, then domestic news will be relevant and may continue to influence asset prices. The third measure is *quantity-based measures* which are designed to quantify the effects of official barriers and frictions to investment opportunities faced by savers and investors.

For the specific case of stock market integration, Adam et al. (2002) similarly classify the literature into two broad categories: price-based measures and quantity-based measures. The quantity-based measures gauge stock market integration using a country's asset quantities and flows. They test whether the portfolio composition of domestic investors diverges from portfolio on the frontier under complete integration. Baele et al. (2004) further classify the quantity-based measures into two groups; the first group comprises measures relating to cross-border activities in both the credit and money markets in a particular market, and the second involves measures that consider home bias. One way of measuring the progress made towards financial integration is to assess the degree to which existing barriers to entry imposed on foreign investors willing to invest in the domestic credit market are declining. The understanding is that financial integration increases with declining asymmetric effects of frictions across borders. Similarly, the extent of home-country bias, which refers to the phenomenon where domestic investors tend to hold more domestic assets in their portfolio even though the holding of foreign assets shares risk far more effectively, is an indicator of the level of market integration. Indirect studies of quantity-based measures of financial integration have also been exemplified in the literature. For example, Portes and Rey (2000) analyse the timing and geographic pattern of cross-border equity flows; Bekaert et al. (2002) explore the steps of world equity market integration by identifying structural breaks in the size of international capital flows; and Baele et al. (2004) apply a number of measures based on asset quantities and flows to examine cross-border activities and home bias to determine the evolution of financial integration.

A major critique of the quantity-based measures of market integration is that they are not sufficiently robust as they do not provide much information relating to either the dynamics of the integration process, or the sources of integration. As a result, the literature on these quantity-based measures has shifted from testing the law of one price in favour of alternative measures that are based on asset prices or returns to test the degree of integration. In contrast, the price-and-return based measures are more consistent with the concept of evaluating returns and volatilities as opposed to quantities. Consequently, the price-based literature has had profound research support. The rest of this section discusses these price-based measures of stock market integration.

A survey of the extant literature indicates that price-based studies have investigated stock market integration along seven broad lines of inquiry, dealing with the issue from different theoretical and statistical perspectives. These measures comprise: (1) asset pricing models, (2) VAR models and causality analysis, (3) cointegration techniques, (4) correlation and covariance analysis, (5) spillover effect analysis, (6) time-varying measures, and (7) wavelet analysis. Figure 4.1 provides a schematic diagram summarising the various market integration measures based on the extant literature, which are also discussed in this section.

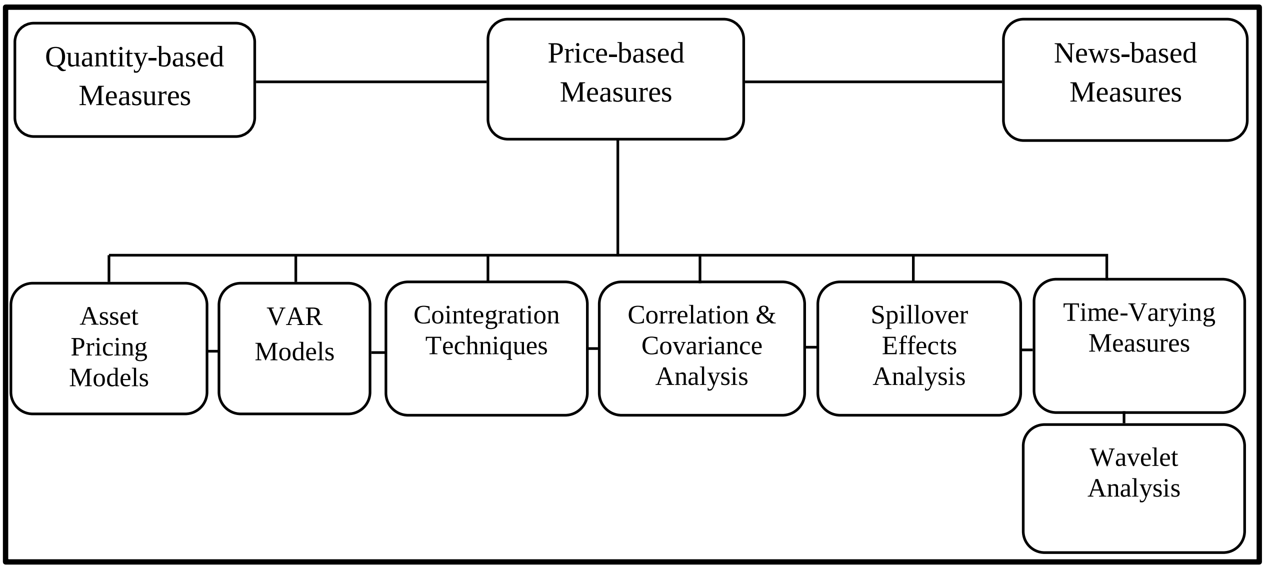


Figure 4.1: A Schematic Diagram of Stock Market Integration Measures compiled from various literature.

4.4.1 Asset Pricing Models

The first line of inquiry in the price-based literature employs a joint test of stock market integration and validation of asset pricing model. Asset pricing studies of this nature can be classified in three broad categories based on their assumed state of market integration: integrated markets, segmented markets, and partially segmented markets. In integrated markets studies, the models normally assume that the world capital markets are perfectly integrated. Common global risk factors are the only relevant asset risk source and asset prices are purely based on the associated covariance of the domestic market returns with the world portfolio. Intuitively, country-specific risk factors which are essentially diversifiable do not influence asset prices and investors are not compensated for such risks in completely integrated stock markets. This set includes studies of a world CAPM (see Harvey, 1991), an international CAPM (see Grauer et al., 1976; and Jorion and Schwartz, 1986), a world CAPM with exchange risk (see Dumas, 1994; and Dumas and Solnik, 1995), a world consumption-based model (see Wheatley, 1988), a world arbitrage pricing theory (see Solnik, 1983; and Cho et al., 1986), world multibeta models (see Ferson and Harvey, 1994), and world latent factor models (see Bekaert and Hodrick, 1992; Campbell and Hamao, 1992). Rejection of these models can be viewed as a rejection of the underlying asset pricing model, inefficiency in the particular market, or rejection of market integration. The difficulty with this strand of literature lies in the interpretation of the joint hypotheses. If the particular asset pricing model employed leads to a decision to reject the null hypothesis, it is unclear whether that should be viewed as evidence that the price or return behaviour cannot be explained by asset pricing theory, or that asset prices or returns are not reflecting their fundamental values in which case the underlying market is informationally inefficient, or should it mean that an error is committed in deciding the null hypothesis?

The other extreme case is a model where the standard CAPM of the form specified by Sharpe (1964), Lintner (1965) and Black (1972) is applied to the returns of a single market. Under such circumstances, the model implicitly assumes that the market is either perfectly segmented from the world market or it sufficiently proxies the world market. The majority of the early ground-breaking asset pricing studies assume the United States is a fully segmented market, or that the market proxy represents a broader world market return. Bekaert and Harvey (1995) argue that such an assumption might no longer be a reasonable working one as the United States equity capitalisation represented less than 50 percent of the world market capitalisation since the 1980s. Accordingly, neither of these approaches is based on inherently plausible assumptions, and their performance in empirical tests has been quite unspectacular.

Subsequently, Errunza and Losq (1985) and Errunza et al. (1992) derived a more realistic approach to asset pricing, specifically an international CAPM in which the assumption is between integration and segmentation (i.e. the so called mild segmentation model). While these models have the advantage for not assuming the pure case of integration or segmentation, they have the disadvantage of assuming that the degree of segmentation is constant over time. This is counter intuitive as some markets have become more integrated over time. Since the fundamental weakness of the asset pricing approach relates to the fact that results heavily depend on the specification of the asset pricing model, a major contribution is a model that takes into account the time variation of the degree of integration. The development of an asset pricing model with time-varying properties by Bekaert and Harvey (1995) and studies thereafter, therefore represent a significant methodological advancement in testing market integration.

4.4.2 VAR Models and Causality Analysis

One strand of the price-based literature attempts to test integration of international stock markets using vector autoregressive (VAR) models, which are essentially atheoretic in nature as no a priori restrictions exist on the structure of relationships among variables. The VAR modelling process involves estimating a system of dynamic simultaneous equations with uniform sets of lagged dependent variables as regressors (Sims, 1980). Due to its atheoretic nature, the VAR system is often regarded as a flexible approximation to an unknown model that represents the actual economic structure. Examples of early studies that applied VAR methodology to examine the daily transmission of international equity returns include Eun and Shim (1989), Von Furstenberg and Jeon (1989), and King and Wadhwani (1990). Nonetheless, VAR models estimated with non-stationary series can produce potentially misleading and spurious results, and Eun and Shim (1989) in particular have been heavily criticised. Even though stationarity can be achieved by differencing the series, the fact that potentially significant information about long-run trends in non-stationary equity prices can be filtered away during the process makes VAR models problematic. Similarly, evidence that non-stationary variables have cointegration relationships has led to the preference of vector error correction models (VECM) over VAR models. It is only in the absence of cointegration relationships among the variables that the use of the VAR model in differences is a recommended alternative.

In fact, in most cases in this strand of the literature, when VAR models are employed they are supplemented by the application of variance decomposition (VDC) or forecast error variance decomposition (FEVD) and impulse response functions (IRF) (Jayasuriya, 2011). While variance decomposition measures the amount of information that each variable contributes to the other variables in the autoregression system and determines the amount of the forecast error variance of each variable attributable to exogenous shocks and the variable itself in the system, impulse response function shows the dynamic response path of one variable attributable to an innovation to another variable, so that the features of the dynamic integration among the market indices and the speed of adjustment of the underlying markets in the autoregressive system can be observed.

Another set of literature has employed causality techniques to analyse the integration of international stock markets. A number of studies have analysed causality in stock price indices using the Granger causality test (see for example Malliaris and Urrutia, 1992; and Singh, 2010). The Granger causality test enables analysis to be made of the predictive ability of one market index in relation to another. The test allows researchers to analyse the direction and significance of causality between markets. According to Granger (1969), if variable X causes variable Y, then Y will be said to be 'granger caused' by X and the coefficient of the lagged values of X will be statistically significant. This would indicate that Y is better predicted using the lagged values of X. Since the Granger causality test results are very sensitive to lags selection and the evidence that the test cannot adequately ascertain true causality, the method no longer appeals to many researchers.

4.4.3 Cointegration Techniques

Another strand of the extant price-based literature on stock market integration is the development and use of cointegration measures to analyse the degree of integration and co-movement in stock markets. The development of cointegration methodology is in direct response to the deficiency of VAR models and the desire of researchers to explore potential long-run relationships among stock markets. In principle, evidence of cointegration relationships among markets is an indication that the underlying markets are integrated. Hence, the technique has an intuitive appeal to researchers studying market integration. According to Engle and Granger (1987), cointegration denotes that non-stationary time series such as stock prices move stochastically together towards some long-run steady state. Accordingly, a necessary condition for complete integration is that there should be n-1 cointegrating vectors in a system of n indices - making it helpful to investigate the degree to which stock markets are integrated (see Bernard, 1991; and Kasa, 1992). Since a cointegration methodology incorporates the long-run relationships and short-run dynamics that possibly exist between market indices in the modelling process, evidence of cointegration is often seen as representing the degree to which long-run diversification opportunities are available to investors. Cointegrated market indices are said to follow the same long-run time path or stochastic trend, and any gains from international portfolio diversification strategy will be limited only to short-run horizons during which periods markets may temporary deviate from their long-run equilibrium (Evans and McMillan, 2009). For example, Kasa (1992) examined integration in the major international equity markets over the period from 1974-1990 and reported a single cointegrating vector, implying low levels of integration, while Allen and MacDonald (1995) examined the relationship among stock prices of national equity markets and found only a small number of significant cointegrating vectors over the 1961-1992 period, signifying a high degree of market segmentation.

Studies using the cointegration approach to investigate integration of national stock markets have been conducted along two primary approaches: the Engle-Granger technique and the Johansen-Juselius technique. While the Engle-Granger technique is essentially bivariate in nature, which allows researchers to test for cointegration between pairs of stock market indices (see Engle and Granger, 1987), the Johansen-Juselius technique is principally a multivariate approach which allows analysis of the presence of more than one cointegration vector or common stochastic trend in the series. One good thing about the Johansen-Juselius multivariate technique is that both the presence and number of the common stochastic trends can be tested at the same time. The technique provides a unified framework for estimating multivariate cointegrating systems using the error correction mechanism. Essentially, the multivariate approach enables a convenient determination of the rank of a matrix of the cointegrating vectors and hypothesis testing, and yields a robust estimation that effectively decouples the long-run relationship from the short-run dynamics. However, this approach, like all other time-domain analyses, is unable to simultaneously capture the time-varying and space-dependency nature of time series data.

A number of studies have employed the Engle-Granger bivariate approach, such as Taylor and Tonks (1989), Arshanapalli and Doukas (1993), Gallagher (1995), Click and Plummer (2005), and Tripathi and Sethi (2010). Taylor and Tonks (1989), for instance, pioneered cointegration analysis in stock markets and found evidence of significant long-run integration relationships in the UK and international stock markets. Tripathi and Sethi (2010) revealed evidence of integration between Indian and the United States, but no cointegration relationship with UK, Japan or China. Also, Kasa (1992) pioneered the use of the Johansen-Juselius multivariate cointegration technique and documented evidence which suggests the presence of one common trend driving the five largest stock markets in the world. Other studies that had used the Johansen multivariate approach had largely reported evidence of stronger integration (see for example, Chan et al., 1997; Manning, 2002; Syriopoulos, 2007; Lucey and Muckley, 2011; and Saha and Bhunia, 2012).

According to the Granger representation theorem, in the presence of a cointegration relationship between series there is always a corresponding error-correction component, owing to the likelihood of the presence of a short-run disequilibrium relationship (Engle and Granger, 1987). The error-correction term (ECT) can be expressed as an error-correction model (ECM). While ECT measures the proportion of the long-run disequilibrium in the cointegration relationship that is being corrected in the short-run, the ECM presents the changes in the dependent variable as a function of both the regressors and the error-correction term. Error-correction models can also be extended to cover cointegration relationship within a VAR model by determining the values of the vector error-correction parameters which measure how the variables react to short-run deviations from long-run equilibrium. In fact, the combined application of cointegration and error-correction models enables effective separation of the short-run and long-run dynamics in stock market integration studies. Some of the studies that have used either the error-correction model or its extended form, the vector error-correction model include Chelley-Steeley et al. (1998), Yang et al. (2003), Psillaki and Margaritis (2008), Singh (2010), and Lucey and Muckley, 2011).

Another important progress in the cointegration approach to investigating stock market integration is the development of models that take into account the presence of possible structural breaks, especially in long-period series. Asset prices and returns are highly susceptible to events like financial crisis, global macroeconomic shocks, and sudden policy changes and the like, which potentially cause structural breaks in series. The presence of structural breaks in economic and financial data can affect the stationarity properties of the series and distort any long-run trends inherent in them (Perron, 1989). In fact, models with constant coefficients have been found to perform poorly under these conditions. Consequently, Gregory and Hansen (1996) have shown that traditional cointegration tests in the presence of structural breaks are very weak and that the remedy is to account for such structural breaks in the modelling process.

The Gregory and Hansen cointegration test incorporates the likelihood of a break in the cointegration relationship of the series at an unknown point in time. Studies that applied the Gregory and Hansen (1996) cointegration test, or its extension, to take into account structural breaks in the series include Huang et al. (2000), who found China and Hong-Kong to be integrated with long-run relation during the period from 1992-1997, Voronkova (2004), who found six cointegration vectors and concluded that emerging markets have become increasingly integrated; and Ibrahim (2009), who found no significant improvement in integration among the Asian regional financial markets. Also, Guidi (2012) analysed the long-run relationship between India and Asian developed markets and documented a cointegration relationship between the countries, likewise, Zeren and Koc (2013), who found that the US, UK, Japan and France) have long-run relation with Turkey.

4.4.4 Correlation and Covariance Analysis

Another line of inquiry into the degree of integration and co-movement of international stock markets is based on the development stock return correlation and covariance or the correlation behaviour of stock returns changes over time. The fundamental argument of this set of literature is that if the correlation structure exhibits instability over time and the trend of such unstable relationship is towards increased correlation, it signifies greater integration of the underlying markets. Conversely, if there is sustained stability in the correlation structure such behaviour indicates market segmentation. Early studies on integration (see for example, Panton et al., 1976 and Watson, 1980) have found stability in the correlation structure among international stock markets. Nevertheless, the majority of studies document sustained instability, indicating greater integration among national stock markets over time (see Meric and Meric, 1989; Karolyi and Stulz, 1996; Longin and Solnik, 2001; Goetzmann et al. 2005; Aslanidis et al., 2010; and Syllignakis and Kouretas, 2011). Indeed, this strand of the literature has swiftly departed from traditional correlation analysis which only measures the degree of linear association between two markets with little or no insight into the dynamic interactions between them.

Generally, correlation analysis involves the determination of unconditional correlations over different sample periods and/or conditional correlations using a range of univariate and multivariate GARCH (M-GARCH) models. Univariate GARCH models allow analysis of individual time series, while M-GARCH models allow a contemporaneous analysis of multiple time series. One advantage of M-GARCH analysis is that the modelling allows the researcher to track the correlation evolution between markets or asset returns over time. Thus, correlation analysis is better able to capture the evolving nature of market integration than cointegration analysis which mainly assumes a long-run stable equilibrium path. The Different multivariate GARCH models highlighted in this strand of the literature include the vectorised GARCH (VECH-GARCH) model developed by Bollerslev, Engle and Wooldridge (1988), the constant conditional correlation (CCC) model proposed by Bollerslev (1990), the BEKK-GARCH model and its diagonal form developed by Baba, Engle, Kraft and Kroner (1991), and the dynamic conditional correlation (DCC) model developed by Engle (2002). Examples of studies that have applied one form or another of these multivariate GARCH models include: Scheicher (2001) who modelled returns and volatility in emerging markets using a multivariate GARCH with a constant conditional correlation, even though the underlying assumption is said to be unrealistic; and Li and Majerowska (2008) who examined the linkages between some emerging markets and two developed markets using BEKK-GARCH and found evidence of return and volatility spillover emanating from developed to the emerging markets.

Even though correlation and covariance analysis has received widespread application, the technique has been critiqued. According to critics, high correlation coefficients may not actually mean increased integration, as a market could exhibit low or even negative correlation in relation to other markets even though it could be perfectly integrated with world markets. Accordingly, differences in industry mix of the country relative to that represented by the world average could cause disconnection between correlation and integration (see Roll, 1992). Carrieri et al. (2006) note that correlations are informative for purposes of portfolio allocation and management but do not constitute an accurate measure of diversification benefits or overall integration of stock markets. Similarly, Pukthuanthong and Roll (2009) convincingly demonstrated the inappropriateness of correlations as an accurate measure of market integration and argue that two highly integrated stock markets may exhibit a low correlation coefficient between them.

4.4.5 Spillover Effects Analysis

A fifth line of inquiry of the price-based literature on stock market integration relates to the concept of spillover effects or transmission of returns and volatility spillovers. The concept is important and has a number of implications for the health and wellbeing of economies and investors. First, returns and volatility spillovers strengthen stock market integration and interdependence, while increased integration could affect cross-country capital flows. Negative capital flows especially in emerging markets can enable spillover to adversely influence macroeconomic and monetary policies in these markets. Second, greater integration and substantial spillover can limit the potential gains from international diversification strategies and discourage international investors and portfolio managers from diversifying internationally. Conceptually, international diversification gains depend heavily on the relative size, frequency and persistence of idiosyncratic and common shocks (Jorion, 1985). The depletion of diversification gains is faster when return and volatility transmission is rapid (Elyasiani and Kocagil, 2001). Moreover, Forbes and Rigobon (2002) regarded evidence of a significant increase in international returns and volatility spillovers following crisis periods as contagion, otherwise it is interdependence.

The inquiry procedure in this aspect of the literature involves modelling spillover effects. Even though various methods involving the application of international capital asset pricing models and vector autoregressive multivariate conditional models are adopted, the variants of GARCH type models are the commonly applied analytic tools in analysing return and volatility spillover effects. A univariate GARCH framework or its multivariate extension can be used in the analysis. The estimation of a GARCH model involves specifying the appropriate mean and variance equations as well as the log-likelihood function (LLF) which will maximise the disturbances under a normality assumption. By these specifications, the estimated unexpected returns and its squared values (which measure the unpredictable part of the return) of one market are extracted and then inserted as exogenous variables in the mean and variance equations of another market. The presence and extent of the spillover effects are indicated respectively by the statistical significance and size of the exogenous variables in the second set of equations.

Pioneering works that analysed spillover effects within the univariate GARCH framework include: Hamao et al. (1990), who studied the short-run interdependence of prices and price volatility across the US, UK and Japan, and reported evidence of price volatility spillovers, and Lin and Teräsvirta (1994), who investigated return and volatility spillover effects between the US and Japan and found no significant lagged spillovers in returns or volatilities. Also, Theodossiou and Lee (1993) and Koutmos and Booth (1995) pioneered the literature analysing spillover effects using the multivariate GARCH analysis. Avouyi-

Dovi and Neto (2004) analysed spillover effects between European and US stock markets within the multivariate GARCH framework and documented evidence of spillover effects. Chuang et al. (2007) applied the MV-GARCH analysis to investigate volatility spillover among six East Asian stock markets and found the Japanese market to be most influential in transmitting shocks to the other markets but least susceptible to volatility spillovers from other markets. Also, Li and Majerowska (2008) examined the linkages between stock markets in Poland and Hungary and those in the US and Germany using MV-GARCH and reported evidence of returns and volatility spillover effects originating in the developed markets. On the other hand, the authors perceive minimum interactions and spillovers among the emerging markets. Lee (2009) also examined volatility spillovers within the MV-GARCH framework and found significant volatility transmission across the six stock markets.

A subset of studies in this strand of the literature however analyses the evolving behaviour of international stock market correlations by investigating the correlation structure among stock markets during periods of crisis. This category of studies mainly focuses on studying contagion effects and the transmission mechanisms of shocks during extreme market movements[17]. The submission in most studies is that contagion exists if cross-market linkages increase significantly following a crisis or shock in one market, otherwise any continued high level of cross-correlation is only evidence of increased interdependence (Dornbusch et al., 2000; Forbes and Rigobon, 2002). Pioneering studies on contagion effects provide evidence of contagion, including: King and Wadhwani (1990) who found a significant increase in cross-market correlations among the United States, UK and Japan following the US market crash in 1987; Lee and Kim (1993) who documented evidence of contagion among twelve major markets due to the 1987 market crash, and Calvo and Reinhart (1996) who found a significant increase in cross-market correlation coefficients following the 1994 Mexican currency crisis. In relation to the 1997 Asian financial crisis Collins and Biekpe (2003) provided evidence of contagion in Africa's largest and most traded markets, and Chiang et al. (2007) confirmed evidence of contagion in Asian stock

[17] An extensive theoretical discussion of the international transmission of shocks is provided in Dornbusch et al., 2000 and Forbes and Rigobon, 2001. Accordingly, the causes of contagion can be divided into two categories: those relating to real and financial linkages - fundamental-based contagion; and contagion due to behaviour of investors and other economic agents. Reported transmission mechanisms of fundamental-based contagion include greater economic and financial integration propagated through bilateral and multilateral trade agreements and stock market integration; whereas the underlying transmission mechanisms of shift contagion include endogenous liquidity shocks, financial cognitive dissonance, political risk perceptions, portfolio rebalancing, and investor herding or information cascades (see Calvo and Mendoza, 2000; Forbes and Rigobon, 2000; and Kodres and Pritsker, 2002).

markets. Moreover, contagion effects have been reported in relation to the 2007-2008 global financial crisis emanating in the United States (see Dooley and Hutchison, 2009; Longstaff, 2010; Pesaran and Pesaran, 2010; Aloui et al., 2011; Kenourgios et al., 2011; Samarakoon, 2011; Aizenman et al., 2012). For example, Kenourgios et al. (2011) investigated financial contagion within a multivariate time-varying asymmetric framework and confirmed contagion effects from the crisis countries to mostly the BRIC countries. In contrast, empirical evidence in Dimitriou et al. (2013) does not affirm the contagion effect for most BRICS in the early stages of the global financial crisis. Linkages among these markets however re-emerged following the collapse of the Lehman Brothers in the United States.

A sub-genre of studies in this strand of literature conducts analysis of international returns and volatility spillovers from the perspective of world crude oil price movements. The rationale of these studies is that movements in crude oil prices can propagate returns correlation and volatility spillovers across stock markets. The value of stocks, measured by stock prices and returns which are the discounted sum of expected future cash flows, is influenced by macroeconomic variables which are in turn affected by oil price movements. Stock markets of both oil exporting and importing countries are thus expected to be influenced significantly by changes in oil prices. Studies along this line of thought often investigate the impact of oil price movements on stock market co-movement (Sadorsky, 1999 and Basher and Sadorsky, 2006), or whether oil price related risk is taken into account in explaining the movements in stock indices (Papapetrou, 2001), or analyse whether oil price movements cause returns and volatility spillovers across national stock markets (see for example, Arouri et al. (2011) who found evidence of the presence of return and volatility transmission between oil price movements and stock markets; and Sadorsky (2012) who analysed volatility spillovers between oil prices and stock prices of clean energy firms and technology companies within a multivariate GARCH framework and documented evidence of large volatility spillover effects between the two types of companies, but minimum volatility spillovers with oil prices).

4.4.6 Time-Varying Measures

The integration of stock markets is not static, but rather a dynamic process which can observe an initially segmented market gradually becoming integrated with the world. Various factors potentially influence stock market interrelationships and, to the extent that these factors change through time, they can cause changes in the relationships over time as well. In fact, the seminal and widely cited works by Campbell (1987) and Bekaert and Harvey (1995), among others, have demonstrated sufficiently that equity risk premium is time-varying. Unfortunately, analyses within the CAPM and cointegration frameworks are unable to capture fully the possible time-varying nature of integration. Even though such partial analysis may provide some indication of changes over time, essential time-varying information may be concealed leading to misleading conclusions.

Pretorius (2002) strongly advised that the best way is not to split the sample periods but to examine the evolution of the relationships over time. Studies employing time-varying measures include Longin and Solnik (1995) who reported increased integration using correlation and covariance matrix estimation methods; Aggarwal et al. (2004) who applied dynamic cointegration techniques and reported time-varying integration among European equity markets; and Awokuse et al. (2009) who found evidence of time-varying cointegration relationships among emerging stock markets using rolling cointegration techniques and algorithms of inductive causation. Also, Syllignakis and Kouretas (2011) showed that integration between Central and South-Eastern European stock markets and those in the US and Germany is time-varying with a tendency to rise during periods of financial crisis. Similarly, Gupta and Guidi (2012) found greater integration between the Indian stock market and three developed Asian markets especially during crisis, but which reverts to initial levels during tranquil periods.

4.4.7 Wavelet Analysis

Conventionally, integration of financial markets is assessed in the time-domain analysis where the correlation coefficient is the most popular measure of co-movement. However, the contemporaneous correlation coefficient obtained through time-domain analysis only measures the degree of co-movement between the series over the sample period. Meanwhile, the degree of co-movement has long been acknowledged as being time-varying (Kizys and Pierdzioch, 2009; Rua, 2010), rendering the correlation coefficient a limited measure. To circumvent this drawback, the practice in the literature is to compute rolling window correlation coefficients or use non-overlapping sample periods. However, market co-movement based on the time-domain aspect of analysis loses information from the frequency domain and has been heavily criticised (Pukthuanthong and Roll, 2009).

An alternative approach in the literature involves the use of frequency domain analysis where Fourier analysis can be applied (see for example, Breitung and Candelon, 2006;

Bodart and Candelon, 2009). Croux et al. (2001), for instance, propose a spectral-based measure, the dynamic correlation, which can be used to measure the co-movement between two series at each individual frequency. While this measure is conceptually similar to the contemporaneous correlation coefficient in the time-domain, it is quite different in that it provides a co-movement measure that can vary across frequencies (Rua, 2010). Nevertheless, the dynamic correlation from frequency domain analysis may not account for the time dependence of co-movement. Consequently, the standard time series econometric method which separately considers the frequency and time aspect of the data loses one side of important information (Uddin et al., 2014). Specifically, studies that only base the analysis on time series aspect lose the frequency aspect, while studies that only base the analysis on frequency aspect also lose the time aspect (Uddin et al., 2014). Thus a general limitation of studies in this area of inquiry is that differences in investment horizons are unaccounted for in the analysis. However, it has been strongly suggested that co-movement or integration analyses need to take into account the differences between short-and long-term investor choices (Rua and Nunes, 2009; Aloui and Hkiri, 2014).

The wavelet approach is a time-frequency analysis that merges both time and frequency aspects and can distinguish between short-and long-term investment horizons (A'Hearn and Woitek, 2001; Pakko, 2004). Wavelets are finite wave-like functions, which can transform time series into a time-frequency representation. The approach has the advantage of creating a good balance between the frequency and time aspects of the analysis. In fact, wavelet analysis can assess simultaneously the relationship between variables (two national stock market indices for instance) at different frequencies and how such a relationship has changed over time (Rua, 2010). Hence, the approach not only allows non-stationary features to be captured in the analysis, but also presents a unique tool that allows both frequency-and time-varying behaviour to be analysed.

Despite its acknowledged unique utility, wavelet analysis is quite scarce in empirical research in economics and finance. As pointed out in Ramsey and Zhang (1996, 1997), perhaps the first time the methodology was implemented in economics appeared in the pioneering work by Ramsey and Lampart (1988a, 1988b) who used the wavelet approach to analyse the interactions between several macroeconomic variables. Subsequently, wavelet analyses have been used in Gencay et al. (2001a, 2001b, 2005), Connor and Rossiter (2005), Gallegati and Gallegati (2007) and counting. The wavelet technique has also been implemented to investigate the co-movement in Asian spot exchange rates during the Asian crisis in 1997 (Karuppiah and Los, 2005), and the cross dynamics of exchange rate expectations (Nikkinen et al., 2011). A common feature of all these studies, however, is that they all use the discrete wavelet transform (DWT). The discrete wavelet has the advantage of ensuring fast implementation, but is nevertheless weak because the number of scales and the time invariant property are strongly dependent on the data length (Ftiti et al., 2015).

In recent times, the wavelet methodology has also been implemented in financial empirical studies to evaluate international stock market co-movement or integration involving both developed and emerging markets (Rua and Nunes, 2009; Graham and Nikkinen, 2011; Graham et al., 2012; Graham et al., 2013; Kiviaho et al., 2014), and to assess international transmission effects and contagion (Sharkasi et al., 2006; Ranta, 2009). In particular, Kiviaho et al. (2014) found the strength of co-movement to vary substantially across European frontier markets both over time and at different frequencies. The co-movement was more intense at lower frequencies and rose during global financial crisis. Graham et al. (2013) provided evidence of a modest degree of return co-movement between the US and MENA stock markets.

4.5 Survey of Empirical Evidence of Market Integration/Co-movements

The review in this section considers a broad range of studies in respect of the subject which are also relevant to the objectives of this chapter. It shows the relevant contributions, discusses the prevailing pertinent issues trending in the literature and attempts to point out the gaps that exist and serve as motivation for the present study. It must however be emphasised from the onset that empirical evidence of international stock market integration is so huge that the exclusion of otherwise very relevant studies is inevitable. Nevertheless, the survey represents a coherent presentation of the existing literature relevant to the objectives of the study. The survey of empirical evidence is conducted on developed equity markets, emerging stock markets, other developing stock markets, and finally studies involving African equity markets.

4.5.1 Evidence from Developed Equity Markets

Stock market integration studies can be traced as far back as the 1960s, although they used data mostly from the developed and major global stock markets. A primary motivation of this area of research is an interest in establishing whether there are linkages in prices, returns and volatility and whether there are still potential benefits in internationally diversified investments. Some early contributors include Grubel (1968), Granger and Morgenstern (1970), Levy and Sarnet (1970), Agmon (1972), Ripley (1973), Lessard (1976), and Hilliard (1979).

On the premise that markets are integrated when correlations exist across them, studies on developed stock markets have mainly employed correlation analysis, capital asset pricing models, cointegration techniques, VAR procedures and GARCH-type models. Specifically, early empirical studies employing simple correlation and regression methodologies found very low correlation among international equity markets in the 1960s and 1970s. Some found some co-movements only between countries in close geographic proximity. For example, Grubel (1968) reported that US investors would have realised better risk adjusted return opportunities between 1959 and 1966 by intentionally diversifying their investment portfolios. Levy and Sarnet (1970) similarly reported the presence of diversification benefits in stock markets owing to differences in the risk-return relationships between markets. More so, Grubel and Fadner (1971) demonstrated that correlation is an increasing function of holding period; and that the correlation between stock index returns is much smaller than the correlation between domestic assets. Granger and Morgenstern (1970) apply spectral analysis to eight stock markets using weekly data and report no evidence of leads or lags.

Agmon (1972) however challenged the market segmentation hypothesis and postulates that there is one world market for equities. Using data from four world leading markets the study finds that share price indices for Germany, Japan, and the United Kingdom respond instantaneously to changes in the share price index of the United States. The study additionally observes the presence of a residual country factor, but the one world hypothesis is not refuted by the presence of the country factors. In fact, although each country's share price index is linked to that of the United States, it is independent of the share price index of each of the other countries investigated. Also, in a comparable methodology to Granger and Morgenstern (1970), Bertoneche (1979) examined the lead-lag relationships among the weekly stock returns of seven European countries and the United States and found evidence suggesting that the countries are integrated. The study however reported weak relationships between the United States and all of the seven countries. In a related study, Hilliard (1979) examined the correlation of ten countries during the 1973-1974 energy crisis using daily stock index prices and found evidence of co-movement among stock markets on the same continent, while markets far apart geographically are generally unrelated.

In Eun and Shim (1989), various methodologies including VAR approach were applied to investigate international transmission of equity market movements using daily returns of the nine largest countries spanning the period from 1980 to 1985. The results indicated greater interdependence among the world's major stock markets and that the United States was the most influential market as its return innovations affected major stock markets. The evidence further showed that Japan, though a comparable market to the United States market, was a follower rather than a leader in the world stock market. Hamao et al. (1990) studied the short-run interdependence across three leading international stock markets (Japan, UK and US). The ARCH family of statistical models is applied to the daily opening and closing prices of the market indices from April 1985 to March 1988. The results pointed to evidence of price volatility spillovers from US to Japan, UK to Japan, and US to UK only, while no other directions of price volatility spillover effects was detected.

Taylor and Tonks (1989) pioneered the application of the bivariate cointegration techniques of Engle and Granger (1987) to examine the integration of UK stock market with those of Denmark, Germany, Japan and the US. Kasa (1992) also pioneered the application of Johansen's (1988) multivariate cointegration technique to evaluate the permanent and transitory components of stock price series and whether or not a signal stochastic trend exists in the relationship among five developed stock markets (Canada, Germany, Japan, UK and US). In this framework, the presence of a single common stochastic trend would mean that the markets are integrated over long horizons, otherwise they are segmented. Both studies find evidence of a long-run relationship (market co-movement) among developed stock markets. Masih and Masih (1997) used cointegration analysis and found evidence which showed that the newly industrialised Asian markets of Hong Kong, Singapore, Taiwan and South Korea exhibited a long-run relationship with developed stock markets (i.e. Germany, Japan, UK and US). Masih and Masih (1999) reported similar results using vector error-correction and level VAR methodologies. In a related study, Masih and Masih (2001) analysed the dynamic causal relationship among international stock markets. Significant interdependence was reported between the major OECD and emerging stock markets. The results further highlight the role of the UK and

US stock markets as influential markets both in the short and long terms, even in the presence of the 1987 financial crisis.

Nearly a decade-and-half later, Bessler and Yang (2003) investigated the dynamic structure of the same set of major developed markets as in Eun and Shim (1989) by applying VAR methodology and the directed acyclic graphs (DAG) framework. The results showed that the United States is greatly influenced by its own past innovations as well as market innovations from France, Germany, Hong Kong, Switzerland, and the UK. The study further found Japan to be one of the most greatly exogenous equity markets and a follower rather than a leader, while the Canadian and French equity markets are among the least exogenous markets. The evidence further showed that the US stock market plays an influential role in affecting price movements in the other major stock markets. In fact, analogous findings were reported in studies such as Malliaris and Urrutia (1992) and Francis and Leachman (1998).

Harvey (1991) applied the conditional CAPM model to a sample of 17 countries (including all major developed markets) to determine their conditional risk and similarly found Japan to be relatively segmented from the rest of the world. The author further established that, with the exception of Japan, a single risk source adequately describes the variation in the returns of the markets examined.

Admittedly, the evidence about the nature of the correlation structure across markets appears to be mixed. Studies such as Panton et al. (1976), Watson (1980), and Philippatos et al. (1983) have all documented evidence supporting stable relationships among national stock markets. Specifically, Panton et al. (1976) investigated the structure of co-movement across twelve major equity markets (Australia, Austria, Belgium, Canada, France, Italy, Japan, Netherlands, Switzerland, United Kingdom, United States, and West Germany) using weekly stock returns from 1963 to 1972. The study applied factor analyses to investigate the intertemporal stability of the returns structure and to identify groups or subgroups of countries that exhibit similar return characteristics. The results showed substantial short-run stability in co-movement among the world’s major stock markets, but weak stable co-movement in the long-run. Specifically, the study noted some year-to-year stability in the pattern of return movements, except that the stability diminishes with longer investment periods.

On the other hand, Madridakis and Wheelwright (1974), Haney and Lloyd (1978), Maldonado and Saunders (1981), Fisher and Palasvirta (1990), Wahab and Lashgari (1993), and Longin and Solnik (1995) reported evidence that suggests instability in the correlation structure among international equity markets. In particular, Longin and Solnik (1995) tested the hypothesis of whether the correlation in global equity returns is constant using monthly data for seven major global equity markets over a 30-year period (1960-1990). A bivariate GARCH model was used to test the assumption of constant conditional correlation, while a threshold GARCH model in the form according to Gourieroux et al. (1993) and Engle and Ng (1993) was developed to test whether the conditional correlation of markets is time variant. The variance term for each market was assumed to depend on the market's past innovations and conditional variance, among other information variables. Longin and Solnik (1995) reported evidence which showed an increasing trend in the correlation structure among global stock markets over the 1960-1990 period, a finding that contradicts the argument that correlation is time invariant. The findings further suggest that correlation increases during periods of high volatility, and that dividend yields and interest rates, among other economic variables contain information about future correlation and volatility as well.

Bracker and Kock (1999) also studied the correlation structure across international equity markets using quarterly time series constructed from the daily returns of ten major international stock markets and the bilateral exchange rates between the US dollar and the other nine markets from 1972 to1993. Their results overwhelmingly pointed to significant changes in the correlation structure over both short-and long-time horizons. Even longer time periods of 6 months, 1 year, 2 years, 5½ years, and 11 years have been found to homogeneously exhibit unstable correlation structure as well. Bracker and Kock further documented evidence to the effect that the degree of international integration as measured by the magnitude of the correlations is positively related to a trend and world market volatility, but negatively associated with exchange rate volatility, term structure differentials among markets, real interest rate differentials, and the world market index returns. These findings thus support a priori expectations that divergent macroeconomic behaviour across countries tends to cause divergent equity market behaviour across markets, and eventually lower correlations across international stock markets.

Empirical studies in the 21st Century continue to report evidence of increasing correlations, suggesting greater interdependence among global markets and lower potential diversification opportunities for that matter. For instance, Goetzmann et al. (2005) developed a new econometric test for hypotheses to assess the changes in the correlation structure of stock markets over time using data for 150 years of international equity market history. The study applied a multivariate approach to test the unconditional correlations using the asymptotic distribution of the correlation matrix in the form according to Browne and Shapiro (1986) and Neudecker and Wesselman (1990). The results convincingly rejected the hypothesis of constant correlation structure in international equity markets between various periods in world economic history. Accordingly, there exist dramatic shifts in cross-market correlations among global stock markets over time, and the diversification benefits potentially available to international investors also change through time.

In Lucey et al. (2004) traditional cointegration analysis, the Haldane and Hall (1991) Kalman Filter technique, and dynamic cointegration analysis were employed to examine stock market integration in European markets. The sample data covered the daily index prices of the main European equity markets over the period from December 31, 1987 to September 30, 2002. The results from the three methods were consistent and pointed to an increased integration/co-movement among European equity markets. The integration was particularly stronger during the 1997-1998 period, during which the EMU and ECB were established. In addition, the study found the German stock market as the dominant market of the European equity markets. Kizys and Pierdzioch (2009) also analysed the global co-movement of continuously compounded stock returns of the world's leading equity markets of France, Germany, Italy, Japan, the UK and the US using time-varying parameter estimation over the period 1975-2004. A Kalman-Filter model employed to estimate the time-varying parameter reported evidence which similarly suggests that the international co-movement of equity returns has changed over time.

In between the stability and instability arguments, Kaplanis (1988) found correlations to be stable, while covariances are unstable. Meric and Meric (1989) also found instability in the correlation structure over shorter time periods and stable relationships in the long run, a finding that contradicts both Panton et al (1976) and Bracker and Kock (1999). Marcus et al. (1991) argued that the correlation structure is influenced by the holding period analysed, while Bracker and Koch (1999) thought the inconsistency in results is attributable to differing sample periods, sampling frequencies, and methodologies used in the studies. In addition, using the "extreme value theory" to study the dependence structure of international equity markets, Longin and Solnik (2001) found correlation to be related to market trend, but unrelated to market volatility. Correlation also increases during bearish markets, but not during bullish markets. Bekaert et al. (2005) however thought that such increasing trends may have stabilised at higher levels after 1995 for the European markets but decreased for pairs of countries.

A subset of studies has also evaluated the integration of developed stock markets by applying the capital asset pricing model (CAPM) to equities within an international context. These studies are often motivated to examine how segmented or integrated a particular stock market is in relation to the rest of the world or the United States market. For example, Campbell and Hamao (1992) employed an international capital asset pricing model (ICAPM) to analyse the integration of long-term capital markets between the U.S and Japan. The study uses monthly excess returns on Japanese and U.S equity portfolios over the United States Treasury bill rate for the period 1971-1990. Evidence of co-movement (common movement) across the two markets is reported, suggesting the presence of integration in long-term capital markets. De Santis and Gerard (1997) analysed the effects of increasing integration among global financial markets on international diversification benefits by testing a conditional version of the international capital asset pricing model using parsimonious GARCH parameterisation. The study uses monthly dollar-denominated stock index returns of the world's eight largest equity markets including the G-7 countries (Canada, France, Germany, Italy, Japan, the UK and the US) and Switzerland from 1970 to 1994. The results indicate that the world price of covariance risk is the same for all countries and varies over time in a predictable fashion, while the price of country-specific risk is zero. The implication of their finding is that the hypothesis of international stock market integration is supported by their study, which further implies significant reduction in the benefits available from an internationally diversified portfolio.

Bekaert et al. (2009) examined international stock return co-movements using weekly portfolio returns from 23 developed markets for the period from January 1980 to December 2005. Using a simple linear factor model on country-industry and country-style portfolios as the benchmark, the study established that parsimonious risk-based factor models (precisely APT model) better fit the data covariance structure than the standard Heston-Rouwenhorst (1994) model. In addition, the study revealed some stylised facts about global stock return co-movements; with the exception of the European stock markets, no upward trend for stock return correlations is found. Industry factors became increasingly more important relative to country factors, (but this trend has since disappeared). The study also found greater and increasing return correlations in large growth stocks across countries than in small value stocks. However, the static nature of most capital asset pricing models is a major drawback which makes them unable to capture the important component of time variation in equity risk premia (Kearney and Lucey, 2004).

A group of studies also applies various multivariate approaches such as the Generalised Autoregressive conditional heteroscedasticity (GARCH) type models to investigate integration of stock markets. This strand of empirical research is motivated by an interest in examining simultaneously stock return dynamics and time-varying volatility. The methodology enables the investigation of spillover effects among stock markets due to increased independence or contagion associated with crises. For example, Avouyi-Dovi and Neto (2004) applied the conditional correlations to measure the degree of interdependence among European and US stock markets using daily stock index returns from 31 December 1993 to 30 July 2002. The Engle's (2001) multivariate procedure for dynamic conditional correlation modelling was adopted alongside copula functions. The evidence reported rejects the assumption of constant correlations between assets and the assumption of no asymmetry in asset price distributions. In effect, the findings uphold the time-varying nature of correlations and support the use of asymmetric joint distribution to capture the presence of rare events in the analysis. The results further showed that correlations and volatility exhibit different intensity in different periods, becoming strong in one period and weak in another period. Also, in periods of high volatility, correlation is found to rise above medium-average, while during periods of low volatility markets exhibit greater interdependence.

In a related study, Morana and Beltratti (2008) assessed the linkages holding across markets and moments using monthly stock returns from the US, UK, Germany and Japan over the period 1993-2004. The results from a principal component analysis (PCA) framework pointed to a progressive integration of the four major stock markets. The evidence indicated increasing co-movements in correlations, prices, returns and volatility, and linkages are noticeably stronger between the US and Europe. The result suggests that the heterogeneity between the US and Europe has steadily declined over time and the two markets are strongly correlated. These findings are generally consistent with some earlier studies such as Yang, et al. (2006) who used cointegration analysis. Bekaert et al. (2005, 2009) also reported similar finding using parsimonious risk-based factor models.

In the Asian markets, Gupta and Guidi (2012) explored the linkages between the Indian stock market and three developed Asian stock markets (Hong Kong, Japan and Singapore) using cointegration methodologies to estimate the time-varying conditional correlation among the markets. The results pointed to a dramatic increase in correlations during crisis periods, but which revert to their initial levels after the crisis. In effect, the markets investigated exhibit short-run rather than long-run relationships, implying the existence of diversification benefits for investors interested in enhancing their risk adjusted returns in the Indian emerging market.

The above studies have implemented mainly time-domain approaches such as CAPM, cointegration analysis, VAR models, and GARCH-types models to investigate market cross-correlations which have been heavily criticised in the literature (see Pukthuanthong and Roll, 2009). As a result, the wavelet analysis, a frequency-time domain procedure has gained popularity recently. The most relevant studies of co-movements in developed stock markets using wavelet analysis include Sharkasi et al. (2006), Rua and Nunes (2009) and Ranta (2009). In particular, Rua and Nunes (2009) used wavelet analysis to assess the co-movement among the major developed stock markets (Germany, Japan, United Kingdom and United States) at both the aggregate and sectoral levels over the 1973-2007 periods. The findings suggested that the strength of co-movements between stock markets depends on the frequency and co-movements being stronger in lower frequency. In a recent study, Ranta (2009) implemented the discrete and continuous wavelet transforms to examine the contagion among major world stock markets during the past 25 years. The study found clear indications of contagion among the major developed stock markets. Also, during major crises, the evidence pointed to increased co-movements at short-time scale, but stable co-movements at long-time scale. The evidence further pointed to gradually increasing interdependence between stock markets. Similar results were reported in an earlier study by Sharkasi et al. (2006) where the authors compared the reaction of emerging and developed stock markets to crashes and events using the discrete wavelet transform. The evidence additionally suggested that developed stock markets react to crashes differently from their emerging markets counterparts. While developed markets take less than a month to recover from a shock, emerging markets could take up to two months to do the same.

4.5.2 Evidence from Emerging Equity Markets

Interest in diversification opportunities has continually put emerging markets[18] under the spotlight. Indeed, studies have reported evidence of diversification opportunities in emerging markets. For example, Goetzmann and Jorion (1999) indicated that the returns in emerging markets are three times higher than those in developed markets. Nonetheless, empirical works on the cross-correlations among emerging stock markets have so far implemented varied methodologies and reported mixed results. For instance, Bekaert and Harvey (1995) proposed a measure of capital market integration based on a conditional regime-switching model which allows the degree of market integration to change over time. The results from a sample of 12 emerging and 22 developed markets pointed to time-varying integration among a number of emerging stock markets. The authors however challenged the common perception that the world capital markets have become more integrated as some emerging markets are found to exhibit less integration with the world market. Accordingly, a major feature about emerging stock markets is that they exhibit differing degrees of integration among themselves and with developed markets (Bekaert, 1995).

Greater co-movements among emerging stock markets have been reported in recent studies on stock market integration in these markets. Arouri et al. (2012) proposed a theoretical testable international capital asset pricing model (ICAPM) for partially integrated (segmented) markets. A suitable framework is then introduced to test the model using a sample of six main emerging markets from Asia and Latin America (Brazil, Chile, Korea, Malaysia, Mexico and the Philippines) and three developed markets (Canada, France and US). Using monthly index returns, the study found evidence suggesting that the degree of stock market integration changes over time. Additionally, most of the emerging markets have become more integrated lately, though the intensity of co-movements, measured by the magnitude of the unconditional correlations, suggests weaker interdependence among emerging markets.

In Korkmaz et al. (2012), the Hong's (2001) version of Cheung and Ng's (1996) causality-in-mean and causality-in-variance tests were implemented to examine causal relationships and interdependence among the CIVETS stock markets (Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa). The data comprised the weekly (Wednesday) stock

[18] Emerging equity markets refer to countries or economies that are progressing towards becoming developed markets, but are still far below par with developed economies or markets.

market prices from July 24, 2002 to December 29, 2010. The findings showed that the contemporaneous return and volatility spillover effects realised after filtering out the ARCH effect and common factors are generally low. The CIVETS stock markets may nevertheless exhibit higher degrees of co-movements and interdependencies. Indeed, the structure and pattern of the causality relationship showed some degree of intra-and inter-regional return and volatility spillover among the markets.

Banmohl and Lyocsa (2014) examined the time-varying correlation of 32 emerging and frontier stock markets with developed stock markets (represented by MSCI World Index) using weekly stock returns over the period from January 2000 to December 2012. Using the standard and asymmetric dynamic conditional correlation model frameworks, including DCC-GARCH, the study observed that the linkages between emerging and frontier markets with developed markets have increased over time. In addition, the asymmetric behaviour of volatility, frequently witnessed in developed stock markets, is not a common phenomenon in emerging and frontier stock markets, except for the Hungarian stock market. Also, a significant positive relationship exists between volatility and correlations in most emerging and frontier markets, suggesting a decrease in diversification benefits during periods of higher volatility.

Studies on the integration of emerging stock markets have largely been conducted on geographic groupings and mostly alongside developed stock markets. In the specific case of emerging stock markets in Asia, Bailey and Stultz (1990), in a pioneering study, show that a US representative investor could reduce portfolio risk by up to 50% by including Asian companies' stocks in the portfolio. Cheung and Ho (1991) and Cheung (1993) respectively examined the correlation structure among 11 emerging Asian stock markets and developed stock markets. The evidence documented in the two studies pointed to weaker correlation between the emerging stock markets group and the developed markets group than the correlation among the developed markets. Chan et al. (1997) likewise examined the integration among Asian stock markets and found evidence of low integration in the 1980s, corroborating evidence reported in earlier studies (Chan et al., 1992; Divecha et al., 1992).

In a study that examines the international integration of Asian regional stock markets over the period 1988-2002 using non-parametric cointegration analyses, Lim et al. (2003) found evidence of the presence of a common force linking these markets. Similarly, Phylaktis and Ravazzolo (2005) applied a multivariate cointegration model to examine the interdependence among a group of Pacific-Basin stock markets and the developed markets of Japan and the US for the period 1980-1998. Evidence of increased interlinkages was reported between the markets, but there were still prospects for long-term gains from internationally diversified investments in the Pacific-Asian markets. The evidence also suggested that the linkages among the Asian markets have not been substantially affected by the Asian crisis in 1997. In a related study, Click and Plummer (2005) examined the degree of integration or segmentation among the ASEAN-5 stock markets using cointegration analysis. Their data series (daily and weekly stock prices) covered the period 1998-2002. The results suggested that the markets are cointegrated, and for that matter are integrated rather than being segmented.

Awokuse et al. (2009) investigated the evolving pattern of the interdependence among nine Asian leading stock markets (Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand) and three world major stock markets (Japan, UK and US). The study employed rolling cointegration techniques and the recently developed algorithms of inductive causation using daily closing index prices over the period 1988-2003. The findings showed evidence of strong time-varying cointegration relationship among the markets, a finding that is consistent with Phylaktis and Ravazzolo (2005) and Dungey and Martin (2007). The study also affirmed the role of financial liberalisation in creating greater integration in international equity markets. Japan and Singapore, in contemporaneous time, were found to exert the greatest significant influence on their counterpart Asian stock markets and were thus said to provide regional leadership. In the long-run however, Japan and the US were found to exert the greatest influence on the emerging markets, with hardly any influence from the UK stock market. The authors further reported evidence suggesting that the influence of Singapore and Thailand has gained momentum since the Asian financial crisis.

Abbas et al. (2013) investigated the presence of volatility transmission among regional stock markets in Asia (China, India, Pakistan, and Sri Lanka) and developed stock markets (Japan, Singapore, UK and US). Using a bi-variate exponential GARCH model on daily index prices in local currency for the period from July 1997 to December 2009, the results indicated the presence of volatility transmission among the four Asian markets. The results also suggested that volatility transmission is present even between countries which are considered to be on unfriendly terms. With regard to the relationship among the developed and Asian markets, the results pointed to the presence of volatility transmission between friendly countries in different regions which are linked economically. In particular, the evidence showed volatility spillover from Japan, Singapore and US to the four Asian stock markets, but not so the other way round.

In Abid et al. (2014), a conditional version of the ICAPM was applied to investigate the dynamics of regional financial integration in the stock markets of Indonesia, Malaysia, Singapore, Sri Lanka, and Thailand. The determinants of the integration were also examined. Using monthly stock index returns for the period from January 1996 to December 2007, the results indicated that the risk is regionally priced. The evidence also shows that the degree of stock market integration varies significantly over time and differs considerably in different markets. The study also found that changes in the degree of integration among these regional stock markets are due largely to the US term premium and the extent of market openness. These findings are consistent with the evidence documented in an earlier study by Lim (2009) who focused on stock market integration within the same group of Asian markets. Guesmi (2012) similarly found varying but increasing degrees of integration among the South-Eastern Asian markets. The study however acknowledged the presence of a significant degree of segmentation in these markets with the regional market.

In the Central and Eastern European stock markets Kenourgios et al. (2009) used a modified asymmetric generalised dynamic conditional correlation (AG-DCC) model based on Cappiello et al (2006) to examine time-varying correlation dynamics. Specifically, they sampled 6 major Central European emerging markets, 6 developed European stock markets, and 2 emerging stock markets of Balkan. The results indicated evidence of integration during the following periods: the dotcom collapse in 2000; the beginning of negotiations between the European Union and Balkans countries in 2000; the first circulation of the euro in 2002; and the joining of the European Union by central European countries in 2004.

In the European markets, Guidi and Ugur (2014) also investigated integration of the South-Eastern European (SEE) stock markets (Bulgaria, Croatia, Romania, Slovenia and Turkey) with the major developed markets (Germany, the UK and the US) using static cointegration analysis. The evidence showed that the SEE equity markets are cointegrated with Germany and the UK markets, but not with the US over the sample period. Further dynamic cointegration analysis points to time-varying cointegration relationships among the SEE markets and their developed counterparts. The cointegration results in Guidi and Ugur (2014) are consistent with the conclusions reached in earlier studies such as Voronkova (2004) who found long-run relationship between Central and Eastern European (CEE) markets and developed stock markets in France, Germany and the UK, and Syriopoulos (2007), as well as Demian (2011), who reported long-run relationship between the CEE markets and those in Germany and the US. Conflicting results have however been reported in Egert and Kocenda (2007), and Gilmore et al. (2008) for Western Europe and CEE markets, and for the developed EU stock markets and three CEE markets, respectively.

Evidence of market interdependence is also reported in the Latin American stock markets (see Christofi and Pericli, 1999; and Chen et al., 2002). Specifically, Chen et al. (2002) use cointegration analysis and error correction vector autoregression techniques to investigate dynamic interdependence among six major Latin American stock markets over the period 1995 to 2000. The study found one cointegration vector among the stock markets. Their results were robust using the US dollar as a common currency and subdividing the samples into pre-and post-periods relative to the Asian and Russian financial crises in 1997 and 1998, respectively.

Evidence of cross-correlations has been reported among stock markets at the regional level. Arouri et al. (2013) estimated a CAPM that allows for different market structures (i.e. perfect integration, strict segmentation and partial integration). Using a multivariate GARCH-in-mean model, the study examined stock market integration among 4 emerging regions and 4 developed regions. The findings indicated that the degrees of stock market segmentation vary between regions and have changed over time with less segmentation between markets. The results also showed that, in comparison with developed market regions, emerging market regions exhibit four major variations: their total risk premium is significantly higher, volatility is greater and is dominated by regional residual risk factors and largely reflects regional events. Similar findings are documented in Gerard et al. (2003) and Chelley-Steeley (2004) for Asian emerging markets, Barari (2004) for Latin American markets, Voronkova (2004) for European emerging markets, and Aggarwal and Kyaw (2005) for stock markets in the NAFTA region. Guesmi and Nguyen (2011) similarly concluded that emerging market regions, including Asia, Latin America, the Middle East, and South-eastern Europe, are segmented from the rest of the world markets.

Dynamic conditional correlations calculated for the period 1996-2008 showed no evidence of significant increase, except for the Latin American region.

A group of studies has analysed the interdependence or linkages between stock markets in emerging economies and developed countries. Li and Majerowska (2008) examined the linkages between the two emerging markets in Poland and Hungary and the developed markets of Germany and the United States. In a multivariate asymmetric GARCH model on the daily stock indices for the period 1998-2005, the study showed that the two emerging markets are linked to the two developed markets in terms of returns and volatility. In particular, there were uni-directional returns spillovers from the United States to each of the other stock markets, and bi-directional returns spillovers between the German and Polish stock markets. Also, there were uni-directional volatility spillovers from the German and US markets to the Polish and Hungarian markets, while bi-directional volatility spillovers existed between the German and US markets and between the stock markets in Poland and Hungary. The study however indicated limited interactions among the markets based on time-varying conditional covariances and the variance decompositions, suggesting the presence of some diversification benefits in the emerging markets.

Ali et al. (2011) investigated co-movement between the Pakistani stock market on the one hand and emerging and developed markets on the other hand. The Johansen (1988) and Johansen and Juselius (1990) approaches to cointegration analysis were applied on monthly stock prices for the period July 1998-June 2008. Mixed findings were reported; while the Pakistani market was found to co-move with China, India, Indonesia and Japan, it did not seem to co-move with Malaysia, Singapore, Taiwan, the UK and the US.

Jayasuriya (2011) also examined the interactions between the stock return behaviour of China and three of its emerging market neighbours in the East Asia and Pacific region (Indonesia, the Philippines and Thailand). Using monthly aggregate stock price indices from November 1993 to July 2008, the study estimated a vector autoregressive (VAR) model alongside impulse response functions and vector decomposition of the VAR analyses. The analyses were intended to establish the relationships among the four emerging markets, and the effect of shocks originating in one market on another market. While the evidence suggested no interlinkages at the aggregate market levels, China was observed to interact with the other markets when foreign investor returns were taken into account. It was further realised that a shock originating in China resonated significantly in the other three emerging neighbouring markets.

In a recent study, Alotaibi and Mishra (2015) examined the effect of return spillovers from regional stock market (Saudi Arabia) and global stock market (United States) on GCC stock markets (Bahrain, Kuwait, Oman, Qatar, United Arab Emirates). The study developed various bivariate GARCH (EGARCH) models for both regional and global returns (including BEKK, constant correlation and dynamic correlation) using weekly index data from June 2005 to May 2015. The results showed positive and significant return spillover effects from both regional and global markets to GCC markets, suggesting that the GCC markets are largely linked with regional and global stock markets. The results however suggest the presence of greater regional integration than global linkage according to the magnitude of the spillover effects.

In terms of wavelet application in emerging market studies, the most relevant works are perhaps Lee (2004), Gallegati (2005), Madaleno and Pinho (2010), Graham and Nikkinen (2011), Akoum et al. (2012), Vacha and Barunik (2012), Graham et al. (2013), Aloui and Hkiri (2014), Kiviaho et al. (2014), Celik and Baydan (2015) and Boako and Alagidede (2016). Most of these studies have however been undertaken along regional lines and in relation to the major developed markets. Evidence in Lee (2004) based on wavelet analysis suggested that movements from international stock markets did affect MENA stock markets but not vice versa. Gallegati (2005) similarly investigated the integration of MENA emerging markets and the developed markets using the discrete wavelet transform. The findings suggested that the MENA stock markets are neither integrated regionally nor internationally. Still in the MENA region, Graham et al. (2013) employed the wavelet squared coherency with simulated confidence bounds to investigate the co-movement among selected MENA region stock markets and with the US stock market. The evidence pointed to a modest degree of co-movement between the MENA region stock markets and that of the US. Also, Aloui and Hkiri (2014) examined the short-term and long-term interdependence between stock markets in the GCC countries using wavelet squared coherence analysis over the period from 2005 to 2010. The results suggested frequent changes in the pattern of the co-movement (particularly after the 2007 financial crisis) for all the selected GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates).

In the Latin American markets, Madaleno and Pinho (2010) analysed the co-movement between the Brazilian stock market and three major developed markets (Japan, UK and US) using the Morlet wavelet coherency analysis revealed to time-varying co-movements. The co-movements reported are strong but vary across time scales. In a similar but broad emerging market study, Graham et al. (2012) implemented the three-dimensional of wavelet squared coherence to examine the integration of 22 emerging stock markets with the United States market. The evidence reported indicates a high degree of co-movement at relatively lower frequencies between each of the individual emerging stock markets and the US market. The strength of the co-movement with the US however differs by country. While a high degree of co-movement was found between the US and the emerging markets of Brazil, Korea and Mexico, there was low co-movement with the markets of Egypt and Morocco. Also, an overall change in the pattern of the market relationship is recorded after 2006, where evidence of high degree of co-movements is detected at relatively higher frequencies. However, there is weak co-movement at the highest frequencies for fluctuations with periods shorter than one year. The findings largely imply that potential diversification benefits may still be available in emerging markets but are much dependent on both the preferred emerging markets and the investment horizon.

In the European stock markets, Graham and Nikkinen (2011) employed wavelet analysis to investigate the short-term and long-term co-movement. Specifically, the study first assessed the co-movement of the Finnish stock market with the developed and emerging stock markets. The study further analysed the co-movement of five developed European markets with a global equity portfolio. The results pointed to co-movement between the stock markets of Finland and the emerging market region only during long-term fluctuations. Also, evidence of co-movement across all frequencies was found between Finland and the developed European market regions, and the Pacific and North American regions. Evidence of higher co-movement was reported at higher frequencies as well. The indication from the results is that diversifying into a developed stock market (France, Germany, Switzerland, or the UK) would attract minimal gains, while opportunities exist for diversifying into the Finnish stock market.

Celik and Baydan (2015) combined both the time-domain (Granger, 1969; and Geweke, 1982) and frequency-time domain (wavelets) methods to analyse co-movements among emerging markets (Brazil, China, India, Indonesia, Russia, South Africa, Turkey) and one developed market (the United States). Using weekly stock data spanning the period from

January 2003 to March 2014 with several sub-sample periods for pre-post crisis analyses, the findings indicated that the markets were heavily affected by the global financial crisis. The phenomenon of asymmetric effect was also observed between the US and some emerging stock markets.

In a very recent study, Boako and Alagidede (2016) examined regional and global correlation of Africa's emerging markets using the continuous Morlet Wavelet transform over the period from January 2003 to December 2014. The findings suggest that Africa's merging stock markets are partially segmented regionally and globally. The study concluded, despite evidence of increased correlation over time, that Africa's emerging markets should still be considered as a separate asset class. Their study however only considers Africa's three emerging markets (Egypt, Morocco and South Africa) and Nigeria. The present study considers regional and global co-movement of Africa's emerging and frontier markets (an Africa-wide study).

4.5.3 Evidence from Developing Equity Markets[19]

There is substantially less literature on stock market integration in developing and frontier markets. In fact, until quite recently, it was non-existent. The few studies recently carried out involving developing/frontier markets have found them to be generally partially segmented with the global stock markets and thus provide opportunities for diversification. For instance, Speidell and Krohne (2007) reported low correlations between frontier and developed stock markets. Studying the diversification benefits across market classifications, Jayasuriya and Shambora (2009) found improved portfolio risk and returns in investments that diversified in frontier equity markets. Carrieri et al. (2007) however argued that cross-market correlations do not provide complete and accurate enough information to measure diversification benefits and market integration. Also, Berger et al. (2011) applied Pukthuanthong and Roll's (2009) approach to analyse frontier equity markets with respect to global market integration and diversification using principal component analysis. The results suggested that frontier markets display low levels of world market integration, even when structural breaks are accounted for. Unlike developed and emerging markets, frontier stock markets (whether considered as an aggregate market or as individual markets) showed no sign of increasing integration over time (Berger et al., 2011). In contrast, the study found strong evidence of significant increasing integration

[19] Developing equity markets refer to stock markets in developing countries, which are normally characterised by small market size, low liquidity, limited investibility and slow informational flows.

between developed and emerging equity markets over time. The low integration with the rest of the world means that frontier markets can offer significant diversification benefits.

In a recent study, Kiviaho et al. (2014) applied the wavelet coherency tool to examine the co-movement of European frontier stock markets with developed European and US stock markets. The findings showed that the strength of co-movement differs greatly across frontier markets, across different time horizons and over time. Central and South-eastern European frontier markets exhibited relatively weaker co-movement with the developed markets than in the Baltic region. The study further revealed that co-movement is stronger at lower frequencies and increased during the global financial crisis period.

4.5.4 Evidence from African Stock Markets

In spite of the increasing interest in research in stock market integration in regional and global stock markets, very little research includes African stock markets (Agyei-Ampomah, 2011). At the same time, varying evidence has been reported with regard to integration of African stock markets. A few African markets are occasionally included in some cross-countries studies of integration elsewhere including: Harvey (1995), Bekaert and Harvey (1995), Pukthuanthong and Roll (2009), Korkmaz et al. (2012), Graham et al. (2012), and Celik and Baydan (2015). In terms of methodology however, the wavelet tool has not been previously applied in any study to investigate the co-movement of African stock markets.

In the African context, Collins and Biekpe (2003) and Wang et al. (2003) are perhaps some of the earliest studies to investigate regional and global integration of African stock markets. These initial studies however examined African stock market integration with particular reference to the 1997-1998 Asian crisis. In particular, Collins and Biekpe (2003) assessed the extent of integration by evaluating the degree of contagion between African stock markets and global emerging markets. The Forbes and Rigobon (2002) approach was applied with minor adjustment to estimate the correlation coefficients. Their test statistics, estimated using exact t-tests from the actual sample correlation coefficients, was then used to measure contagion and interdependence in African stock markets with emerging markets. Daily price indices for eight African countries were used to calculate rolling two-day averages of daily returns to account for differences in market opening times. Referring to the specific case of the Hong Kong crash on October 17, 1997, the study specified January 2, 1997 to October 17, 1997 as a tranquil period and October 20, 1997 to

November 28, 1997 as a crisis period. The Granger causality tests were also applied with weekly index data to examine the contemporaneous relationships and direction of causality among the markets. The evidence suggested that interlinkages in African markets fall more into regional blocks such as among countries in Southern African region. Also, the results of the adjusted correlation coefficients pointed to no evidence of contagion and integration for any African market except the stock markets in Egypt and South Africa. Some sharp contradiction emerges from the findings in Collins and Biekpe (2003) when compared with those in Forbes and Rigobon (2002). Forbes and Rigobon (2002) documented that no emerging market suffered from contagion during the 1997 Asian crisis. Wang et al. (2003) however found evidence of time-varying integration in African stock markets, which however seems to have declined after the Asian crisis. Using cointegration analysis to estimate long-run relationship between markets and generalised impulse response functions to explore short-run causal dynamic linkages among the markets, Wang et al. (2003) showed that regional integration between most African stock markets was considerably weakened after the 1997-1998 crisis. The findings in Collins and Biekpe (2003) and Wang et al. (2003) thus appear to lend some support to the view that markets become integrated regionally before becoming integrated globally (see for example Phylaktis and Ravazzolo, 2002). The argument is based on the premise that most countries are likely to begin international trading by first buying and selling in neighbouring countries.

Nevertheless, it is likely that countries will become globally integrated before becoming regionally integrated due to advances in communication technology, financial instruments and the proliferation of financial information. Depository receipts and country funds, for instance, which are normally located in developed markets rather than developing or emerging markets could bring about global integration prior to regional integration. Collins and Abrahamson (2004) explore whether global integration precedes regional integration with a sample of African stock markets. In a vector autoregressive (VAR) framework based on Bekaert's (1995) specification, the author investigated the extent of global integration in the African stock market on a sector-by-sector basis, while exploring the process of integration on a regional basis. Focusing on seven African markets (Egypt, Kenya, Mauritius, Morocco, Namibia, South Africa, and Zimbabwe), Collins and Abrahamson (2004) reported evidence showing that the most integrated sectors include information technology and non-cyclical services, and cyclical services. South Africa, Egypt and Morocco, the only emerging markets, were found to be the most integrated markets in Africa. Further analyses of integration with global markets (Belgium, France, Germany, Italy, Netherlands, and UK) revealed that global integration is stronger than regional integration only in Egypt and Morocco. Significant evidence however points to regional integration in Africa.

Another strand of empirical works has addressed the integration of African stock markets and the implications of integration on investment analysis and risk sharing using various time series models. For example, Alagidede (2008, 2010) examined integration among African stock markets and with the rest of the world as well as the implications of market integration for portfolio diversification and risk sharing. The Johansen (1991) approach to cointegration analysis was applied using monthly closing index prices for four Africa's emerging markets (Egypt, Kenya, Nigeria and South Africa), two Latin American markets (Brazil and Mexico), one Asian emerging market (India), and three developed markets (Japan, UK and US). The methodology afforded the opportunity for the study of the long-run relationship and short-run dynamics among African stock markets and with global markets. The results showed that African stock markets are not well integrated with each other, raising serious concerns about the years of market reforms and economic cooperation. It seems that geographic proximity and economic ties may not matter for African stock market integration. The results also showed evidence of a weak stochastic trend between African stock markets and the world market. An important implication of this finding was that international diversification benefits are still available in African markets.

A similar conclusion was reached in Agyei-Ampomah (2011) who examined the nature and extent of linkages between African stock markets and their relationship with regional and global indices. The Barari (2004) methodology was applied using monthly data from ten African stock markets over the period from January 1998 to December 2007. The results showed that African stock markets, except South Africa, remain segmented from global markets despite liberalisation efforts and structural adjustments. Total volatility in these markets is greatly influenced by country-specific factors, suggesting that market systematic risk is priced. An interesting finding in Agyei-Ampomah (2011) is the low (and occasionally negative) correlation between stock markets even in the same regional economic bloc. Such low correlation or limited linkage is fertile ground for diversification opportunities. Also, evidence of time-varying integration, but declining levels of global and regional integration was reported. While this evidence is consistent with Wang et al.

(2003), it contradicts the finding of Bekaert et al. (2002) that integration of emerging markets increases following liberalisation efforts.

Adebola and Dahalan (2012) examined the co-movement of ten African stock markets using the cointegration techniques of Johansen's (1988, 1991) maximum likelihood approach. Using monthly market indices over the period from February, 1997 to October, 2011 the findings reported indicate less than full cointegration vectors, suggesting that African stock markets are not fully integrated. The results however suggest that larger stock markets lead and influence smaller stock markets in Africa. The results largely imply limited opportunities from diversifying portfolios in African stock markets.

In the regional context, Piesse and Hearn (2005) examined volatility transmission across the return structure of stock market indices of ten stock markets in SSA to measure integration. The authors employed exponential GARCH model with weekly and monthly index prices and reported evidence which suggests that SSA stock markets are correlated. Volatility transmissions (both uni-directional and bi-directional) were found across these markets with the Nigerian and South African markets playing a lead role in the propagation of spillovers in the other markets. In an earlier study however, Piesse and Hearn (2002) reported evidence of integration among the markets within the Southern African Customs Union (SACU), but little integration among SSA stock markets. Piesse and Hearn (2002) thus suggested that volatility transmission effects in SSA markets are typically short-term only and do not result in significant long-term change in the levels of stock market indices.

In an early study in the MENA region, Darrat et al. (2000) explored the pattern and extent of interdependence in Egypt, Morocco and Jordan with global stock markets. The results of the study showed that the MENA region was segmented from global stock markets even though high levels of regional co-movement were reported between markets. Also, Yu and Hassan (2008) investigated financial integration in the MENA region by examining the structure of interdependence and transmission mechanisms within and between MENA stock markets and world stock markets. EGARCH-in-mean models with a generalised error distribution confirmed the presence of leverage effect and leptokurtosis prevalence in the MENA stock markets. Evidence of large and predominantly positive volatility spillovers and volatility persistence in conditional volatility was also reported. Own-volatility spillovers were however generally higher than cross-volatility spillovers for all markets, suggesting the presence of strong GARCH effects. In a related study, Alkulaid et al. (2009) employed the state space procedure to investigate linkages and lead-lag relationship among MENA stock markets and regions. While the evidence indicated no spillover effect between markets in the North African region, linkages are found between stock markets in Levant region. The result further indicated that more interaction occurs among stock markets in the GCC region than either the North African or the Levant regions. Interestingly, the findings suggest that the stock market in the United Arab Emirates (UAE) leads all stock markets in the GCC region.

Neaime (2012) however documented somewhat different results from those of Alkulaid et al. (2009) on MENA stock markets. The author applied GARCH-in mean, the threshold ARCH and ARCH-M, and VAR models to investigate global and inter-and-intra- regional linkages between MENA region stock markets and the more mature stock markets. Daily prices of the three developed markets (France, UK and US) and seven MENA markets spanning the period 2007-2010 are used. The results suggested that the MENA stock markets are largely integrated with world stock markets with five of the seven markets investigated (Egypt, Jordan, Morocco, Tunisia and UAE) found to be integrated with the world stock markets.

4.6 Methodology and Data Description

This section presents the methodology used to investigate the evolving co-movement of African stock markets with the world stock market. The methodology used in the present study is the wavelet squared coherence analysis, a time-frequency domain approach. As a secondary analysis, however, the study further applies a multivariate DCC-GARCH analysis as robustness check and to serve as a basis for comparison. While the two approaches are similar in terms of their ability to show time-varying correlations over time, they differ substantially. Whereas the DCC-GARCH approach shows time-varying correlation over time in the time-domain only, wavelet analysis shows the same in a time-frequency domain. In addition, DCC-GARCH analysis provides a single correlation coefficient for a point of time, while wavelets analysis provides several correlation coefficients at varying frequencies for a particular point of time.

4.6.1 The Wavelet Analytical Approach

Tracing their roots from filtering methods and Fourier analysis, wavelets are finite wave-like functions which can transform time series into a time-frequency representation. The choice of the wavelet methodology is influenced by its desirable properties and superiority over many alternative methodologies. In particular, wavelet analysis effectively estimates correlation in a time-varying fashion and captures structural changes in the data using phase difference technique. As a time-frequency analysis, wavelet analysis merges both time and frequency aspects and can distinguish between short-and long-term investment horizons (A'Hearn and Woitek, 2001; Pakko, 2004). It is able to assess simultaneously how two stock markets are related at different frequencies and how such relationship evolves over time (Rua, 2010). Wavelet analysis: (1) works for both stationary and non-stationary data and does not really require the stationarity assumption; (2) is able to preserve both time and frequency information, and; (3) decomposes the fluctuations in a variable (Crowley, 2005). It is therefore an integrated framework for a robust simultaneous analysis that enables the identification of areas within a unified time interval-frequency band space along which two stock markets move together (McCarthy and Orlov, 2012; Graham et al., 2013). It also reveals interactions between stock markets which would otherwise be concealed using other alternative contemporary econometric models (Aloui and Hkiri, 2014).

The choice of wavelet analysis involves a number of considerations, including choosing between real and complex wavelets, continuous and discrete wavelets, orthogonal and redundant decompositions (Ftiti et al., 2014). In this study, we use the Continuous Morlet Wavelet coherence (CMWC) transform to analyse the evolving integration of stock markets in Africa. Continuous wavelets are more robust to noise compared to other decomposition techniques and are best in analysing the phase interactions between two time series (Ftiti et al., 2015). Similarly, the Morlet wavelet coherence is very well localised in scales and in frequency, while the Mexican hat wavelet gives a poor frequency localisation, although it has a good time localisation (Ftiti et al., 2015).

On the other hand, the standard time series econometric methods (such as cointegration analysis, GARCH-type models, etc.), which consider separately the frequency and time aspects of the analysis lose valuable information from one side (Uddin et al., 2014). Specifically, studies that only base the analysis on time series aspect lose the frequency aspect, while studies that only base the analysis on frequency aspect lose the time aspect. They can only provide a snapshot of co-movement over a particular sample period or at the frequency level, but not both at the same time. Such studies are also unable to account for differences in investors in terms of their preferred investment horizons. Meanwhile, it has been suggested strongly that cross-correlation analyses should allow for differences in short-term and long-term investor choices (Candelon et al., 2008; Aloui and Hkiri, 2014).

The wavelet approach is thus a suitable tool for concurrently analysing the behaviour of time series in terms frequency and time aspects. Wavelets are particularly useful for analysing variables with finite signals or those that exhibit distinctly different behaviour in different periods of time (Crowley, 2005). Wavelet analysis is based on the wavelet transform that transforms the signal or time series through the help of functions known as wavelets. A wavelet is a real-value or a complex-value function $\psi(.)$ defined over the real axis and is assumed to be square integrable $\psi(.) \in L^2(\mathbb{R})$ (Aloui and Hkiri, 2014). Wavelets involve two fundamental filters namely, the father wavelets ϕ and the mother wavelets ψ. The father wavelet (i.e. scaling function) integrates to 1 and represents the smooth, trend or low-frequency part of the signal, while the mother wavelet integrates to 0 and represents the detailed, volatile or high-frequency part specified as follows:

$$\int \phi(t)\,dt = 1 \tag{4.11}$$

$$\int \psi(t)\,dt = 0 \tag{4.12}$$

Mathematically, the wavelet is defined as follows:

$$\psi_{v,s}(t) = \frac{1}{\sqrt{s}}\psi\left(\frac{t - v}{s}\right) \tag{4.13}$$

where v is the location parameter giving the precise position of the wavelet, s is the scale dilatation parameter of the wavelet defining how the wavelet is dilated or stretched, $\frac{1}{\sqrt{s}}$ is the normalisation factor ensuring that wavelet transforms are similar across scales and time series with the unite variance of the wavelet $\left\|\psi_{v,s}\right\|^2$, and $\psi_{v,s}(t)$ denotes elementary functions which are obtained using wavelet transform and derived from a time-localised mother wavelet $\psi(t)$. Also, it should be noted that several types of wavelets with varied specifications are discussed in the wavelet literature. In the present study, we follow Grinsted et al. (2004), Rua and Nunes (2009) and Vacha and Barunik (2012) and use the Morlet wavelet. The Morlet wavelet provides good feature extraction properties and a good balance between frequency and time localisation (Grinsted et al., 2004; Rua and Nunes, 2009; Vacha and Barunik, 2012). Addison (2002) describes it as a complex or analytic wavelet within a Gaussian envelope that has good time-frequency localisation. The Morlet wavelet with $\omega_0$denoting the central frequency of the wavelet employed in this study is presented as follows:

$$\psi^M(t) = \pi^{-\frac{1}{4}} e^{i\omega_0 t} e^{-t^2/2} \tag{4.14}$$

We follow the common practice in the wavelet literature and set the dimensionless frequency parameter $\omega_0 = 6$ to provide a good balance between time and frequency localisation (Grinsted et al., 2004; Rua and Nunes, 2009; Vacha and Barunik, 2012).

Also, a wavelet function is a small wave that has a beginning and an end (Graham et al., 2012). The waves can be manipulated to allow a complex, non-stationary signal to be represented as frequency components with time localisation. Although different wavelet functions exist in the literature, including discrete and continuous wavelets, the latter type is applied in this study. Continuous-time wavelets better represent complex signals and are able to preserve more information than any alternative types (Graham et al., 2012). To qualify for application in the computation of continuous wavelet transform (CWT) a wavelet function[20], $\psi(t)$ must fulfil a number of conditions. First, the wavelet function must have zero mean and its square should integrate to unity (Percival and Walden, 2000; Gencay et al., 2002) as exemplified in the following equations:

$$\int_{-\infty}^{\infty} \psi(t)dt = 0\text{, and} \tag{4.15}$$

$$\int_{-\infty}^{\infty} \psi^2(t)dt = 1 \tag{4.16}$$

Second, the wavelet function is further required to meet the so-called *admissibility condition* (Daubechies, 1992) defined in equation (4.17) below. Essentially, the function transforming the signals needs to behave like a window in both frequency and time and be adequately localised in both domains. Thus, the wavelet being analysed should decrease

[20] Wavelet analysis recognises a father wavelet and a mother wavelet. Whereas the father wavelet is a scaling function representing the smooth and trend (low frequency) aspect of the signal, the mother wavelet denotes the detailed (high frequency) aspects by scale, focusing on the extent of manipulation of the wavelet transform (Crowley, 2005).

quite rapidly towards zero in both positive and negative directions of the time-domain (Chui 1992).

$$C_{\psi} = 2_{\pi} \int_{-\infty}^{\infty} \frac{\left|\hat{\psi}(\omega)\right|^2}{|\omega|} d\omega < \infty \tag{4.17}$$

In the above representation, $\hat{\psi}(\omega)$ denotes the Fourier transform of $\psi(t)$, with $\hat{\psi}(\omega) = \int_{-\infty}^{\infty} \psi(t) e^{-i\omega\tau} dt$ with the integral covering all the frequencies ω. This condition allows a time series $x(t)$ to be reconstructed from its continuous wavelet transform, $W_x(v, s)$.

4.6.1.1 The Continuous Wavelet

To extend the wavelet analysis to co-movement or integration analysis of two stock index time series $(x_t \; and \; y_t, \; t = 0,1, \dots, n)$, we execute the continuous wavelet transformation for each of the respective time series. Following Rua and Nunes (2009) and Vacha and Barunik (2012), the continuous wavelet transform $W_x(v, s)$ of $\psi(t)$ of a discrete time series $x(t), \; t = 1, 2 \dots, n$ is defined as a convolution as follows:

$$W_x(v,s) = \int_{-\infty}^{\infty} x(t) \psi_{v,s}^{*}(t) dt = \frac{1}{\sqrt{s}} \int_{-\infty}^{\infty} x(t) \, \psi^{*} \left(\frac{t-v}{s}\right) dt \tag{4.18}$$

where s denotes the scale, v signifies the time position and $*$ represents a complex conjugate. The amplitude of the transform $|W_x|$ can be construed as the wavelet power $|W_x|^2$ which is the squared of $|W_x|$. To obtain $W_x(v,s)$, we project the specific wavelet $\psi(.)$ on the selected time series. It is important to note that the key feature of the wavelet transform is the energy preservation of the selected time series. Thus the wavelet transform has the aptitude to decompose and subsequently reconstruct and recover the original time series $x(t)$ from the wavelet transform (Daubechies, 1992; Rua and Nunes, 2009) through the following:

$$x(t) = \frac{1}{C_{\psi}} \int_{-\infty}^{\infty} \left[\int_{-\infty}^{\infty} \frac{1}{\sqrt{s}} \psi \left(\frac{t-\tau}{s}\right) W_x(v,s) d\tau \right] \frac{ds}{s^2}, \qquad s > 0 \tag{4.19}$$

This unique property of the wavelet transform is then used for the power spectrum analysis to specify the variance as

$$\|x\|^2 = \frac{1}{C_{\psi}} \int_{0}^{\infty} \left[\int_{-\infty}^{\infty} |W_x(v,s)^2| dv \right] \frac{ds}{s^2}, \qquad s > 0. \tag{4.20}$$

4.6.1.2 The Wavelet Squared Coherency Technique

Subsequently, we assess the co-movement or cross-correlation behaviour of stock markets over time and frequency using the wavelet squared coherence. For this reason, the cross-wavelet transform is introduced initially prior to performing the wavelet squared coherence. Following the representation in Rua and Nunes (2009), we construct the cross wavelet transform of two stock index time series $(x_t \, and \, y_t)$ with corresponding continuous wavelet transforms $W_x(v,s)$ and $W_y(v,s)$ as follows:

$$W_{xy}(v,s) = W_x(v,s)W_y^*(v,s) \tag{4.21}$$

where v denotes the position index, s is the scale and $*$ represents the complex conjugate. Torrence and Compo (1998) define the cross wavelet transform as $\left|W_{xy}(v,s)\right|$. Like the wavelet power $|W_x|^2$, the cross wavelet power can be defined as $\left|W_{xy}\right|^2$ (Graham et al. 2012). The cross wavelet power shows areas within the time-frequency space where the two stock index time series exhibit high common power. It can be construed as a measure of the local covariance between two stock index time series at each scale (Aloui and Hkiri, 2014).

In the final part, to measure the co-movement between two given stock markets, we employ the wavelet coherency technique to measure the coherence of the cross wavelet transform in the time-frequency space. As a measure of localised correlation coefficients in frequency and time, the coherence provides a useful tool for detecting stock market co-movement/integration (Aloui and Hkiri, 2014). Following Torrence and Webster (1999) and Rua and Nunes (2009), we define the wavelet squared coherence measure as the squared absolute value of the smoothed cross wavelet spectra, normalised by the product of the smoothed individual wavelet power spectra of each of the selected stock index time series. Formally, the wavelet squared coherence is presented as follows:

$$R^2(v,s) = \frac{\left|S\left(s^{-1}W_{xy}(v,s)\right)\right|^2}{S(s^{-1}|W_x(v,s)|^2)S\left(s^{-1}\left|W_y(v,s)\right|^2\right)} \tag{4.22}$$

where s denotes a smoothing operator. The wavelet squared coherence $R^2(v,s)$ falls in the range $0 \leq R^2(v,s) \leq 1$ and can be interpreted as a measure of the correlation coefficient between the two stock index time series. A high value of the wavelet squared coherence (values closer to 1) would imply high levels of co-movement or integration between two stock markets, while a low wavelet squared coherency value (values closer to 0) would imply low levels of co-movement or integration. Moreover, the behaviour of the coherence over the time-frequency space would help measure evolving stock market integration. Also, we assess the statistical significance of the co-movement between stock markets in the time-frequency space by comparing the squared coherence values to a background spectrum of a large number of white noise pairs simulated through Monte Carlo methods (see Graham et al., 2013). The co-movement between the stock markets is interpreted as being statistically significant at the 5% level in areas where the actual squared coherence exceeds the 95% confidence interval for the background spectrum.

4.6.1.3 The Wavelet Phase Difference

To complete the analysis, we use the wavelet phase differences to depict any lead/lag relationships in the time series of any two stock markets. In line with Torrence and Webster (1999) we define the wavelet coherence phase difference as follows:

$$\phi_{xy}(v,s) = \tan^{-1}\left(\frac{\mathfrak{I}\left\{S\left(s^{-1}W_{xy}(v,s)\right)\right\}}{\mathfrak{R}\left\{S\left(s^{-1}W_{xy}(v,s)\right)\right\}}\right) \tag{4.23}$$

where $W_{xy}(v,s)$ is the cross-wavelet transform (XWT) of two stock market time series (v and s) and $\mathfrak{I}$ and $\mathfrak{R}$ represent a fictional and a real part operator, respectively. Phase difference is depicted in the wavelet squared coherence plots using arrows. Theoretically, zero phase differences indicate that the two stock index series examined move in tandem. Arrows pointing to the right (left) suggest that the time series are in-phase (out-of-phase), or are positively (negatively) correlated. When arrows point to the right (left) and downward (upward) the first index series leads (lags) the second index series by $\pi/2$.

4.6.2 Dynamic Conditional Correlation (DCC-GARCH) Analysis

The correlations between returns of stock market indices can be used to show periods when co-movements have evolved. Stock market return correlations have been found to be time-varying with the majority of the evidence pointing to increased levels of correlation (Kearney and Lucey, 2004; Chelley-Steeley, 2005). Multivariate GARCH-type models are standard estimation procedures used to capture time-varying relationships between time series. The Dynamic Conditional Correlation, Generalised Autoregressive Conditional Heteroskedasticity (DCC-GARCH) standard procedure proposed by Engle (2002) is used in this study to estimate time-varying conditional correlations. The purpose here is to enable us compare the results from a time-domain DCC-GARCH model with those reported from the frequency-time-domain wavelet analysis. The DCC-GARCH model is a flexible yet parsimonious parametric model that has seen wide empirical implementation (Hwang et al., 2013). It provides a number of advantages over alternative estimation procedures (Chiang et al., 2007). First, the DCC-GARCH model directly accounts for heteroscedasticity as it effectively estimates the correlation coefficients of the standardised residuals. It allows direct inference on the cross-market conditional correlations. Second, the model allows additional regressors to be included in the mean equation to capture the influence of a common factor. Third, the DCC-GARCH model is good at examining multiple asset returns without using too many parameters. Thus the resulting estimates from the DCC-GARCH procedure provide dynamic trajectories of correlation behaviour for stock-market-index returns within a multivariate setting (Chiang et al., 2007). This information facilitates analysis of the correlation behaviour of stock market indices in the presence of multiple regime shifts due to shocks, crises, and other exogenous changes.

Multivariate GARCH estimation procedures such as the VECH (Bollerslev et al., 1988) and the BEKK-GARCH (Baba et al., 1991) are alternative models but have the limitation of being very expensive in estimation time if the number of assets exceeds two (Chiang et al., 2007). The constant conditional correlation (CCC) model proposed by Bollerslev (1990) is another alternative that could be employed. However, while the CCC model is an attractive parameterisation and consists of time-varying covariances, its main weakness is its restrictive and unrealistic assumption of constant correlation between time series (Silvennoinen and Terasvirta, 2008).

To begin with, the return and variance equations, following Chiang et al. (2007), can be respectively specified as follows:

$$r_t = \gamma_0 + \gamma_1 r_{t-1} + \gamma_2 r_{t-1}^{US} + \varepsilon_t \tag{4.24}$$

$$h_{ii,t} = \alpha_i + \beta_i h_{ii,t-1} + \delta_i \varepsilon_{i,t-1}^2 \quad i = 1, 2, \ldots\ldots, 12 \tag{4.25}$$

In these formulations, $r_t = (r_{1,t}, r_{2,t}, \ldots\ldots, r_{n,t})'$, $n = 12$; $\varepsilon_t = (\varepsilon_{1,t}, \varepsilon_{2,t}, \ldots\ldots, \varepsilon_{n,t})'$ $and\ \varepsilon_t | \mathrm{I}_{t-1}(r_t) \sim N(0, H_t)$. Also, we follow the conventional approach and include in the mean equation an AR(1) term and the one-period lagged US stock return (represented by the S&P 500). While the inclusion of the AR(1) term is intended to account for autocorrelation in stock returns, that of the lagged stock return is intended to account for the United States as a global factor (Chiang et al., 2007). The inclusion is also based on empirical findings that suggest that the US market has had an important influence on stock returns in developing and emerging markets.

A key assumption is that the returns of the individual stock market index are multivariate and normally distributed with zero mean and conditional variance-covariance matrix H_t on the information available at $t-1$ defined as $E_{t-1}(r_t) \sim N(0, H_t)$. Subsequently, the multivariate DCC-GARCH model is formally presented as follows:

$$H_t = D_t R_t D_t \tag{4.26}$$

where $D_t = diag\left(\sqrt{h_{ii,t}}\right)$ is the $(n \times n)$ diagonal matrix of time-varying standard deviation from univariate GARCH models with $\sqrt{h_{ii,t}}$ on the leading (i$^{\text{th}}$) diagonal, $i = 1,2, \ldots, n$; and $R_t = \{\rho_{ij}\}t$ is $(n \times n)$ conditional or time-varying correlation matrix. The univariate GARCH (P, Q) processes containing the elements in D_t takes the form

$$h_{i,t} = \psi_i + \sum_{p=1}^{P_i} \alpha_{ip} \varepsilon_{i,t-p}^2 + \sum_{q=1}^{Q_i} \beta_{iq} h_{i,t-q} \qquad \forall i = 1, 2. \tag{4.27}$$

Engle (2002) proposes a two-step procedure for estimating the conditional covariance matrix H_t using the DCC model. In the first step, univariate volatility models are estimated to obtain the estimates of $\sqrt{h_{ii,t}}$ for each of the stock returns. In the second step, the stock-return residuals are standardised (transformed) by their conditional standard deviations $u_{i,t} = \varepsilon_{i,t} / \sqrt{h_{ii,t}}$ from the first step and used to estimate the parameters of the conditional correlation. The DCC model provides the evolution of the correlation as follow:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha \mu_{t-1} Q'_{t-1} + \beta Q_{t-1} \tag{4.28}$$

where $Q_t = \left(q_{ij,t}\right)$ denotes the $(n \times n)$ time-varying covariance matrix of $u_{i,t} = \varepsilon_{i,t} / \sqrt{h_{ii,t}}$; $\bar{Q} = E[\mu_t \mu_t']$ denotes the $(n \times n)$ unconditional variance matrix of $u_{i,t}$, and α and β are nonnegative scalar parameters satisfying the condition $(\alpha + \beta) < 1$. Recognising that Q_t does not normally have ones on the diagonal elements, it is appropriately scaled to obtain a suitable correlation matrix R_t using the equation:

$$R_t = (diag(Q_t))^{-1/2}\, Q_t (diag(Q_t))^{-1/2} \tag{4.29}$$

where $(diag(Q_t))^{-1/2} = diag(1/\sqrt{q_{ii,t}}, \dots \dots, 1/\sqrt{q_{nn,t}})$. Thus R_t is now a correlation matrix having ones on the diagonal and off-diagonal elements which are less than one in absolute value, providing that Q_t is positive definite. Typically, an element of R_t takes the form $\rho_{ij,t} = q_{ij,t}/\sqrt{q_{ii,t}q_{jj,t}}, \quad where\ i,j = 1,2, \dots, n, and\ i \neq j.$

Consequently, the time-varying correlation coefficient $\rho_{ij,t}$ between two stock markets i and j can then be expressed as follows:

$$\rho_{ij,t} = \frac{(1-\alpha-\beta)\bar{q}_{ij} + \alpha u_{i,t-1}u_{j,t-1} + \beta q_{ij,t-1}}{\sqrt{\left[(1-\alpha-\beta)\bar{q}_{ii} + \alpha u_{i,t-1}^2 + \beta q_{ii,t-1}\right]}\sqrt{\left[(1-\alpha-\beta)\bar{q}_{jj} + \alpha u_{j,t-1}^2 + \beta q_{jj,t-1}\right]}} \tag{4.30}$$

It should be recalled that the estimation of DCC-GARCH model involves the utilisation of a two-step procedure to maximise the log-likelihood function (Engle, 2002). That is, if ω and φ denote the parameters in D_t and R_t respectively, then the log-likelihood function (of the observations on ε_t) for the DCC model is represented as follows:

$$L(\omega,\varphi) = \left[-\frac{1}{2}\sum_{t=1}^{T}(nlog(2\pi) + \log|D_t|^2 + \varepsilon_t' D_t^{-2}\varepsilon_t\right] + \left[-\frac{1}{2}\sum_{t=1}^{T}(\log|R_t| + u_t' R_t^{-1} u_t - u_t' u_t)\right] \tag{4.31}$$

The first part in this likelihood function represents volatility, measured as the sum of individual GARCH likelihoods, which can be maximised during the first step. The second part represents the correlation component of the likelihood function in the second step which can be maximised to estimate time-varying correlation coefficients.

4.6.3 Testing Unit Root in the Time Series

A prerequisite for performing regression analysis using time series data is that the data must be stationary, otherwise spurious regression results may be produced and misleading conclusions and recommendations professed. But for the DCC-GARCH analysis, tests of unit root would not be required in wavelet analysis. The condition of stationarity or non-stationarity of time series can be accomplished by conducting a test for the presence of unit roots. A variable is stationary when it contains no unit root, but becomes non-stationary in the presence of a unit root. Even though unit roots can be verified either by checking the significance of the coefficients of autocorrelation functions or by examining the extent of the decaying in the correlogram, a formal stationarity testing is advised (Brooks, 2014: 361). A number of methods are available for formal test of stationarity such as the Augmented Dickey-Fuller (1979, hereafter referred to as ADF), the Phillips and Perron (1988, hereafter referred to as PP), the Kwiatkowski et al. (1992, KPSS), and the Elliot et al. (1996, DF-GLS) unit-root tests.

In the present study, two versions of the unit root tests, namely, the ADF and PP methods are used to examine the stationarity of the 11 African stock market indices and those of the United States and China. Both tests have the same asymptotic distribution and specify the null hypothesis as $H_0\colon \phi = 0$ against the alternative hypothesis of $H_1\colon \phi < 0$. The ADF test involves the estimation of the following regressions: test without an intercept (eqn. 4.32), test with an intercept only (eqn. 4.33), and test with an intercept and a deterministic trend (eqn. 4.34). The acceptance or otherwise of the null hypothesis is determined by the probability values and tau t tests. The successful rejection of the null hypothesis signifies that the series are stationary and are thus suitable for econometric estimation. On the other hand, failure to reject the null hypothesis implies that the series contain unit roots, and would require that the model be first-differenced to obtain stationarity of the series.

$$\Delta y_t = \phi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + u_t \tag{4.32}$$

$$\Delta y_t = \beta_1 + \phi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + u_t \tag{4.33}$$

$$\Delta y_t = \beta_1 + \beta_2 t + \phi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + u_t \tag{4.34}$$

where t is the time or trend variable. The lag length is determined empirically using the Schwarz Bayesian Information Criterion $SBIC = ln(\hat{\sigma}^2) + \frac{k}{\mathrm{T}}\ln \mathrm{T}$, with $\hat{\sigma}^2$ being the residual variance, $k = p + q + 1$ being the total number of parameters estimated, and T denoting the sample size[21]. Also, the ADF test includes the lagged difference terms of the dependent variables to deal with serial correlation in the error terms. The PP test however applies a different approach from the ADF unit root test to deal with the possibility of the presence of serial correlation in the error terms. The PP test specifies nonparametric statistical methods without adding lagged difference terms in the following regression:

$$\Delta y_t = \Omega D_t + \delta y_{t-1} + \mu_t \tag{4.35}$$

where D_t is a vector of deterministic terms such as constant, trend, etc., $\Delta y_t = y_t - y_{t-1}$ and $\mu_t$is white noise I(0) and may be heteroscedastic. The PP test modifies the ADF test statistics to correct for possible serial correlation and heteroscedasticity in the errors μ_t. The PP test statistics (Z_t *and* Z_π) are computed as follows:

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\sigma}^2}\right)^{\frac{1}{2}} \times Z_\pi = 0 - \frac{1}{2}\left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2}\right) . \left(\frac{\mathrm{T} \times SE(\hat{\pi})}{\hat{\sigma}^2}\right) \tag{4.36}$$

$$Z_t = \mathrm{T}_\pi - \frac{1}{2}\frac{\mathrm{T}^2 \times SE(\hat{\pi})}{\hat{\sigma}^2}\left(\hat{\lambda}^2 - \hat{\sigma}^2\right) \tag{4.37}$$

The terms σ^2 and λ^2 in equations *(4.36)* and *(4.37)* are consistent estimates of the variance parameters

$$\sigma^2 = \lim_{n\to\infty} \mathrm{T}^{-1} \sum_{t=1}^{T} E[\mu_t^2] \tag{4.38}$$

$$\lambda^2 = \lim_{n\to\infty} \sum_{t=1}^{T} E[\mathrm{T}^{-1} S_T^2] \tag{4.39}$$

where $S_T = \sum_{t=1}^{T} = \mu_t$ with the sample variance of the least squares residual $\hat{\mu}^2$ being a consistent estimate of σ^2 and the Newey-West long-run variance estimate of μ_t using $\hat{\mu}^2$ is a consistent estimate of λ^2.

[21] The SBIC is strongly consistent and asymptotically delivers the correct model order (Brooks, 2014), even though it is not necessarily superior to the Akaike's information criterion (AIC) and the Hannan-Quinn information criterion (HQIC).

4.6.4 Data and Preliminary Analysis

A description of the data and statistical properties are examined in this section. The data comprises weekly closing stock price indices of eleven (11) of Africa's leading stock markets and the United States spanning the period from 4th January 2002 to 26th December, 2014 (providing 678 weekly observations for each market). The main stock market indices examined are those in South Africa (Johannesburg Stock Exchange, FTSE/JSEASI), Mauritius (Stock Exchange of Mauritius, SEMDEX), Namibia (Namibia Stock Exchange, NSXASI), Botswana (Botswana Stock Exchange All Companies Index, BSEACI), Nigeria (Nigerian Stock Exchange, NGSEASI), Ghana (Ghana Stock Exchange Composite Index, GSECI), Cote D'Ivoire (West African Regional Stock Exchange, BRVMCI), Morocco (Morocco All Share Index, MASI), Egypt (The Egyptian Exchange, EGX), Tunisia (Tunis Stock Exchange, TUNINDEX), and Kenya (Nairobi Stock Exchange, NSEASI). The weekly stock price index of the United States, the S&P 500 Composite Index, is used as a proxy for the world stock market because the U.S. market is commonly regarded as a global factor.

Stock market data are inherently problematic, especially in developing countries due to nonsynchronous trading, infrequent trading and short-term correlation due to noise. Nonetheless, weekly data should cause fewer problems than daily data (Graham et al., 2013). All markets in this study are open to foreign investors to various extents (see Table 2.1 in chapter Two). All the market index data, obtained from DataStream International (Thomson Financial), are denominated in US Dollars to circumvent exchange rate problems and ease comparison. Missing data due to national holidays and events were assumed to stay the same as those of the trading days immediately preceding the affected dates ending the week (see Chiang et al., 2007). It is should be noted that the sample period covers some major global events including the spectacular upsurge in oil prices in 2007 and early 2008, the global financial crisis and economic meltdown covering the period 2007-2009, the subsequent gradual recovery in 2010, and the long-lasting Euro-zone debt crisis which started sometime in 2009. The data was analysed using MATLAB 7.1 (for wavelet analysis) and OxMetrics7 (for DCC-GARCH analysis).

In Figure 4.2, we graph the time series plots of the 11 African stock indices and the S&P 500 composite index. It can be inferred from the graph that most African stock market indices and S&P500 composite index appear to exhibit long-swing movements over the sample period. The behaviour of the indices however varies greatly over the period. The most erratic behaviour appears to be exhibited by South Africa, followed by Tunisia and Morocco. Seven of the eleven African markets (Cote D'Ivoire, Egypt, Ghana, Kenya, Mauritius, Namibia and Nigeria) however exhibit weekly price indices that appear far below \$1,000 throughout the sample period.

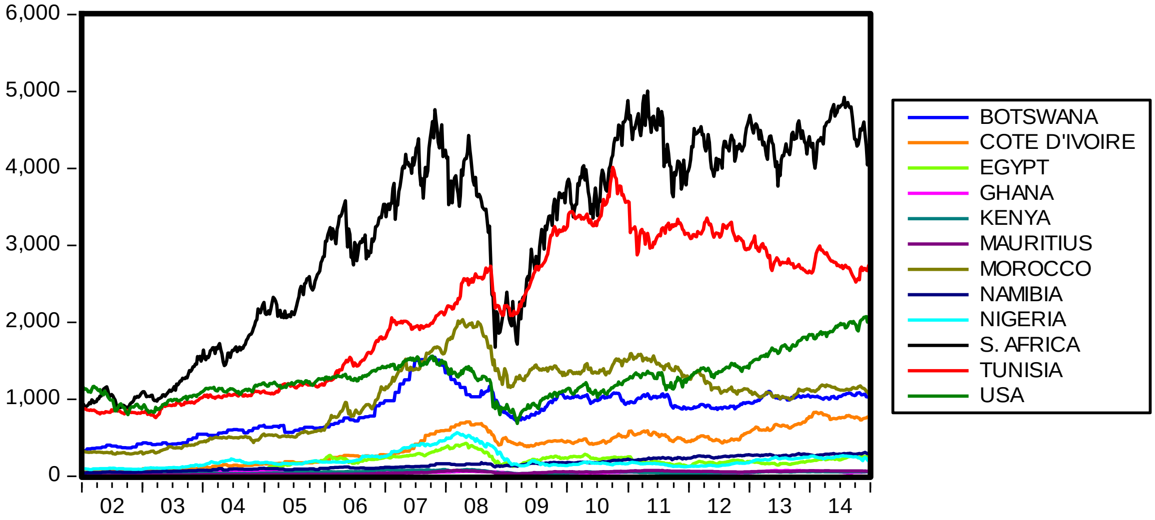


Figure 4.2: Weekly stock market indices of African markets and the USA

Following the classical approach, the returns are computed as the first difference of the natural log of each stock price, expressed as percentages using the equation

$$r_t = [ln(P_t/P_{t-1})] \times 100 \qquad (4.40)$$

where r_t is weekly stock index return, P_t is the stock price at current week (t) and P_{t-1} is the previous week's stock price. The weekly returns are used instead of level data largely because the focus of the study is on weekly price dynamics over time. It should also be noted that non-stationarity, which is a major stylised fact about the behaviour of stock market indices, is not a source of concern when applying wavelet analysis; as such data filtering is not a priority (Aloui and Hkiri, 2014). Besides, wavelet analysis has the uncommon advantage of decomposing time series into their time scale components.

Table 4.1 presents a summary of the key statistics of the indices, indicating the four moments (mean, variance, skewness and kurtosis) of return distribution. All the market indices posted positive mean returns. All individual African markets outperformed the S&P 500 index in the United States during the sample period. The highest mean return is recorded in Egypt (0.347) followed by the West African regional stock market in Cote D'Ivoire (0.331), with Nigeria having the lowest mean return in Africa. Interestingly, the lowest average return in recorded in Nigeria is however still higher than the mean returns in both China (0.099) the United States (0.085), indicating that returns are quite high in Africa like most developing and emerging markets. Generally, volatility, as measured by the standard deviation in Table 4.1, appears very high in all the African stock markets. With the exception of Tunisia, which recorded 1.784 standard deviation, all the other market indices posted standard deviations higher than the rule of thumb of 2. The highest volatility occurs in Egypt, with a standard deviation of 4.197. This position is further strengthened by Egypt recording the most minimum return (-21.926) and a maximum return (14.594) that is far lower than its counterparts. This feature is consistent with financial theory relating to the risk-return trade-off. Higher returns are required as compensation for investing in a more volatile or risky assets.

Table 4.1: Summary statistics of African stock market returns (logarithmic returns)

Index	Mean	S.D.	Min.	Max.	Skewness	Kurtosis	Jarque-Bera	LBQ(16)
Kenya	0.173	3.109	-13.895	20.305	0.468	10.023	(2353.96)***	31.62**
Egypt	0.347	4.197	-21.926	14.594	-0.802	6.803	(435.71)***	40.10***
Morocco	0.178	2.393	-12.364	8.623	-0.667	6.279	(524.56)***	32.53***
Tunisia	0.169	1.784	-11.860	7.213	-0.799	9.494	(1261.51)***	39.23***
Botswana	0.167	2.232	-14.397	16.030	0.631	13.199	(4668.99)***	39.17***
Mauritius	0.258	2.309	-15.929	11.521	-0.511	10.447	(1416.12)***	106.66***
Namibia	0.278	2.723	-18.036	13.900	0.446	12.091	(1594.02)***	13.06
S. Africa	0.229	4.048	-19.088	24.419	-0.305	7.269	(353.43)***	36.38***
Cote D’Ivoire	0.331	3.056	-11.342	21.388	1.586	12.927	(2979.28)***	20.32
Ghana	0.138	2.550	-12.981	21.903	0.862	15.749	(3063.48)***	176.87***
Nigeria	0.129	3.356	-15.022	16.281	-0.090	6.926	(480.55)***	52.63***
USA	0.085	2.474	-20.084	11.356	-0.862	11.291	(2022.67)***	29.69**

Notes: ** and *** denote statistical significance at 5% and 1% levels, respectively. S.D. is standard deviation, min. is minimum return value, max. is maximum return value, and LBQ is the Ljung-Box test statistic for serial correlation. The sample contains 677 observations (04/01/2002-26/12/2014) for each considered stock market.

However, there are no guarantees that higher risk would offer the highest possible return. This claim is supported by the fact that the lowest mean return in Nigeria coincides with a high volatility measure (3.356). South Africa, which shows a lower mean return (0.229) relative to markets such as Cote D'Ivoire, Egypt, Mauritius and Namibia, is also the second highly volatile market in Table 4.1. In the light of these characteristics, while risk is indicative of higher potential returns, it is equally an indication of higher potential losses. Overall, investors in Africa face a risk-return trade-off where higher potential returns are linked to potentially high risks.

The distributional properties of index returns, as indicated by the third and fourth moments, appear to exhibit extreme observations. In Table 4.1, five African market indices (Botswana, Cote D'Ivoire, Ghana, Kenya and Namibia) show positive skewness, while six of them and the United States show negative skewness. Positive skewness is indicative of a return distribution with an asymmetric tail that extends towards more positive values, while negative skewness shows a return distribution with an asymmetric tail that extends towards more negative values. Thus the skewness in the weekly returns suggests returns distribution that is typically asymmetric. Generally, investors prefer positively skewed return distribution over negatively skewed return distribution because of risk, which implies "winning money isn't as good as losing money is bad". Also, the significantly high values of kurtosis suggest that the weekly returns of African stock markets are leptokurtic distributed. The Jarque-Bera (JB) test statistics and corresponding probability values reinforce the excess kurtosis and skewness measures and suggest evidence against normal distribution for all the market indices. Deviation from the normality assumption is partly attributable to the presence of second moment temporal dependencies. Assuming a linear process for returns with such temporal dependencies could lead to the exclusion of important features of the time series. The issue of temporal dependence of second moment is further supported by the Ljung-Box Q-statistics (LBQ) calculated for 16 lags. The hypothesis that all serial correlations up to the 16^{th} lag are jointly zero is rejected. Specifically, the null hypothesis that "there is no serial correlation" is rejected for all the countries except Cote D'Ivoire and Namibia. A possible reason for autocorrelation is non-synchronous trading (Fisher, 1996), which is a common feature of African stock markets (Alagidede, 2008). In most African markets trading is concentrated on few stocks with many stocks experiencing non-trading over long periods. These statistics suggest that the conditional variance processes may be appropriately parameterised using GARCH models.

To further visualise the behaviour of prices and returns, Figures 4.3 and 4.4 present the graphs of weekly price indices and returns for African stock market indices. An initial observation in Figure 4.3 is that there was a sharp plunge in all stock indices following the

US sub-prime mortgage market crash in 2007 and the eventual 2008-2009 global financial crisis. The decline was generally severe from mid-2008 to early 2009.

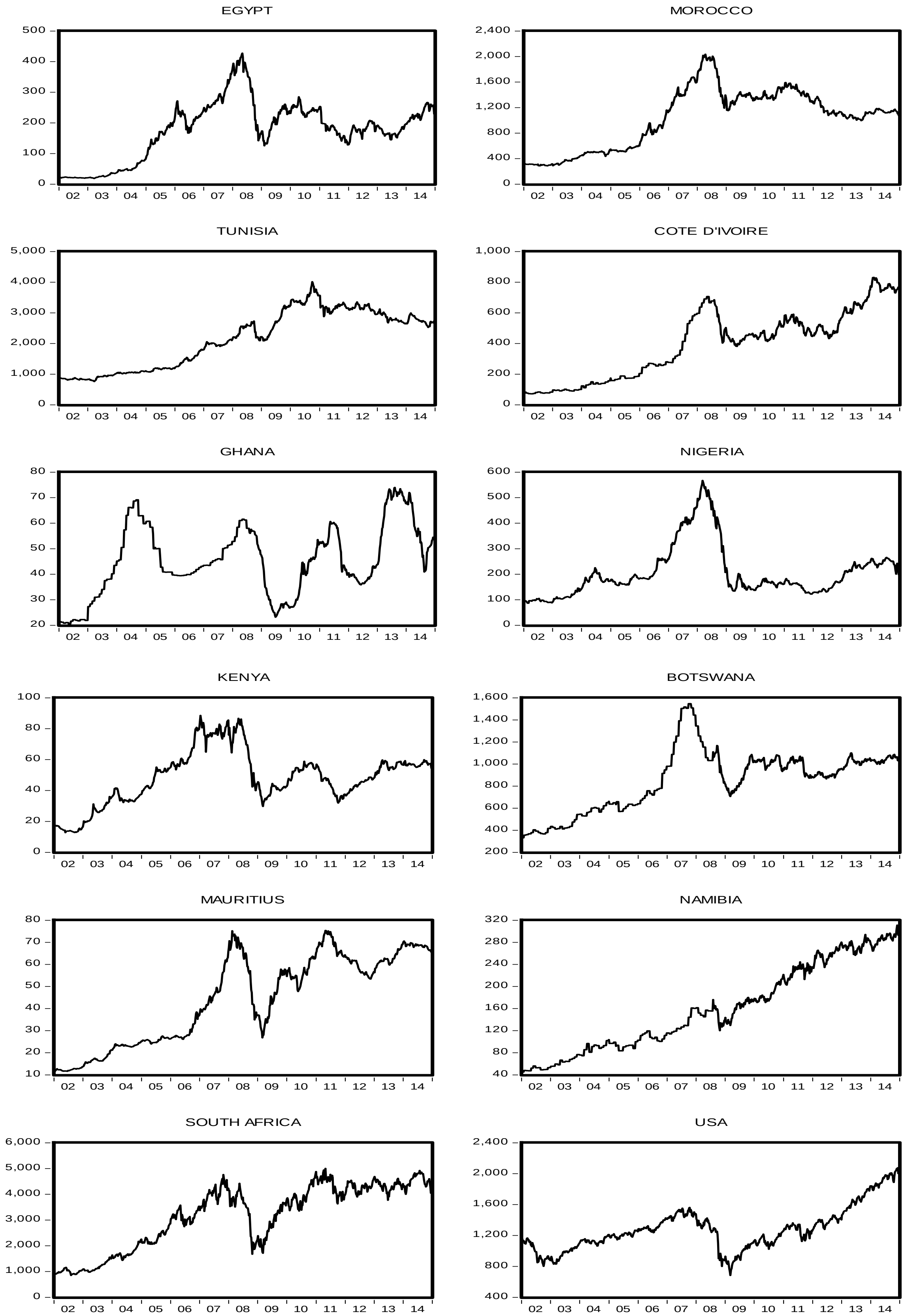


Figure 4.3: Weekly stock price indices of African stock markets
Source: Authors' calculations from data obtained.

For example, the Egyptian bourse experienced a sharp drop from around April 2008 through to the first quarter in 2009. The markets in Cote D'Ivoire, Ghana, Morocco and Tunisia plummeted between August 2008 and mid-2009, while the Nigeria market appears to have experienced the sharp drop much earlier, in June 2008.

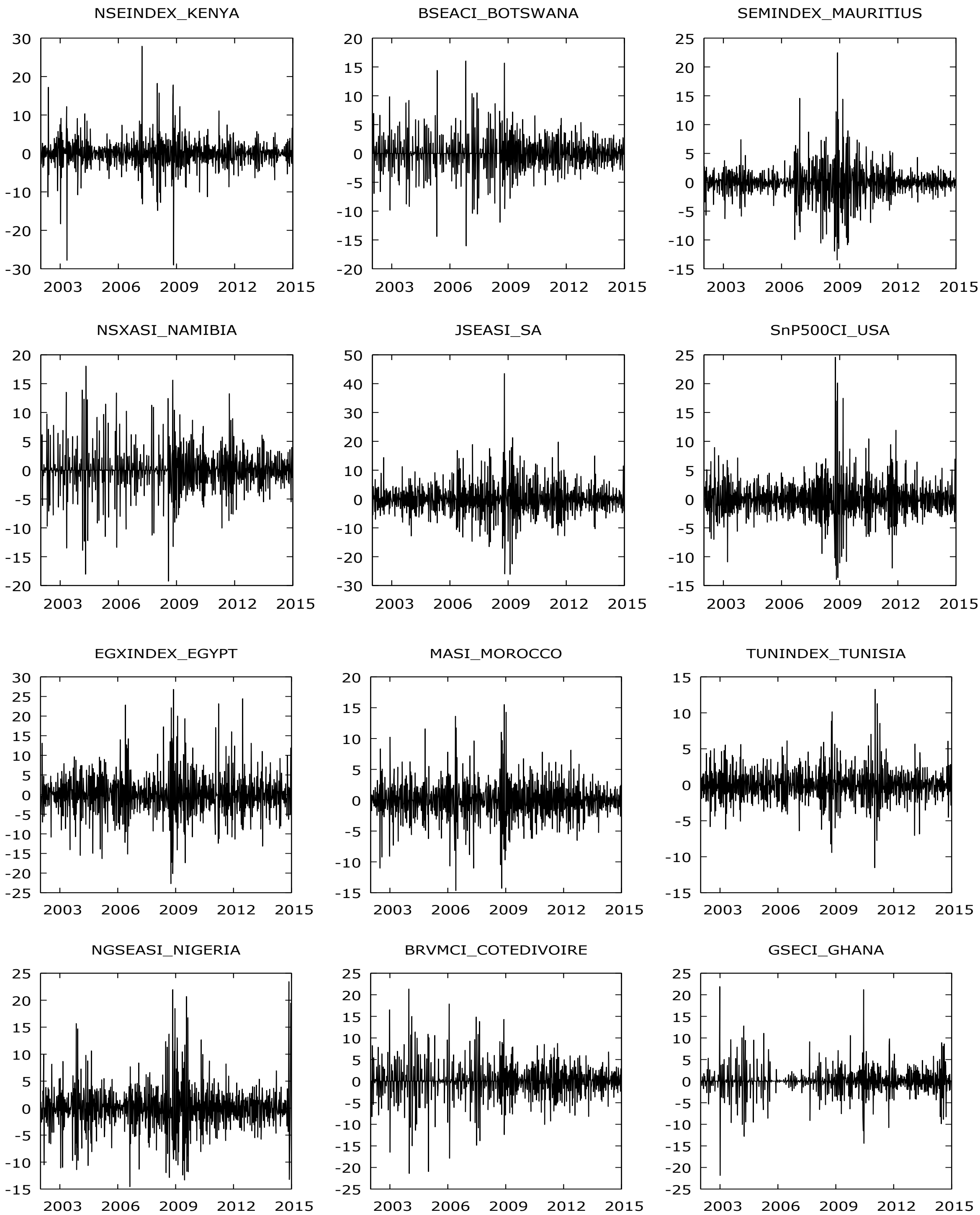


Figure 4.4: Weekly stock returns of African stock market indices
Source: Authors' calculations from data obtained.

A few markets (i.e. Botswana, China and South Africa) sharply dropped during late 2007 through to the early part of 2009. All the markets however appear to have responded to the gradual recovery which was experienced around mid-2009. Even though all the markets have maintained the upward trend since the recovery period, the general performance of the individual indices remains far below what it was prior to the 2008-2009 global financial crisis. An implication of these statistics is that African stock markets were not spared from the global financial crisis, signifying that Africa's integration with the world market may have improved.

The plots of return series for Africa's stock market indices in Figure 4.4 depict the usual phenomenon of volatility clustering in stock returns. Clustering of volatility is a major stylised fact for financial market data, a feature that makes GARCH models a suitable methodology in time-domain analysis.

Next, we turn to the unconditional correlations among African stock markets and with the United States market which serve as a naïve measure of integration. The results are displayed in Table 4.2. A striking observation in Table 4.2 is that all African stock markets exhibit positive cross correlation with the United States market, the proxy for the world stock market. Also, the correlations are in most cases low for pairs of African stock market returns and the United States. Relatively lower and in some cases negative correlations can be observed among African stock markets. The simple correlation statistic ranges between 0.008 and 0.565 with most of them being statistically significant. The highest degree of correlation occurs between the South African and United States markets (0.565), while the lowest degree of correlation is recorded between the Nigerian and United States markets (0.008). The Namibian market recorded the next highest degree of correlation with the United States (0.503), while the next lowest degree of correlation is recorded between Ghana and the United States (0.044). It can be inferred from the correlation coefficients that Southern African region markets exhibit strong association with the United States, whereas the West Africa region markets exhibit week correlation with the United States. The contemporaneous correlations reported in Table 4.2, nonetheless, suggest greater correlation between Africa's market and the world market compared to those reported in previous studies (see Alagidede, 2010). These results may have signified greater co-movement of African markets with the rest of the world over time.

In terms of correlations within Africa, the statistics suggest that unconditional correlations are greater for intra-regional markets than for inter-regional markets. In particular, stock markets in the Southern African region exhibit higher degrees of correlation (see correlation coefficient for Botswana and Namibia, Botswana and South Africa, and Namibia and South Africa).

Table 4.2: Unconditional cross correlations of weekly stock returns in Africa

	BOT	COD	EGY	GHA	KEN	MAU	MOR
BOT	1.000						
COD	0.262***	1.000					
EGY	0.019	0.068	1.000				
GHA	0.012	0.156***	0.052	1.000			
KEN	0.144***	0.097***	0.274***	0.094**	1.000		
MAU	0.171***	0.152***	0.216***	0.037	0.222***	1.000	
MOR	0.138***	0.169***	0.229***	-0.051	0.147***	0.219***	1.000
NAM	0.503***	0.185***	0.075**	0.010	0.132***	0.165***	0.138***
NGA	0.042	0.015	0.070*	0.082**	0.070*	0.035	0.030
RSA	0.344***	0.231***	0.079**	-0.025	0.154***	0.234***	0.171***
TUN	0.158***	0.132***	0.165***	-0.004	0.155***	0.211***	0.326***
USA	0.174***	0.117***	0.193***	0.044	0.131***	0.275***	0.168***

	NAM	NGA	RSA	TUN	USA
NAM	1.000				
NGA	-0.026	1.000			
RSA	0.328***	-0.031	1.000		
TUN	0.168***	-010	0.211***	1.000	
USA	0.317***	0.008	0.565***	0.165***	1.000

Source: Authors' calculations on sample 2002-2014
Note: *, ** and *** denote significance at 10%, 5% and 1% levels.

Similarly, the cross correlation between Morocco and Tunisia (0.326) and Egypt and Morocco (0.229) show a moderate degree of correlation between markets in the North African region. However, stock markets in the West African region (Cote D'Ivoire, Ghana and Nigeria) appear to exhibit relatively weak cross correlation (in some cases no correlation) with each other and with markets across different regions. In fact, the occasionally negative correlation coefficients observed in Table 4.2 occur consistently between a West African region market and a counterpart market in a different region. In particular, the Nigerian stock market has a very low cross correlation with all African markets (and in some cases negative correlations). An important inference from these correlation statistics is that the West African Capital Market Integration Council (WACMIC), and indeed Africa's policy makers and market regulators must intensify efforts to improve the integration of the sub-region globally and regionally. It is not enough to liberalise stock markets, but it is absolutely important that such steps should ensure the removal of indirect barriers that daunt investments from the financial system.

Although low cross correlations suggest the presence of potential gains from diversifying in these markets, investors usually take into account several factors in their portfolio selection and allocation decisions. On the other hand, Kenya, the only leading market in the East Africa region, exhibits positive and statistically significant cross correlations with all African stock markets.

In general, the results of the unconditional correlation analysis of Africa's stock index returns indicate that the stock markets of Africa exhibit varied degree of co-movement with each other and with the world market. The stock markets in South Africa, Namibia and Mauritius are perhaps the most globally integrated African markets and equally exhibit greater integration regionally. Nevertheless, a number of African markets appear to have moderate correlations with the world market, but low correlations among themselves. However, it must be noted that the static nature of unconditional correlations, as in Table 4.2, may present an inaccurate picture about the dynamic nature of co-movements. Practically, Africa has undertaken widespread market-oriented reforms and the cross correlations between regional markets and with the world market may have evolved over time and across frequencies. The wavelet squared coherence tool is appropriate for analysing time-frequency varying dependency.

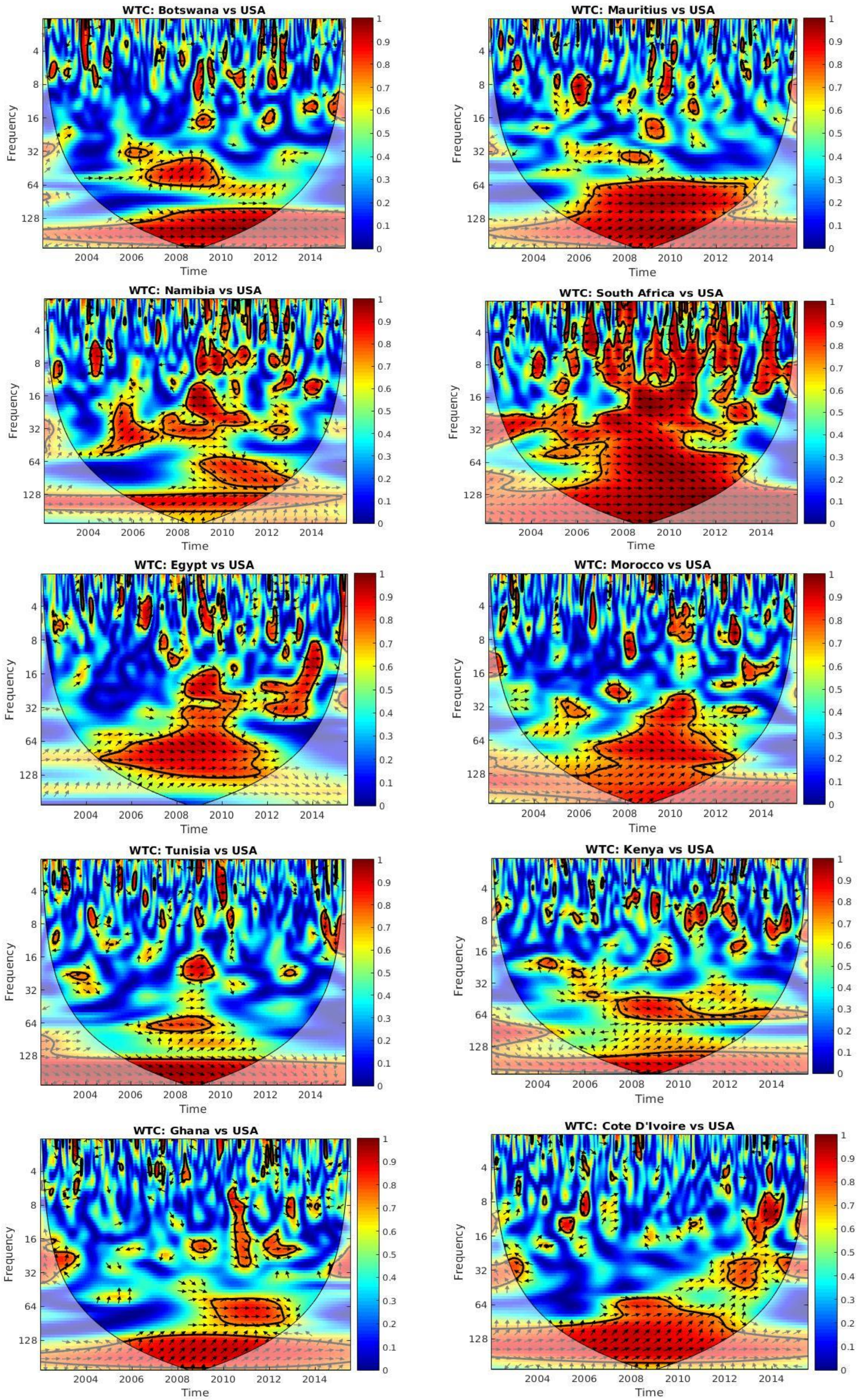
4.7 Empirical Results and Discussion

In this section, we apply the wavelet squared coherence as a measure of the localised correlations among our markets along with phase difference arrows which give an indication of the association and cause-effect or lead-lag relationships between stock markets. The results from the wavelet squared coherency analysis based on the continuous Morlet wavelet transform specification are presented and discussed sequentially. In section 4.7.1 we investigate the evolution of global co-movement/integration of African stock markets applying the plots of wavelet coherence and phase difference between African markets and the S&P 500 composite index of United States market. The results for evolving regional co-movement/integration of Africa's stock markets are presented and discussed in Section 4.7.2. The extent and pattern of intra-regional and inter-regional co-movements in African stock markets are also examined in this section. In Section 4.7.3, we present and discuss the results from the DCC-GARCH analysis. By this exercise, we are able to connect and compare the results from the time-frequency-based wavelet coherency analysis with the results from a purely time-domain DCC-GARCH analysis. The Section thus accomplishes objective two of this study which sought to analyse the evolving integration of Africa's stock markets.

4.7.1 Evolving Global Co-movements of African Stock Markets

Until very recently, the co-movements of markets had been analysed using traditional methods which are time-domain in nature and unable to capture simultaneously both time and frequency aspects of the data. In Figure 4.5, we present the wavelet squared coherency and phase different arrows for each pair of the considered African stock market and the world market (proxied by the S&P 500 in United States). The wavelet squared coherency measures the local correlation, and the phase difference arrows indicate any lead-lag relationships between two stock markets. The wavelet squared coherence is displayed using contour plots since it involves three dimensions (coherence, frequency and time). In Figure 4.5, the horizontal and vertical axes represent time and frequency, respectively. It is important to note that the frequency scale enables us to distinguish between short-term and long-term stock market co-movements, and between short-term and long-term fluctuations. Since we are dealing with a fairly long sample period (12 years with 677 return series), we consider 2-32 weeks of scale as short term, 32-64 weeks of scale as medium term, and 64-256 as long term (see Graham et al., 2013). Also, the cone of influence, indicating the region of edge effect, contains black contour lines that connote the 5 percent significance level. The significance level was simulated using the Monte Carlo method of two white noise series with Bartlett window type. Conversely, areas outside the cone of influence represent time-frequency space with no significant cross correlations. The vertical bar to the right of the wavelet squared coherence plots contains colour codes which indicate the extent/strength of local correlations (coherence). The colour code for coherency power ranges from red (high coherence) to blue (low coherence). Consequently, regions within the time-frequency space where two markets significantly co-move can be clearly observed.

For ease of interpretation, the frequencies are converted to time units (weeks) ranging from 4-weeks scale (high frequency) to 128-weeks scale (approximately two-and-half years, low frequency). Again, the index positioned first is the first series and the other is the second series, given that the order of presentation is necessary for validity (Madaleno and Pinho, 2012).


WTC: Botswana vs USA
WTC: Mauritius vs USA
WTC: Namibia vs USA
WTC: South Africa vs USA
WTC: Egypt vs USA
WTC: Morocco vs USA
WTC: Tunisia vs USA
WTC: Kenya vs USA
WTC: Ghana vs USA
WTC: Cote D'Ivoire vs USA
Frequency
4
8
16
32
64
128
Time
2004
2006
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0.1
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1

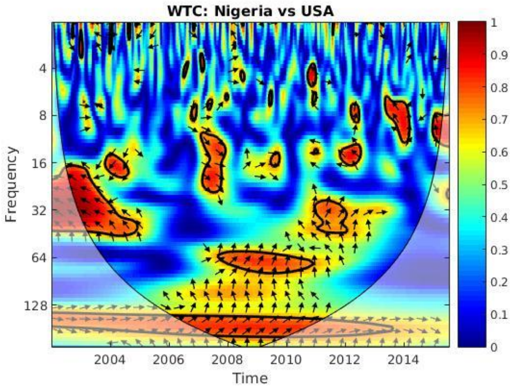


Figure 4.5: Wavelet squared coherency and phase difference plots between Africa's markets and the world market

Thus a visual assessment of the plots should enable us perceive the evolving/varying co-movements of Africa's stock markets with the world market, both over time and across different frequencies. In this unified framework,

1) a red area/contour at the bottom (top) of the wavelet coherence and phase difference plots signifies strong co-movement at low (high) frequencies;
2) a red area at the left-hand (right-hand) side within the cone of influence indicates strong co-movement at the beginning (end) of the sample period;
3) arrows pointing to the right (left) suggest that the pair of markets is in-phase (out-of-phase), or they are positively (negatively) correlated;
4) arrows pointing to the right (left) and downward (upward) signify that the first series leads (lags) the second series; and
5) more red colour codes in the region of edge effect signify high correlation or greater co-movement, while blue colour codes denote low correlation or lower co-movement.

The wavelet squared coherence plots in Figure 4.5 reveal noteworthy findings about the co-movement dynamics of Africa's stock markets with the world market. At first glance, highly visible regions of significance (red contours) can be observed in the wavelet squared coherency plots for the considered pairs of stock markets, but in varying intensity. The coherencies of Africa's stock markets largely extend over longer periods towards the middle and the end of the sample period. In addition, it is clearly observed that the dynamics of the interactive relationship between the examined African stock markets and the world stock market is changing quite rapidly over time and across frequency. Besides, the co-movements between the Southern African region (i.e. Botswana, Mauritius, Namibia and South Africa) exhibit greater and stronger fluctuations with the world market over time and at all levels of frequencies compared to markets in any of the other regions (i.e. East Africa, North Africa and West Africa regions).

Moreover, the magnitude and intensity of the coherencies observed in Figure 4.5 for the pairs of markets indicate that the degree of co-movement of African stock markets with the world market varies significantly across different markets. A typical case in point in the wavelet coherency plots in Figure 4.5 is the South Africa-USA pair. The coherency plot between the two stock markets shows noticeably very high and extended co-movement across all frequencies and over the entire sample period. Except for a few instances of low cross correlations, the coherencies between the two markets are largely higher than 0.8 as depicted by the extended red contours within the region of edge effect. The period from 2007 to 2013, which overlaps with the global financial crisis, reveals the greatest and most significant degree of co-movement between the South African and United States markets. Indeed, the market integration literature (Graham et al., 2013) suggests increased dependence among stock markets during financial crisis.

Similar findings are observed for the pairs of stock markets involving Egypt-USA, Morocco-USA, and Namibia-UAS, though the South Africa-USA pair is clearly distinct (see Figure 4.5). Greater coherencies (above 0.6) are perceived for the Namibia-USA pair mainly after 2008 at all frequency scales. For the Egypt-USA and Morocco-USA pairs, greater coherencies are observed at the middle and towards the end of the sample within the 16-128 and 32-128 frequency bands, respectively. The coherencies between Botswana and USA, Kenya and USA, and Mauritius and USA indicate a greater degree of co-movement. Referring to the Botswana-USA pair, we observe a greater degree of coherencies at various frequencies (i.e. 4-16 and 32-128 weeks) over the period 2008-2012. In the specific case of the Kenya-USA pair, greater coherencies are observed at higher frequencies (i.e. 4-16 weeks of scale) toward the middle and end of the sample period (i.e. short-term fluctuations). Patches of high coherencies are also observed at medium-scale frequency (i.e. 32-64 weeks of scale) during the 2008-2013 periods. The coherencies for the Mauritius-USA pair exhibit a moderate degree of co-movement at higher frequencies (i.e. 4-8 weeks of scale) between 2009 and 2010. Greater coherencies are further observed for the Mauritius-USA pair at lower frequencies for the extended period covering 2007-2013. For the Tunisia-USA pair, spots of greater coherencies are detected during the 2008-2010 period at different frequencies. Patches of red contours within the region of edge effect can also be observed in the wavelet coherency plots in

Figure 4.5 for each of the stock markets in Cote D'Ivoire, Ghana and Nigeria paired with the United States market. It is however important to point out that coherencies observed outside the cone of influence (i.e. the region of edge effect) are not significant statistically; as such no meaningful econometric inferences can be made about them.

An important implication of the findings in Figure 4.5 is that the magnitude and intensity of African stock market integration is growing and tends to be considerably affected by the financial crisis periods. Notably, the greater co-movement at lower frequencies extending towards relatively higher frequencies (i.e. 4-8 and 8-16 frequency bands) at the middle and towards the end of the sample coincides with the inception of the subprime financial crisis period (2007-2009). Essentially, the global co-movement dynamics of Africa's emerging and frontier stock markets are evolving gradually in both time and frequency, although this varies across markets and scales.

The findings observed in the wavelet coherency plots in Figure 4.5 suggest a declining trend in short-term more than long-term diversification gains in Africa's stock markets. This is particularly relevant in relation to the only three emerging markets (Egypt, Morocco and South Africa) and four frontier stock markets (Botswana, Kenya, Mauritius and Namibia). The results in Figure 4.5 corroborate findings in other prior studies such as Boako and Alagidede (2016) and Alagidede (2010). The findings in this study however contradict evidence in previous studies (such as Agyei-Ampomah, 2011) that suggest that African stock markets are still segmented. At best the segmentation of African markets has declined considerably and continually over time. In fact, the findings suggest that African stock markets are partially integrated with the world market and support Harvey's (1995) view that emerging markets are becoming more integrated into the global financial system.

From a financial standpoint, the evidence of increasing significant coherencies between most African stock markets and the United States at low and high frequencies implies that some minimal contagion may have occurred during the global financial crisis. The financial literature mostly perceives contagion effects as a significant increase in cross correlations following a shock to an individual market (Forbes and Rigobon, 2002). In fact, Forbes and Rigobon (2002) underscored the need to distinguish "contagion effect" from "increased stock market interdependence". It is "contagion effect' when a significant increase in co-movement is detected during financial crisis relative to tranquil periods. Conversely, continuous higher but insignificant levels of correlations observed during financial crisis are perceived as “increased interdependence”. The red areas confined to the region of significance (i.e. cone of influence) at the middle and toward the end of the sample period implies significant increase in co-movement due to the financial crisis. This finding, to some extent, supports the finding in Collins and Biekpe (2003) but contradicts Forbes and Rigobon (2002). The above studies however used time-domain analysis which is unable to capture time-varying correlations at different scales.

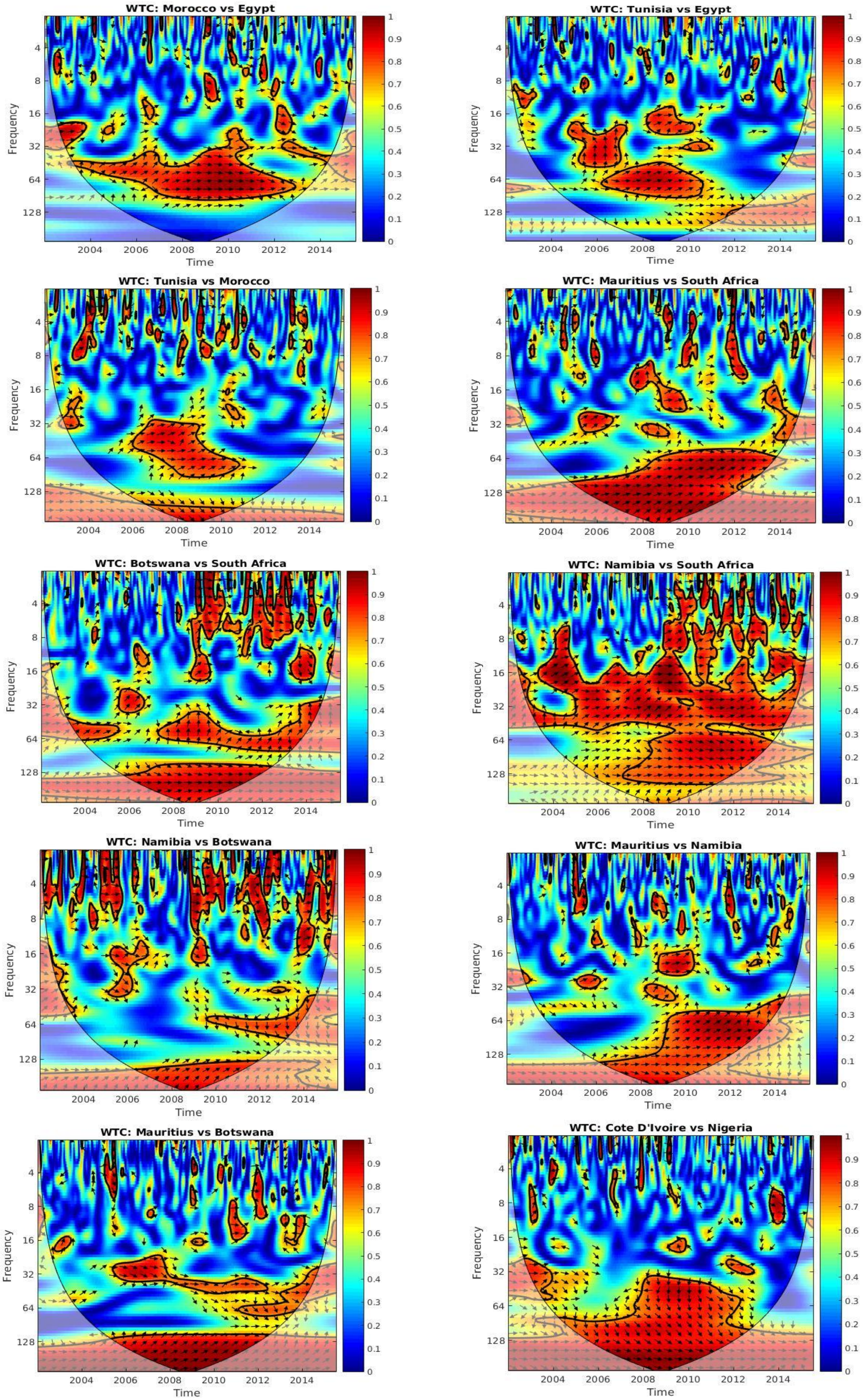
Another notable observation detected from the wavelet squared coherency plots in Figure 4.5 is a consistently changing pattern of the co-movement of African markets with the rest of the world. The market pairs for the United States with South Africa, Namibia, Egypt, and Morocco are classic examples. Initially, a few red contours are observed at high frequency (i.e. 4-16 weeks of scale) at the start of the sample period (i.e. 2002-2006). Eventually, we detect greater significant co-movements in the coherency plots following 2007 at almost all frequency scales. Meanwhile, the time-varying behaviour of the coherencies from an empirical stance could create structural breaks in the asset-price series in the event of significant external shocks. In fact, the market integration literature (Charles and Dane, 2006) has highlighted the need for the effects of market liberalisation and financial crisis to be considered as the major source of the instability in the pattern of stock market cross correlations. The changing pattern of co-movement observed in the coherency plots may have significant practical implications. From a portfolio diversification standpoint, the detection of significant co-movement over time and frequency denotes that potential benefits from diversifying internationally are limited for portfolio managers, international investors, and hedge funds in the African stock markets. Moreover, short-and long-term investors, respectively, who focus on co-movement of stock returns at higher frequencies (i.e. short-term fluctuations) and lower frequencies (i.e. long-term fluctuations) may adopt a pessimistic outlook towards investing in Africa.

Furthermore, the phase difference arrows in the coherency plots are used to analyse the direction of correlation and cause-effect or lead-lag relationships. From the phase differences, we perceive highly positive local correlations (coherencies) for all market pairs involving Africa’s stock markets and the global market (as arrow vectors largely point right in Figure 4.5). The phase difference further indicates that the relationships among the considered stock market indices are largely nonhomogeneous across scales as arrows mainly point left and right, and up and down constantly. As a result, we are unable to infer easily any lead-lag nexus between market volatilities, although short periods of leading or lagging can be detected in some instances. These findings are similar to the conclusion reached in a recent study by Boako and Alagidede (2016). In a time-domain analysis, Giovannetti and Velucchi (2013) however found that shocks from the United States are propagated in Africa and significantly affect their financial markets. This finding is not entirely different from those in this study as we perceive evidence of leading and lagging at various scales and time periods.

4.7.2 Evolving Regional Co-movements of African Stock Markets

The co-movement dynamics among Africa's stock markets are examined in this section using the wavelet squared coherency plots. First, we analyse the wavelet squared coherency and phase difference plots for a pair of stock markets within the same region (intra-regional co-movement analysis) and present the results in Figure 4.6. Specifically we examine the following pairs of stock markets: Morocco and Egypt, Tunisia and Egypt, Tunisia and Morocco for the North Africa region; and Cote D'Ivoire and Nigeria, Cote D'Ivoire and Ghana, Ghana and Nigeria for the West Africa region. The pairs of stock markets examined in the Southern Africa region are Mauritius and South Africa, Botswana and South Africa, Namibia and South Africa, Namibia and Botswana, Mauritius and Namibia, and Mauritius and Botswana. For the East Africa region, the Kenyan stock market (a frontier market) is the only leading stock market included in this study. Second, we measure inter-regional co-movement using the wavelet squared coherency plots for pairs of stock markets across different regions in Africa: East Africa, North Africa, Southern Africa, and West Africa (see Figure 4.7). In analysing the inter-regional co-movement among African stock markets, we pair the leading stock market in each region (which is also the most integrated market in that region) with the other regions' stock markets. From the wavelet coherency plots in Figure 4.6, we observe South Africa, Egypt, Kenya and Nigeria, respectively, as the most integrated Southern Africa, North Africa, East Africa and West Africa regions' stock markets.

Figure 4.6 presents the wavelet squared coherencies and phase difference plots between markets in the same regional bloc in Africa to examine intra-regional co-movements. As depicted by the red contours within the region of edge effect (i.e. region of significance levels), intra-regional co-movements in African stock market returns are non-constant over time and differ among pairs of markets. In particular, greater intra-regional co-movements are perceived in the Southern Africa region (but with greater variation over time and frequencies).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WTC: Tunisia vs Egypt
WTC: Tunisia vs Morocco
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WTC: Botswana vs South Africa
WTC: Namibia vs South Africa
WTC: Namibia vs Botswana
WTC: Mauritius vs Namibia
WTC: Mauritius vs Botswana
WTC: Cote D'Ivoire vs Nigeria
Frequency
Time
4
8
16
32
64
128
2004
2006
2008
2010
2012
2014
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0.1
0.2
0.3
0.4
0.5
0.6
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0.9
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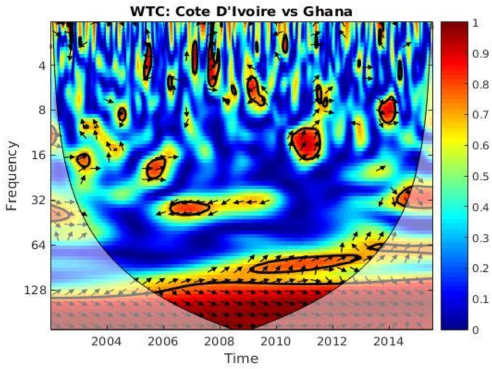


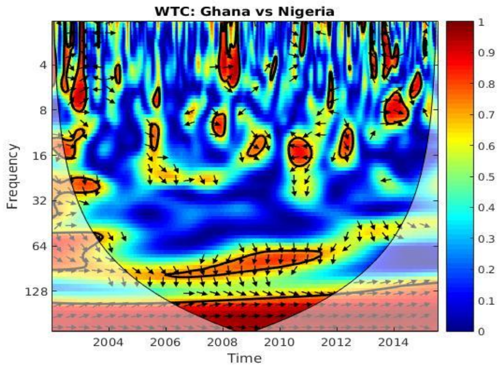


Figure 4.6: Wavelet squared coherency and phase difference plots for intra-regional co-movements of African stock markets.

The co-movement between Namibia and South Africa is the greatest of all, followed by the Botswana-South Africa pair, the Namibia-Botswana pair, and then the Mauritius-South Africa pair. The coherencies are nonetheless weaker relatively for the Mauritius and Namibia pair and the Mauritius and Botswana pair.

Also, the coherency plots point to evidence of co-movement at high and low frequencies, suggesting the existence of short-and long-term fluctuations. Moreover, evidence of varying co-movements is perceived in all pairs of markets after 2007 which coincides with the inception of the global financial crisis. The coherencies are particularly greater at higher scale frequencies (i.e. 4-16 weeks) and extend towards the middle and end of the sample period (i.e. 2008-2014) for Namibia-South Africa, Botswana-South Africa, and Namibia-Botswana pairs of markets. Of course, the Namibian stock market contains several South African shares. To the extent that none of these markets was a source of the crisis in the 2007-2009 period, this continuous significant increase in co-movement in the southern Africa region could be seen as increasing interdependence rather than contagion (see Forbes and Rigobon, 2002). In fact, many prior studies (Collins and Biekpe, 2003; Alagidede, 2010; Giovannetti and Velucchi, 2013) have found South Africa in particular to be highly correlated and more integrated with the world and regional markets.

The wavelet squared coherency plots in Figure 4.6 however show that intra-regional co-movements in the North Africa and West Africa regions' markets are generally low at all frequencies over the entire sample period. The coherency plots show fewer patches of the red areas in the region of edge effect than those observed in the Southern Africa region markets. The exception perhaps is the co-movements observed between stock markets in the North Africa region. The wavelet coherency plots for the Morocco-Egypt and Tunisia-

Egypt pairs indicate relatively greater co-movements at medium-scale frequencies (i.e. 34-64 weeks of scale) during the 2006-2011 periods. The Tunisia-Morocco pair however shows relatively greater co-movements at high and medium frequencies during the 2008-2010 periods. For the West Africa region markets, the results in Figure 4.6 generally point to low cross correlations, with a few instances of greater co-movements at lower scales (i.e. towards 128 weeks) during the 2007-2012 periods. Therefore, the patterns of co-movements in the North and West Africa regions' markets are observed to have varied over time with an inclination towards greater correlations at the middle of the sample period. From an Africa-wide perspective, the dependence among stock markets can be described as being highly dynamic and varying greatly in time and frequencies.

From a portfolio diversification view, the generally low correlations among markets in the same regional bloc qualify them to be treated as separate asset classes for purposes of diversification and portfolio selection strategies. For example, the results for the Southern Africa region markets imply some diversification gains in the short- to medium- term relative to the long-term. However, diversification gains may be limited substantially in the long-term investment horizons involving the Southern African markets. Similarly, potential diversification gains are available in stock markets in the North and West Africa regional blocs for both short- and long-term investment horizons.

In addition, phase difference arrows in the wavelet coherency plots in Figure 4.6 are largely pointing right which signifies that correlations for all pairs of African markets are in-phase (i.e. are positively correlated). The phase difference arrows further show that Africa's stock markets exhibit nonhomogeneous relationships across scales and time as arrows generally point left and right, and up and down constantly. Consequently, no clear lead-lag nexus can be easily inferred from market volatilities. There is however evidence of intermittent and short periods where leading or lagging can be detected between stock markets. For example, the lead-lag nexus shows that Botswana lags South Africa at medium-scale frequencies during the 2008-2012 periods; Mauritius lags South Africa at lower frequencies during the 2008-2010 periods; and Namibia lags South Africa at relatively higher frequencies nearly throughout the sample period. On the other hand, Mauritius leads Botswana at higher frequencies during the 2010-2012 periods, while Cote D'Ivoire leads Nigeria at relatively lower frequencies during the 2008-2010 periods.

Figure 4.7 presents the wavelet squared coherency and phase difference plots for inter-regional co-movements among African stock markets. In all, we analyse nine wavelet coherency plots to examine co-movements between regional markets as follows: North Africa region and Southern Africa region (i.e. Egypt-South Africa and Morocco-South Africa pairs), East Africa region and North Africa region (i.e. Kenya-Egypt and Kenya-Morocco pairs), East Africa and Southern Africa (i.e. Kenya-South Africa pair), East Africa region and West Africa region (i.e. Kenya-Nigeria pair), East Africa region and Southern Africa region (i.e. Kenya-South Africa pair), East Africa region and West Africa region (i.e. Kenya-Nigeria pair), West Africa region and North Africa region (i.e. Nigeria-Egypt and Nigeria-Morocco pairs), and finally West Africa region and Southern Africa region (i.e. Nigeria-South Africa pair). The evidence, as reflected by the few red areas within the cone of influence in Figure 4.7, generally points to low inter-regional co-movements among stock markets across different regions in Africa.

The co-movement however seems to be greater between all pairs at lower frequencies (i.e. 64-128 weeks of scale) during the 2008-2010 periods. Also, the co-movement between the North Africa and Southern African regions' markets is distinct as the evidence in Figure 4.6 points to relatively higher and stronger co-movement at low and high frequencies (i.e. 8-16 weeks and 64-128 weeks) over an extended period, 2006-2012. Thus the North Africa-Southern Africa regional co-movement is the greatest in Africa, but still lower than Africa's correlation with the world. On the other hand, the coherencies between the North Africa and West Africa regions' markets signify low local correlations between the two regions. The evidence thus points to time-varying but relatively slower patterns in the co-movement dynamics among regional markets in Africa. From the wavelet coherency plots in Figure 4.7, co-movements between all pairs of stock markets appear to have improved somewhat over the 2008-2010 period, but reverted to low frequencies afterward for most regional pairs. Barring the few instances, the evidence in this study (Figure 4.7) largely points to greater global integration than regional co-movement. The finding thus contradicts the conclusion by Collins and Abrahamson (2004) and the traditional view that markets become regionally integrated before global integration.

In terms of phases, the phase difference arrows in the wavelet coherency plots in Figure 4.7 largely point right which signifies that local correlations for all pairs of markets are in-phase (i.e. are positively correlated).

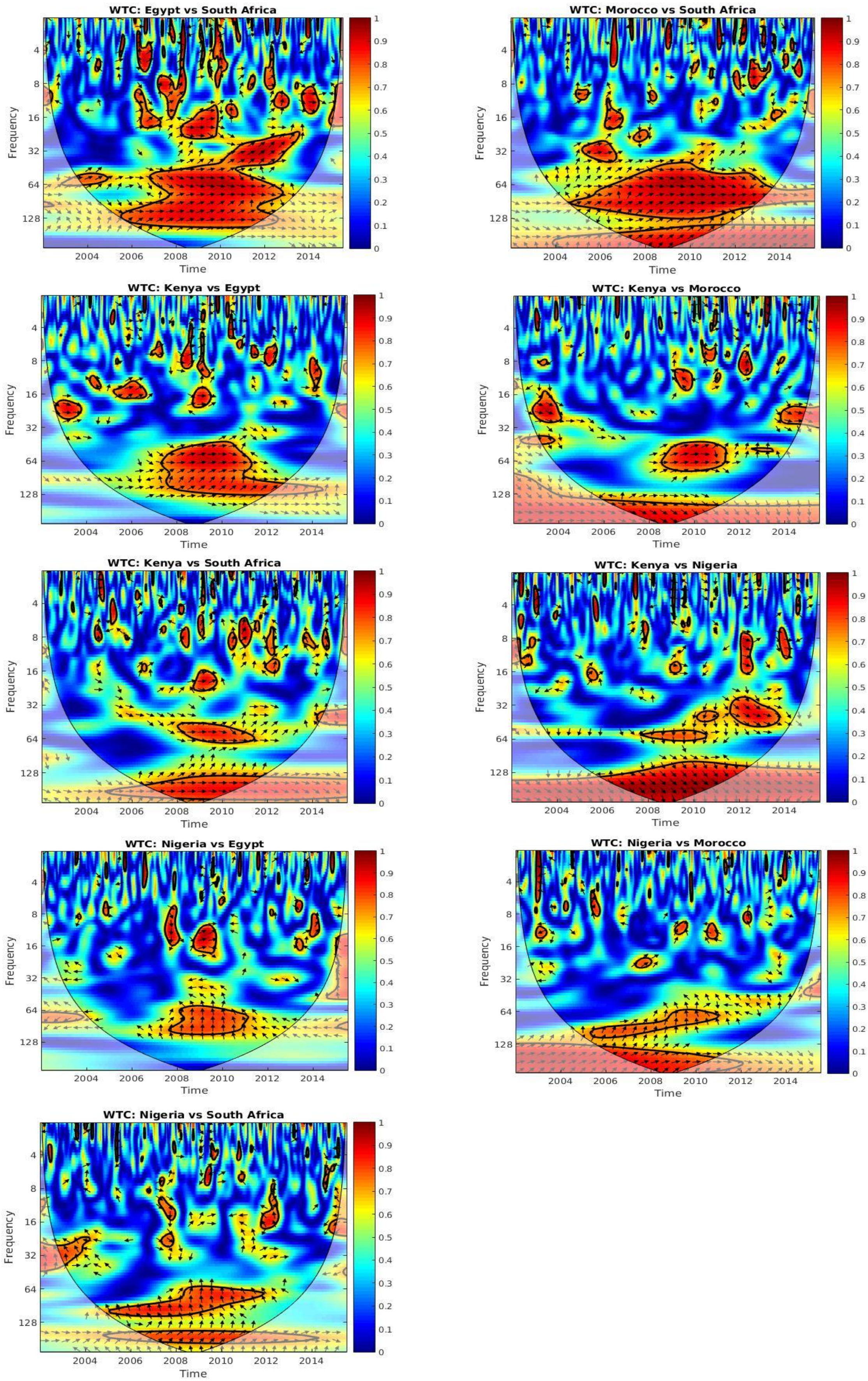


Figure 4.7: Wavelet squared coherency and phase difference plots for inter-regional co-movements of African stock markets.

Also, the phase difference arrows indicate that Africa's regional stock markets exhibit nonhomogeneous relationships across scales and time as arrows largely point left and right, and up and down constantly.

Consequently, no visible lead-lag nexus can be easily inferred from market volatilities, except to say that evidence of intermittent and short-periodic leading and lagging can be observed in a few instances. For example, the lead-lag nexus shows that the West Africa region markets lag the North Africa and Southern Africa regions' markets at the lower frequency bands of 64-128 weeks during the 2008-2010 period, which also overlaps with the global financial crisis periods. Also, the East Africa region markets and the Southern Africa region markets both appear to have led the West Africa region markets at lower frequencies during the same period.

From a practical financial perspective, the variability in the various aspects of inter-regional co-movements presents several implications for investors, and portfolio and hedge fund managers. While opportunities for regional diversification seem plausible due to the exhibition of generally low correlations, these diversification opportunities differ between regions and across investment horizons. While some horizons support long-term investments, the evidence mainly appears to favour short-to-medium term ones. It is important to note that the substantially greater interactive linkages observed among African stock markets following the global financial crisis periods have since reverted in most cases. However, longer-term investment horizons are likely to offer lower diversification benefits compared to short-term horizons.

4.7.3 Empirical Results from the Standard Time-Domain DCC-GARCH Analysis

In this section, we present and briefly discuss the empirical results from an alternative time -domain methodology, the standard econometric analysis from a DCC-GARCH model. The motivation is to provide empirical evidence of the time-varying nature of African stock market co-movements based on a pure time-domain Engle's (2002) multivariate DCC-GARCH model. As a precondition for the time-domain analysis involving time series, we implemented the unit root tests, the results are reported in Table 4.3. The results for the unit root tests for all equations for both the ADF and PP test procedures show that the series are all stationary after first differencing. Consequently, the study used the first differenced of the series in analysing the time-varying relationships and conditional correlations between markets in Africa and between African markets and the world stock market. In the first place, the ARCH and GARCH effects of each market in relation to the world stock market are verified.

Table 4.3: Results of Unit Root Tests

Variable	*Test Equation*	ADF Unit Root Test		PP Unit Root Test	
		Levels	*First Difference*	*Levels*	*First Difference*
Cote D'Ivoire	*None*	*1.563379*	*-23.03178****	*1.384400*	*-23.35702****
	Intercept only	*-0.410790*	*-23.17437****	*-0.505165*	*-23.40251****
	Intercept & Trend	*-1.856550*	*-23.16308****	*-2.026249*	*-23.39079****
Ghana	*None*	*-0.098138*	*-8.784563****	*-0.073239*	*-24.29759****
	Intercept only	*-2.384584*	*-8.801437****	*-2.293427*	*-24.28466****
	Intercept & Trend	*-2.389794*	*-8.810193****	*-2.296440*	*-24.26540****
Nigeria	*None*	*-0.431189*	*-8.172780****	*-0.405642*	*-25.25936****
	Intercept only	*-1.815359*	*-8.178047****	*-1.749780*	*-25.23957****
	Intercept & Trend	*-1.747364*	*-8.191094****	*-1.683065*	*-25.05377****
Kenya	*None*	*0.256746*	*-24.94598****	*0.099687*	*-25.22896****
	Intercept only	*-1.793356*	*-24.95769****	*-1.897907*	*-25.22745****
	Intercept & Trend	*-1.523119*	*-24.97223****	*-1.699793*	*-25.19811****
Egypt	*None*	*0.141951*	*-23.93246****	*-0.088647*	*-24.34799****
	Intercept only	*-1.589766*	*-23.94930****	*-1.737510*	*-24.26995****
	Intercept & Trend	*-1.400736*	*-23.95017****	*-1.663659*	*-24.26444****
Morocco	*None*	*0.346846*	*-24.33714****	*0.141680*	*-24.83305****
	Intercept only	*-1.520840*	*-24.35791****	*-1.552430*	*-24.82641****
	Intercept & Trend	*-0.578373*	*-24.43332****	*-0.863550*	*-24.84325****
Tunisia	*None*	*0.984523*	*-23.91356****	*0.771758*	*-24.15325****
	Intercept only	*-1.224883*	*-23.98013****	*-1.240492*	*-24.18055****
	Intercept & Trend	*-0.649971*	*-23.99860****	*-0.959080*	*-24.18238****
Botswana	*None*	*0.296310*	*-9.830371****	*0.312306*	*-26.44464****
	Intercept only	*-1.816775*	*-9.870468****	*-1.882154*	*-26.31356****
	Intercept & Trend	*-1.747479*	*-9.899400****	*-1.832888*	*-26.30132****
Mauritius	*None*	*0.868155*	*-15.62285****	*0.583409*	*-25.23987****
	Intercept only	*-1.281092*	*-23.40265****	*-1.406225*	*-25.20987****
	Intercept & Trend	*-1.769051*	*-23.40178****	*-2.245636*	*-25.19847****
Namibia	*None*	*2.008336*	*-27.27638****	*2.422925*	*-27.27858****
	Intercept only	*-0.326054*	*-27.50111****	*-0.174832*	*-27.81297****
	Intercept & Trend	*-3.815749*	*-27.48652****	*-3.560766*	*-27.80122****
South Africa	*None*	*0.307691*	*-21.11636****	*0.367644*	*-28.49516****
	Intercept only	*-1.755293*	*-21.16100****	*-1.678052*	*-28.52255****
	Intercept & Trend	*-2.689565*	*-21.16469****	*-2.467642*	*-28.51656****
USA	*None*	*1.282233*	*-26.75953****	*1.313045*	*-26.75016****
	Intercept only	*0.273363*	*-26.80744****	*0.320976*	*-26.80744****
	Intercept & Trend	*-1.158100*	*-26.89440****	*-1.158100*	*-26.88358****

Source: Author's calculation using data

The empirical results of the time-varying relationships between the world market (represented by the S&P 500 in the US) and each of the African stock markets estimated using the DCC-GARCH model are presented in Table 4.4. The ARCH and GARCH parameters (α and β, respectively) are largely statistically significant for most countries.

Table 4.4: Multivariate Condition Correlation Coefficients from the DCC-GARCH

Market	Parameter	Estimate	SE	t-stat.
Kenya	P	0.027	0.057	0.465
	A	0.510***	0.105	4.850
	B	0.365***	0.094	3.868
	L-L	-1781.749		
Botswana	P	0.160***	0.056	2.861
	A	0.315***	0.110	2.793
	B	0.340***	0.112	5.171
	L-L	-1671.817		
Mauritius	P	0.125**	0.049	2.534
	A	0.303**	0.166	2.422
	B	0.619***	0.130	4.760
	L-L	-1493.058		
Namibia	P	0.148	0.200	0.739
	A	0.234***	0.048	4.892
	B	0.501***	0.112	4.489
	L-L	-1825.129		
S. Africa	P	0.558***	0.032	17.520
	A	0.280***	0.086	3.248
	B	0.672***	0.096	6.990
	L-L	-2063.631		
Egypt	P	0.050	0.047	1.067
	A	0.464***	0.094	4.910
	B	0.363***	0.102	3.574
	L-L	-2054.99		
Morocco	P	0.048	0.068	0.714
	A	0.525***	0.114	4.616
	B	0.337***	0.075	4.477
	L-L	-1687.055		
Tunisia	P	0.127**	0.053	2.415
	A	0.168*	0.099	1.692
	B	0.747***	0.207	3.615
	L-L	-1499.812		
Cote d'Ivoire	P	-0.008	0.102	-0.080
	A	0.194***	0.051	3.787
	B	0.585***	0.149	3.934
	L-L	-1883.429		
Ghana	P	0.032	0.054	0.596
	A	0.305***	0.090	3.372
	B	0.349	0.383	0.911
	L-L	-1659.447		
Nigeria	P	-0.046	0.044	-1.052
	A	0.399***	0.106	3.760
	B	0.593***	0.087	6.816
	L-L	-1863.081		

Notes: The table displays results of Engle (2002) DCC-GARCH (1, 1) estimations. The model is estimated using the Gaussian-distribution. ρ is measures correlation, while $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are respectively the ARCH and GARCH parameters under the restrictive condition of non-negativity satisfying $\boldsymbol{\alpha} + \boldsymbol{\beta} < \mathbf{1}$ in all cases. L-L is log-likelihood, SE is standard error, and t-stat is t-statistics. *The* * **, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. The world stock market is proxied by S&P 500 Composite Index in the United States. The sample covers the periods 18/01/2002–26/12/2014 containing 676 weekly observations for each market.

The values of the ARCH parameters are fairly sizeable in most cases, suggesting that conditional volatility changes quite rapidly. Also, the GARCH coefficients are quite large for most countries. Higher GARCH coefficients are indicative of significant fluctuations of return volatility over time. Moreover, the necessary condition $\alpha + \beta < 1$ for model stability holds for all market pairs, with the sum of the parameters being closer to unity for most market pairs. This suggests that the DCC (1, 1)-GARCH (1, 1) model adequately measures time-varying conditional correlations, displays mean reversion along a constant level and may control for the high degree of persistence in conditional volatility in most markets.

Next, the study examined the time-varying relationships among African stock markets with a view to gauging intra-regional and inter-regional co-movements. To this end, the ARCH and GARCH coefficients were analysed using the leading stock market in each Africa region market as alternative markets in place of the world market. These leading regional markets include South Africa (for the Southern Africa region markets), Egypt (for the North Africa region markets), Kenya (for the East Africa region markets), and Nigeria (for the West Africa region markets). The estimated results are reported in four different Panels, namely Panels A to D in Table 4.5. These results measure the behaviour of conditional volatility between South Africa and other African stock markets (Panel A), Egypt and other African stock markets (Panel B), Kenya and other African stock markets (Panel C), and between Nigeria and other African stock markets (Panel D). An important observation from the results is that the values of the GARCH coefficients are considerably larger and statistically more significant than those of the ARCH and constant coefficients.

Specifically, the results in Panels A and B show GARCH coefficients that are very large and statistically significant (except Tunisia). Most of the coefficients in Panels C and D are however insignificant statistically. The larger values of the GARCH parameters in Panels A and B suggest that the conditional volatility of African stock market returns depends significantly on their past volatility than their past return shocks.

Table 4.5: Time-varying Relationships among African Stock Markets

Panel A: South Africa versus African stock markets

Market	$\boldsymbol{\alpha}$	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	Log Likelihood
South Africa				
Kenya	0.067(1.409)	0.006(0.539)	0.937(42.00)***	-3402.163
Egypt	0.083(2.144)**	0.00(0.009)	0.862(1.661)*	-3673.986
Morocco	0.163(4.317)***	0.002(0.00)	0.969(32.95)***	-3280.405
Tunisia	0.172(4.612)***	0.00(0.003)	0.864(0.218)	-3094.281
Botswana	0.321(2.510)***	0.053(2.564)***	0.935(36.36)***	-3105.827
Mauritius	0.130(1.247)	0.010(1.701)*	0.982(83.52)***	-3121.906
Namibia	0.326(3.243)***	0.011(2.564)***	0.979(35.45)***	-3241.218
Cote D'Ivoire	0.178(2.160)**	0.034(2.048)**	0.946(30.99)***	-3371.026
Ghana	-0.005(-0.156)	0.00(0.219)	0.999(199.9)***	-3247.083
Nigeria	-0.020 (-0.533)	0.00 (0.001)	0.759(3.778)***	-3481.106

Panel B: Egypt versus African stock markets

Market	$\boldsymbol{\alpha}$	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	Log Likelihood
Egypt				
Kenya	0.203(4.824)***	0.083(1.261)	0.616(1.849)*	-3440.556
Morocco	0.157(4.189)***	0.011(0.377)	0.638(2.160)**	-3331.612
Tunisia	0.061(1.042)	0.012(1.812)*	0.971(95.91)***	-3147.595
Botswana	-0.003(-0.096)	0.00(0.001)	0.883(4.454)***	-3222.250
Mauritius	0.108(1.811)*	0.016(2.058)**	0.958(52.61)***	-3174.225
Namibia	-0.024(-0.434)	0.009(1.457)	0.979(80.25)***	-3364.243
South Africa	0.083(2.144)**	0.00(0.022)	0.862(1.661)*	-3673.986
Cote D'Ivoire	0.046(1.605)	0.00(0.000)	0.245(0.107)	-3455.286
Ghana	0.012(0.304)	0.021(0.995)	0.925(11.43)***	-3292.442
Nigeria	0.082(2.002)**	0.111(1.898)*	0.00(0.000)	-3520.890

Panel C: Kenya versus African stock markets

Market	$\boldsymbol{\alpha}$	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	Log Likelihood
Kenya				
Egypt	0.203(4.824)***	0.083(1.261)	0.616(1.849)*	-3440.556
Morocco	0.171(4.370)***	0.00(0.00)	0.069(0.132)	-3054.617
Tunisia	0.171(3.472)***	0.027(1.226)	0.856(10.49)***	-2860.761
Botswana	0.0747(2.304)**	0.00(0.00)	0.040(0.012)	-2932.075
Mauritius	0.144(3.520)***	0.042(0.631)	0.432(0.730)	-2907.533
Namibia	0.083(2.342)**	0.00(0.00)	0.005(0.002)	-3069.191
South Africa	0.067(1.409)	0.006(0.539)	0.937(42.00)***	-3402.163
Cote D'Ivoire	0.099(2.052)**	0.008(1.083)	0.974(45.10)***	-3151.635
Ghana	0.098(2.958)***	0.005(0.767)	0.025(0.019)	-2983.601
Nigeria	-0.016(-1.052)	0.107(1.819)	0.435(3.939)***	-3546.385

Panel D: Nigeria versus African stock markets

Market	$\boldsymbol{\alpha}$	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	Log Likelihood
Nigeria				
Kenya	0.123(2.052)**	0.007(0.888)	0.980(47.42)***	-3242.525
Egypt	0.082(2.002)**	0.111(1.898)*	0.000(0.00)	-3520.890
Morocco	0.024(0.618)	0.00(0.000)	0.861(0.971)	-3137.867
Tunisia	-0.013(-0.336)	0.077(1.911)*	0.00(0.000)	-2952.270
Botswana	0.021(0.647)	0.00(0.065)	0.215(0.116)	-3027.855
Mauritius	0.094(2.566)***	0.00(0.000)	0.855(0.421)	-2981.817
Namibia	-0.009(-0.283)	0.001(0.110)	0.00(0.000)	-3165.093
South Africa	-0.020(-0.533)	0.000(0.000)	0.760(3.778)***	-3481.106
Cote D'Ivoire	0.062(1.943)*	0.007(0.224)	0.008(0.002)	-3244.207
Ghana	0.080(1.765)*	0.030(1.876)*	0.909(35.99)***	-3083.076

Notes: The *sample covers the periods 18/01/2002 – 26/12/2014 containing 676 weekly observations for each market. The α, $\theta1$, and $\theta2$ are parameters of the GARCH (1, 1) process.* T-statistics are in parentheses. *The* * **, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. T-statistics are in parentheses.

This indicates that the DCC (1, 1)-GARCH (1, 1) model, especially for Panels A and B, may have adequately captured the dynamic nature of the behaviour of return correlations and volatilities between stock markets.

It is important to check whether the considered market index series show evidence of multivariate ARCH effects and to test the adequacy of the multivariate GARCH specification in capturing the volatility linkages between stock markets. Thus the study performed diagnostic checking; robust tests for model standardised residuals are estimated and presented in Table 4.6. The results generally point to the absence of multivariate ARCH effects and support the adequacy of the multivariate GARCH specification.

Table 4.6: Diagnostics and Robust Tests for Model Standardised Residuals

Market	Skewness	Kurtosis	Jarque-Bera	Q(10)	$Q^2(10)$	ARCH Effect
Kenya	-0.3552***	11.342***	3637.9***	59.0835***	19.54	18.095
Egypt	0.4573***	2.9891***	42.428***	85.7106***	10.7157	25.166
Morocco	-0.3233***	2.5183***	190.40***	57.4149***	3.3436	26.515
Tunisia	-0.2964***	3.3237***	321.05***	99.5905***	30.162	34.985
Botswana	0.6228***	9.4593***	2564.0***	70.0304***	21.7549	52.175
Mauritius	0.4243***	1.7207***	85.159***	61.7253***	23.8932	47.131
Namibia	0.6487***	6.0***	1061.4***	104.571***	63.9721	57.520
South Africa	0.5830***	5.9641***	1040.2***	109.763***	17.5667	20.629
Cote D'Ivoire	-0.1183***	4.9140***	681.74***	92.8304***	28.6529	60.067
Ghana	0.2557***	10.648***	3200.9***	68.1272***	5.6361	58.396
Nigeria	0.6980***	4.7509***	690.65***	72.0388***	8.0643	29.174
USA	0.8647***	7.0163***	1470.8***	78.1076***	63.3212	28.119

Source: Authors' calculations using data

Furthermore, the study gauged the co-movements among African stock markets and the world markets using the dynamic conditional correlations from the DCC (1, 1)-GARCH (1, 1) analysis. Table 4.7 presents the dynamic conditional correlations between pairs of stock markets to examine the time-varying characteristics of the correlation matrix in the considered markets. Both positive and negative conditional correlation coefficients can be observed, with most of them appearing statistically significant. Similar to their unconditional correlations reported in Table 4.2, the magnitudes of the conditional correlations are generally low, ranging between 0.001 and 0.581. The highest conditional correlation occurs between the markets in Botswana (BSEASI) and Namibia (NSXASI), while the stock markets in Ghana (GSECI) and Namibia (NSXASI) exhibit the lowest conditional correlation. The next highest conditional correlation is recorded between the South Africa (JSEASI) and USA (S&P500) stock markets. A close inspection of these conditional correlation coefficients indicates that markets in the Southern Africa region appear to exhibit relatively higher conditional correlations compared with other markets.

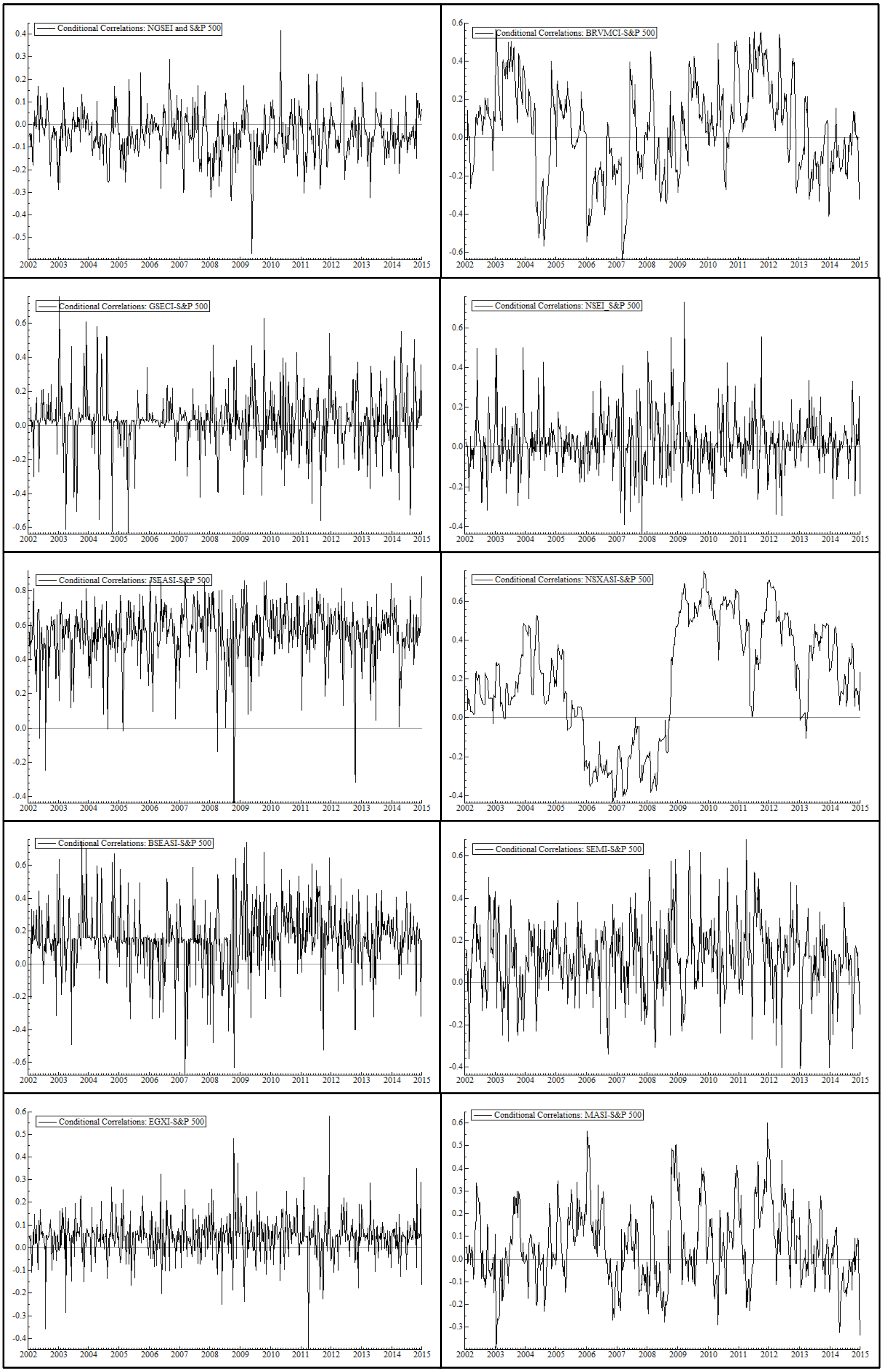
Table 4.7: Dynamic conditional correlations of stock returns from DCC-GARCH

	BSEASI	BRVM	EGXI	GSECI	NSEI	SEMI	MASI
BSEASI	1.000						
BRVM	0.248***	1.000					
EGXI	-0.037	-0.028	1.000				
GSECI	-0.031	0.155**	0.067*	1.000			
NSEI	0.080	0.042	0.158***	0.059	1.000		
SEMI	0.126**	0.166***	0.009	-0.029	0.082*	1.000	
MASI	0.126***	0.141**	0.079*	-0.098	0.085*	0.190***	1.000
NSXASI	0.581***	0.182***	-0.005	0.001	0.092*	0.139***	0.110**
NGSEI	0.026	0.016	0.015	0.022	0.035	0.008	-0.036
JSEASI	0.360***	0.198***	-0.038	-0.043	0.036	0.142***	0.079
TUNI	0.126***	0.121**	0.044	-0.018	0.070	0.176***	0.346***
S&P500	0.190***	0.104**	0.033	0.026	0.062	0.118**	0.057

	NSXASI	NGSEI	JSEASI	TUNI	S&P500
NSXASI	1.000				
NGSEI	-0.070	1.000			
JSEASI	0.317***	-0.046	1.000		
TUNI	0.181***	-0.032	0.169***	1.000	
S&P500	0.279***	-0.037	0.544***	0.102**	1.000

Note: *, ** and *** denote significance at 10%, 5% and 1% levels.
Source: Authors' calculations on sample 2002-2014

Higher dynamic conditional correlations are associated with extreme market movements such as economic downturns or financial crisis. Thus some extent of time-varying correlations (co-movements) may be perceived among markets in Southern Africa (JSEASI, NSXASI, BSEASI, and SEMI) on the one hand, and between them and the world market (the United States) on the other. The markets of Morocco and Tunisia also exhibit similar patterns in their conditional correlations.


Conditional Correlations: NGSEI and S&P 500
Conditional Correlations: BRVMCI-S&P 500
Conditional Correlations: GSECI-S&P 500
Conditional Correlations: NSEI_S&P 500
Conditional Correlations: JSEASI-S&P 500
Conditional Correlations: NSXASI-S&P 500
Conditional Correlations: BSEASI-S&P 500
Conditional Correlations: SEMI-S&P 500
Conditional Correlations: EGXI-S&P 500
Conditional Correlations: MASI-S&P 500

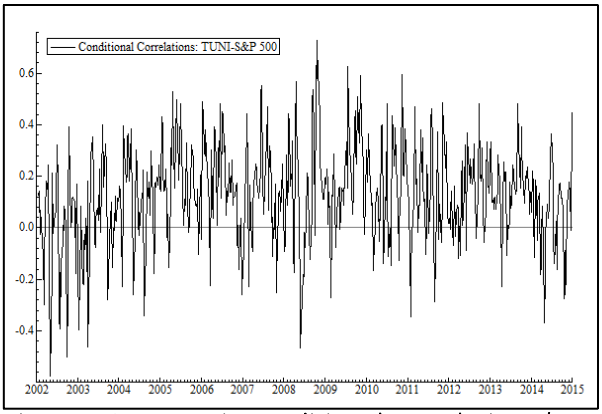


Figure 4.8: Dynamic Conditional Correlations (DCCs) of the world with African stock markets

In general however, the conditional correlation coefficients vary substantially over time and across different markets. These observations are depicted in the DCC plots in Figure 4.8 between the world market and the stock markets in Africa.

A close inspection of the evolution of the conditional correlations in Figure 4.8 reveals the presence of various tendencies. This means that assuming constant correlations in the interpretation may lead to mistaken and misleading conclusions. The graphs in Figure 4.8 exhibit interesting observations. First, parcels of high and low conditional correlations can be observed regardless of the considered market pairs. Conditional correlations between a stock index and the world market returns range from a value as high as 0.8 to a value as low as 0.1 in absolute terms.

Moreover, the correlations exhibit peaks and troughs mostly around the 2007-2009 period for most market pairs, justifying the dynamic nature of the correlations. The behaviour of the conditional correlations suggests increased interdependence during and soon after the financial crisis periods. The plots further display behaviour of sudden drops followed by sharp increases in the cross-correlations, which are indications of improvement in market integration. The graphical analysis of the conditional correlations between stock markets in Africa reported in Figure 4.8 indicates a similar behaviour to the plots in Figure 4.7 (plots of wavelet coherence). However, the inability of the DCC-GARCH model to capture simultaneously time-varying co-movement both in time and scales makes the Morlet wavelet coherency analysis most suitable for this study.

4.8 Chapter Summary and Concluding Remarks

This chapter investigated the evolving integration or co-movement of African stock markets and the world market. The chapter initially introduced the theoretical foundations that underlie interest in empirical research on stock market integration. In particular, the implications of higher interdependence of international stock markets for national financial markets and portfolio construction and management were highlighted. The theoretical and empirical literature was reviewed in line with the objectives of the chapter. The estimation methodologies implemented in this chapter were subsequently specified followed by a description of the data and their statistical properties. In the final sections, the empirical results from the continuous Morlet wavelet coherency analysis were presented and discussed, comparing them to those obtained from the pure time-domain DCC-GARCH analysis.

Overall, we conclude that co-movements between stock markets are both time-varying and scale dependent but with significant variations between market pairs. For African stock markets, greater global co-movements at both short- and long-term frequency scales are perceived in the emerging markets of South Africa, Egypt, and Morocco as well as stock markets in the Southern Africa region. The South African market is more integrated with world market than any other African market. On the other hand, lower intra-regional and inter-regional co-movements in both short- and long-term horizons exist among stock markets in Africa. Nevertheless, the relative strength of these dependencies differs between pairs of markets and pairs of regions. No definite and stable lead-lag relationships could be observed either among stock markets in Africa or between them and the world market. An important implication of the findings in this chapter is that potential international and regional diversification advantages still exist in Africa's emerging and frontier markets, but these opportunities vary considerable in time and in scale. If the rising trend in global dependence observed in this chapter were to continue, then long-term international diversification benefits would reduce substantially in the near future. In the next chapter, we analyse the link between market integration and informational efficiency of stock markets in Africa by addressing the straightforward question of whether a more integrated market is also a more informationally efficient market.

CHAPTER 5

Market Integration and Informational Efficiency of Stock Markets in Africa

"National stock exchanges are an endangered species in a world where technology allows anybody to trade anything from anywhere you can use a laptop computer. In such an environment, big markets are better than little ones because as the number of potential buyers and sellers increases, the prices they bid and ask are likely to reflect the true value of whatever is being traded, whether it be stocks or bolts of cloth."

International Herald Tribune (June 2000)

The present chapter hypothesises and tests the association between market integration and informational efficiency and thus accomplishes objective three *(i.e. to analyse the association between market integration and informational efficiency of stock markets in Africa).* The chapter is structured in five main sections. Section one introduces the chapter, explaining the need for empirical research on the relationship between the two policy variables. Section two reviews the theoretical link between market integration and informational efficiency, surveys the limited empirical literature, and formulates the hypothesis to be tested. The methodology and how the variables are measured, as well as description of data and their summary features are discussed in section three. The empirical results are presented and discussed in section four. The chapter summary and concluding remark are provided in section five.

5.1 Background Introduction

The world has witnessed active moves by countries, especially developing and emerging economies to liberalise their markets since the 1980s. The goal was to make such markets generally accessible to investors globally, which should ultimately facilitate economic growth. Generally, the liberalisation packages comprised the removal of statutory restrictions on investments which had hitherto prevented foreign investors from participating in local markets. Consequently, the volume of international capital flows to emerging and frontier markets, in particular, increased significantly. However, the occurrence and ramifications of financial crises around the world during the 1997-2011 period have generated discussion on the desirability of full-scale financial liberalisation and market integration. Many have wondered if the real benefits of market integration adequately justify the volatility and spillovers associated with an integrated world capital market. Besides, there are disagreements and inconclusive evidence on the growth-enhancing benefits of capital market openness (see Edison et al., 2004; Henry, 2007; Kose et al., 2009). One thing is however obvious from evidence, liberalisation policies have increased the integration of stock markets worldwide (see for example Carrieri et al., 2011; Bekaert et al., 2011). In keeping with this global consensus, a relevant policy question thus arises and relates to whether increased market integration with world stock markets is associated with higher degrees of informational efficiency in stock markets. This policy question is even more relevant for emerging markets, considering their unique characteristics and position within the global financial system.

The goal of this chapter therefore is to examine the link between stock market integration and informational efficiency (market efficiency) in Africa's stock markets by *testing the hypothesis that a more globally integrated market is also a more informationally efficient market* (in the spirit of Hooy and Lim, 2013). The link between market integration and market efficiency is very under researched. Perhaps the only studies that have endeavoured to address the issue empirically are Li et al. (2004), Bae et al. (2012) and Hooy and Lim (2013). Whilst Li et al. (2004) and Bae et al. (2012), respectively, analysed the efficiency effect of financially opened markets at the firm and country levels, Hooy and Lim (2013) concentrated on developed and leading emerging markets. Thus no study has empirically examined the relationship between market integration and market efficiency in African stock markets. Consequently, we close this gap and extend the empirical literature on market integration from an African perspective. This study is important because within a unified framework we are able to consider simultaneously the two separate but core policy variables from a purely developing-world perspective. Academia, market participants, and policy makers are increasingly concerned with the effects of increasing global integration because of their far-reaching consequences for the world economies and financial markets. From the outset, it must be pointed out that this chapter does not directly test any of the forms of the efficient market hypothesis (EMH) neither does it examine causality between the two concepts. There is so much literature about stock market efficiency in Africa that tried to test the EMH (See Alagidede and Panagiotidis, 2009; Abdmoulah, 2010; Harrison and Moore, 2012; Smith and Dyakova, 2013; Youssef and Galloppo, 2013).

Market integration is a central concept in the international finance literature.[22] Studies have attempted to measure the macroeconomic and financial effects of market integration (see for example Bekaert and Harvey, 1995, 1997, 1998, 2000; Domowitz et al., 1997; Kim and Singal, 2000; Henry 2000a, b). In the recent past, economists had studied the welfare gains regarding risk-sharing benefits of market integration (Karolyi and Stulz, 2003) as well as the investment and growth opportunities associated with financial market integration (Bekaert et al., 2001; 2005; 2009). However, the opening up of many developing and emerging markets to foreign equity investors following various market reforms has sparked concerns over the benefits of financial market integration. In particular, the episodes of financial crisis around the world are said to be linked to increased integration of the world financial markets. Notwithstanding, there is compelling empirical evidence which suggests that access to world capital markets is beneficial. Notably, lower cost of capital (Bekaert and Harvey, 2000; Henry 2000b; Martin and Rey, 2004), increased diversification benefits and the efficiency of real investment (Mitton, 2006; Chari and Henry, 2008; Bae and Goyal, 2010), and greater productivity and growth (Bekaert et al., 2005, 2009) have been identified as some of advantages of financial liberalisations.

The informational efficiency upshot of market integration deserves considerable policy attention globally and in Africa especially for at least two reasons. First, African stock markets have largely been found to be informationally inefficient, yet efficient price discovery is a key function of stock markets and the promotion of informational efficiency is a basic goal of capital market regulators. In an informationally efficient market, the arrival of new information is swiftly incorporated into security prices and market participants are deemed to be very well informed. Informationally efficient markets promote investor confidence, provide feedback on corporate decisions and ensure that corporate executives are pursuing shareholder wealth-enhancing strategies (Durnev et al., 2004; Chen et al., 2007). Majumder (2012) pointed out that wrong investment strategy can endanger the optimal allocation of resources. Importantly, efficient markets have serious implications for government policies and the general wellbeing of society. In fact, Morch et al. (1990) long ago highlighted that market efficiency would be immaterial if the stock market did not influence economic activities. Dow and Gorton (1997) exemplified the link between an efficient stock price and efficient allocation of investment resources in a theoretical model, showing that the stock market indirectly guides business managers by transmitting information about potential investment opportunities and company cash

[22] See Agenor (2003) for a comprehensive survey of the benefits and costs of financial market integration.

flows.[23] Empirically, a number of studies confirm that efficient stock prices boost capital allocation efficiency (Wurgler, 2000), promote efficient private capital investments, greater productivity and faster economic growth (Durnev et al., 2004), and enhance the positive relationship between corporate investment and stock prices (Chen et al., 2007).

Second, the informational efficiency effect of market integration deserves the singular attention of policymakers and market regulators in order to avoid misallocation of resources which can hinder long-term economic growth. This is particularly important given that African stock markets are mostly perceived to be less efficient than and less integrated with the rest of the world. Besides, core policy goals emphasise the need to enhance greater market integration and promote greater market efficiency. It is therefore pertinent to ask the relevant policy question of whether there exists a positive association between these two important policy goals of ensuring that markets are integrated and efficient.

Indeed, policymakers might have to reconsider any commitment to further integrate the world capital markets if increased market integration resulting from financial liberalisation is negatively associated with informational efficiency (Hooy and Lim, 2013). On the other hand, policymakers would have to intensify their commitment to integrate the world capital markets if greater levels of market integration are associated with higher degree of market informational efficiency. Also, the absence of significant association would show that the two are and can be pursued as independent policy goals. Indeed, Lence and Falk (2005) demonstrate within standard dynamic general equilibrium asset-pricing model that market integration and market efficiency are independent of each other. Thus whichever way it turns out, the results would provide a unique and important contribution to this area of research as the literature is very sparse globally and completely non-existent in Africa. African markets are fast becoming an attractive destination for international investments. There is thus a need for an understanding of the drivers of informational efficiency. A study of the link between market integration and informational efficiency should provide useful insights for policymaking and regulating financial markets.

[23] Related to Dow and Gorton's theoretical contribution, a number of theoretical studies have recently considered the feedback effect from stock prices to real investment decisions such as Goldstein and Guembel, 2008; Dow et al., 2011).

5.2 Literature Review and Hypothesis Formulation

Market integration and market informational efficiency are central concepts in the international financial markets literature. The literature on stock market integration is huge and keeps growing. Similarly, market efficiency has received more empirical attention and wider coverage than any other topic in the finance literature. However, these two important concepts in finance have often been studied separately and therefore have remained largely distinct concepts in the finance literature. Their nexus is often implied but not explicitly analysed (Hooy and Lim, 2013). Besides, the focus of empirical studies has been to examine the extent to which markets are integrated with or segmented from the world market when studying market integration, and to test whether a financial market is efficient or inefficient when studying market efficiency[24]. Yet theory suggests, with empirical backing, that market integration is associated with market efficiency (Hooy and Lim, 2013). It should however be noted that greater market integration is not necessarily an indication of higher market efficiency (Hooy and Lim, 2009). Unless a market is fully integrated with the world market, efficient pricing of assets on the basis of information available to market participants does not guarantee dividends that are comparable to global standards.

The literature has commonly defined market integration in terms of the law of one price. The law of one price within a mean-variance framework suggests that securities with similar risk profile should offer the same risk-adjusted returns. That is, in an integrated world capital market, the price of securities risks should equalise across markets. Lim (2009) highlights that it is erroneous to define market integration based on the degree of correlations because differing industry structures can cause low correlations between very integrated markets. This view is corroborated by Carrieri et al. (2007) and Pukthuanthong and Roll (2009) i.e., that the unconditional correlations of broad market index returns are an inappropriate measure of market integration. The study of market integration has gained popularity because of its effects on investors, corporations and economies. Adverse effects associated with higher market integration include greater short-term costs to companies and markets as growing interdependence is characterised by crashes and shock spillovers

[24] Studies on integration of African markets are substantial (see Collins and Biekpe, 2003; Wang et al., 2003; Collins and Abrahamson, 2004; Alagidede, 2008, 2010; Agyei-Ampomah, 2011; Adebola and Dahalam, 2012). Also, a number of studies have tested the informational efficiency of Africa's stock markets (see Magnusson and Wydick, 2000; Appiah-Kusi and Menyah, 2003; Smith and Jefferis, 2005; Lim, 2007; Alagidede and Panagiotidis, 2009; Abdmoulah, 2010; Harrison and Moore, 2012; Smith and Dyakova, 2013; Youssef and Galloppo, 2013). Although results are mixed, the general consensus is that African markets are largely inefficient.

across markets. Besides, an integrated world stock market is indicative that asset returns are the same everywhere and that potential benefits from international diversification available to global investors and country funds would be eliminated. There are however upsides to greater market integration such as international risk sharing, lower cost of capital and greater capital flows, efficient stock prices, technology transfers, improved financial systems, enhanced welfare gains and greater economic growth (Prasad et al., 2003). In short, market integration can lead to market informational efficiency, which is very desirable.

The premise of the Efficient Market Hypothesis (EMH) is that, in an informationally efficient financial market, security prices should reflect the best possible estimate of their true economic value. The assumption is that stock prices fully incorporate all information so that changes in asset prices reflect only news and/or unanticipated events. Also, in an informationally efficient market, stock prices are deemed rational and reflect only useful characteristics such as asset risk (Alagidede, 2008). Under such circumstances, asset prices are deemed unpredictable and unforecastable. The present study stems from a number of theoretical models that consider the advantages of market integration resulting from market reforms that sought to liberalise the world capital markets. Albuquerque et al. (2009), for instance, propose a model in which global investors are in possession of global private information deemed valuable for trading in various countries simultaneously. The rationale is that market integration should lead to improved informational efficiency in the local financial markets. Local market participants typically underreact to global private information owing to the presence of information asymmetry between them and their foreign counterparts. Thus stocks that are inaccessible to global investors poorly incorporate global information into their prices. Conversely, greater accessibility which results from market integration is said to improve information dissemination (Bae et al., 2004) and market efficiency.

Also, a number of earlier models have suggested a linkage between the speed of information incorporation and the extent of market participation (Merton, 1987; Basak and Cuoco, 1998; Shapiro, 2002; and Hou and Moskowitz, 2005). A shared argument advanced in the literature is that severe market restrictions due to institutional forces and information- and transaction- related costs can cause delayed share price adjustment. Similarly, Bae et al. (2012) recently argued that local market frictions that restrict foreign investments in emerging stock markets may inhibit prompt incorporation of global market information. The removal of market restrictions in emerging stock markets is perceived enhancing informational efficiency. Moreover, the importance of analysing the efficiency effects of some market reforms has been recognised in the study of such domains as private property rights protection (Morch et al., 2000), securities laws (Daouk et al., 2005), corporate transparency (Jin and Myers, 2006), short-selling regulations (Bris et al., 2007), insider trading laws (Fernandes and Ferreira, 2009), trade opening (Lim and Kim, 2011), and financial liberalisation (Li et al., 2004; Bae et al., 2012). The rationale behind all these studies is to highlight the linkage between market integration and the informational efficiency of stock markets and the policy implications for such a nexus.

Empirical literature on the link between market integration and market efficiency has so far been very limited. Perhaps the most relevant studies that have analysed the empirical link between the two variables are Li et al. (2004), Bae et al. (2012), and Hooy and Lim (2013). Li et al. (2004) studied the market efficiency effect of capital market liberalisation by comparing individual stock return co-movements across emerging markets. The results show that higher firm-specific variation is related to greater capital market openness, suggesting that greater foreign accessibility to stocks is closely associated with improved informational efficiency of domestic stock markets. Similarly, Bae et al. (2008, 2012) used the degree of accessibility of foreign investors to emerging stock markets to assess the influence of investibility on the diffusion of common news across markets. The results indicate that returns of highly-investible securities with large foreign investor accessibility lead returns of non-investible stocks that are closed to foreign investors. The evidence additionally shows that greater investibility facilitates prompt incorporation of global and local market information into stock prices. Hence, the finding implies that greater foreign investor participation in the local market facilitates rapid information incorporation, which is consistent with the idea that increased market integration creates greater informationally efficient prices in emerging markets. In particular, Bae et al. (2012) suggest that foreign investors are better positioned to process global information and thus end up enhancing market informational efficiency. Generally, foreign investor participation in emerging stock markets increases with growing market integration and facilitates speedy diffusion of global market information among investible securities in national financial markets. However, the use of investible weight by Bae et al. (2012) has been severely criticised because it measures the evolution and intensity of stock market openness in a *de jure* instead of a *de facto* manner (Hooy and Lim, 2013).

In a recent study, Hooy and Lim (2013) explicitly addressed the issue relating to whether a more integrated market is associated with a higher degree of informational efficiency. An adjusted pricing error from a standard international asset pricing model is used as a surrogate for market integration. Informational efficiency is measured as an inverse of the aggregate country-level price delay. Using data from 49 developed and emerging countries the study found evidence in support of the hypothesis that the more integrated markets become with the world market, the more informationally efficient they become. The study however focused on developed and major emerging stock markets, incorporating only three markets from Africa (Egypt, Morocco, and South Africa). Several other African countries have recently qualified as frontier markets based on S&P/Dow Jones Index classification, suggesting a greater level of openness of these markets to foreign accessibility and investments. Besides, addressing the relationship between market integration and market efficiency is more crucial in emerging and frontier markets where integration with the world is significantly less than complete (Li et al., 2004).

5.2.1 Hypothesis Formulation

The hypothesis formulated and tested in this study is that "there exists a positive association between stock market integration and the informational efficiency of stock markets in Africa". In the spirit of Hooy and Lim (2013), stock market integration in this study is measured using an adjusted pricing error from an equilibrium international asset pricing model (ICAPM) suggested by Stehle (1977). We also apply their price delay measure to determine market informational efficiency. Hence, informational efficiency of stock market is measured by the speed with which each aggregate stock market responds to global common information (see Hooy and Lim, 2013).

Attempts have been made at various levels in the past to assess relative informational efficiency among markets across the world. The World Bank Group's composite indicator for gauging the relative informational efficiency among stock markets around the world is a good example. Until recently, a well-known country-level measure has been the R-square statistic obtained by regressing individual stock returns on contemporaneous domestic market index returns (proxy for local market-wide information) and the United States market index returns (representing worldwide market information). This is then aggregated across stocks applying either variance weights or equal weights (see Jin and Myers, 2006; Fernandes and Ferreira, 2008a, b). This measure is said to be inversely related to the amount of firm-specific information contained in stock prices, suggesting that a lower R-square means that stock prices have more firm-specific information in them (Morch et al., 2000). Intuitively, the share price of a firm should convey little firm-specific information when a strong correlation exists between the firm's stock return and market return. In spite of its popularity, the validity of the regression method that yields the R-square statistic has been challenged (see for instance Ashbaugh-Skaife et al., 2006; Hou et al., 2006; Kelly, 2007; and Teoh et al., 2008). Unlike the information-efficiency model involving the R-square statistic, the price delay model is robust at capturing the informational efficiency and can be used to compare the speed of adjustment to global market occurrences for a broad cross-section of stock markets (Lim, 2009).

An alternative measure to the speed of stock price adjustment to specific event or information is the popular event study methodology pioneered by Fama et al. (1969). However, the price delay measure has the double advantage of measuring the speed of information incorporation while at the same time examining factors causing the delay of stock prices in response to local market-wide information (Lim 2009). In rationalising the hypothesis of a positive association between stock market integration and informational efficiency in this study, we applied Hooy and Lim's (2013) approach by comparing the proportion of stock returns accounted for by global and domestic factors in the following three different scenarios:

a. If a market is fully segmented from the rest of the world (i.e. the case of perfect segmentation), its stock returns are exposed mainly to domestic market shocks, and for that reason a significant delayed response to global information is expected;
b. If a market is fully integrated with the rest of the world (i.e. the case of perfect integration), the market is more sensitive to global events and its stock returns are expected to respond swiftly to global information; and
c. In between the two extreme situations lies an intermediate case of a partially integrated market in which stock returns are determined by a combination of domestic and global factors. The importance of the global factors however increases with the degree of market integration.

Essentially, we hypothesise that an African stock market that becomes more integrated with the world stock market also becomes more informationally efficient. Of course, financial market theory suggests that, although investors are exposed to both global common and country-specific risks within fully integrated capital markets, only the global common risks are priced because unsystematic country-specific risks can be completely diversified internationally.

5.3 Methodology and Data Description

This section describes how the two policy variables of market integration and market efficiency are measured empirically in the present study. As noted previously, the methodology is based largely on the Hooy and Lim's (2013) approach.

5.3.1 Empirical Measure of the relevant Variables

In the spirit of Hooy and Lim (2013), we empirically measure stock market integration using the single factor International Capital Asset Pricing Model (ICAPM) proposed by Stehle (1977). This is a simple but widely accepted equilibrium asset pricing model, which by its formulation allows for both the direct and indirect forms of investment barriers (Hooy and Lim, 2013). The model is specified in the following form:

$$r_t^m = \gamma + \psi r_t^w + \varepsilon_t \tag{5.1}$$

where r_t^m is the domestic market excess return at week t, r_t^w is the world market excess return at week t, and ε_t is white noise. The intercept (γ) in equation (5.1) is a mispricing measure and would equal zero (0) indicating the absence of mispricing in ICAPM, if a market is perfectly integrated with the rest of the world. Thus the mispricing measure (γ) is correlated with higher bureaucratic barriers, transaction cost, tax on international investments and barriers to firm information (Korajczyk, 1996). Following Hooy and Kim (2013) and Levine and Zervos (1998), the empirical measure of integration is the absolute value of the pricing error in equation (5.1) multiplied by (-1) as follows:

$$INTEGRATE = -|\gamma| \tag{5.2}$$

A higher (lower) value of INTEGRATE indicates greater (less) integration between the domestic stock market and global markets.

Also, the empirical measure of market efficiency or informational efficiency is the stock price delay measure. In cross-company studies within a single market, the stock market index is frequently used to determine the price delay measure through which the relative speed with which individual firms react to market common information can be captured. In a cross-market study however, the appropriate approach is to use a global market-wide information set which allows the price delay measure to capture the relative speed of adjustment of each market to the global common information (Lim and Hooy, 2013). To this end, we employed the country-level price delay measure proposed by Lim and Hooy (2013), which involves an unrestricted ICAPM, in the following specification:

$$r_t^m = \alpha + \psi r_t^w + \sum_{k=1}^{4} \Omega_k r_{t-k}^w + \varepsilon_t \tag{5.3}$$

The R-squares from equations (5.1) (restricted version) and (5.3) (unrestricted version) are then used to estimate the price delay measure in the following form:

$$DELAY = 1 - \frac{R_{restricted}^2}{R_{unrestricted}^2} \tag{5.4}$$

The price delay is an inverse measure of informational efficiency, and a higher value of DELAY would indicate a lower degree of efficiency of the stock market and vice versa. Also, a higher value of the DELAY suggests that lagged world market returns (r_{t-k}^w) accounts for more variation in the domestic index returns, and that there is greater delay from the domestic market in responding to global market-wide factors that has common effects across markets.

5.3.2 Empirical Model Estimation

In this study, the pooled Ordinary Least Squares (OLS) regression method is used to examine the empirical relationship between market integration and market informational efficiency. The determinants of stock price delay are well-grounded both in the theoretical and empirical literature. Cross-sectional determinants for stock price delay identified in various studies include firm size, trading volume, analyst coverage, market friction, institutional ownership, short sales restriction, intra-industry phenomenon, and the degree of investibility (see the study by Lim 2009 and references therein). We originally intended to control for the influence of these determinants in our analysis. However, due to data accessibility issues, the final analysis concentrated on the macro-level counterparts for firm size (SIZE) and trading volume (VOLUME). Thus the following pooled cross-sectional OLS regression model is estimated in the present study:

$$DELAY_{i,t} = \gamma + \delta INTEGRATE_{i,t} + X'_{i,t}\psi + v_{i,t} \tag{5.5}$$

where δ which is our parameter of interest measures the effect of market integration on informational efficiency. The vector $X'_{i,t}$ denotes the two control variables (SIZE and VOLUME) with ψ as coefficient vector. γ is an intercept measure while $v_{i,t}$ is the error term capturing all other omitted variables in the regression model. In this specification, the standard errors allow for clustering at the country-level as they are robust to heteroscedasticity in the variance-covariance matrix (see Hooy and Lim, 2013).

5.3.3 Data and Preliminary Analyses

The data consists of weekly closing stock-price indices of eleven African stock markets from 7th January, 2000 through to 26th December, 2014 obtained from Morgan Stanley Capital International (MSCI). The data set is made up of the main stock market indices of Botswana, Cote D'Ivoire, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, Nigeria, South Africa, and Tunisia. All indices are denominated in US Dollars to ensure uniformity in currency, circumvent exchange rate related problems and lay emphasis on global factors rather than local factors. The value-weighted MSCI All-Country World Index is used to proxy for global factors, while the United States 3-month Treasury bill rates serve as a proxy for the global risk free rate. The MSCI World Index is a broad global equity benchmark and its performance is frequently used as a surrogate for the performance of the world equity markets. The two control variables (SIZE and VOLUME) are calculated using the panel data on the market capitalisation of listed companies and turnover ratio from the World Bank's World Development Indicators (WDI, 2016). The SIZE (stock market size) is proxied by the natural logarithm of the market capitalisation of listed companies, while the VOLUME (trading volume) is proxied by the natural logarithm of one plus the turnover ratio (see Hooy and Lim, 2013 for a similar treatment).

For the empirical analyses, the weekly price indices were transformed into continuously compounded weekly returns using the formula $R_t = [\ln(P_t) - \ln(P_{t-1})] \times 100$. We initially estimated equation (5.1) annually using weekly index returns (obtaining 15 annual observations for each stock market) and subsequently computed INTEGRATE for each market based on equation (5.2). Similarly, equation (5.3) is estimated annually using weekly index returns and the DELAY is then computed for each market based on equation (5.4). The conversion of weekly data to annual returns was achieved by taking the average of all the weekly returns (51 weeks) for each stock market. Prior to the empirical results however, the statistical properties of the data set are verified. Table 5.1 reports the descriptive statistics (Panel A) and correlation matrix (Panel B) of the relevant variables. The values of the standard deviation suggest that there is considerable variation in the countries, which allows for pooled cross-sectional regression analysis. The DELAY and INTEGRATE measures are negatively skewed, showing that most of the actual series are generally greater than the mean. In contrast, SIZE and VOLUME are positively skewed, which suggests that actual series of these variables are largely below their mean values. In terms of distribution of the series, INTEGRATE is leptokurtic with kurtosis above three, while the rest of the variables can be said to be flat with short tails. The Jarque-Bera statistics however suggest that the variables are not normally distributed as the normality tests are rejected in all cases.

Table 5.1: Descriptive Statistics and Correlation Matrix

	DELAY	INTEGRATE	SIZE	VOLUME
Panel A: Summary Statistics				
Mean	0.591341	-1.524805	3.314665	2.241214
Median	0.714286	-0.674544	3.230655	2.164472
Maximum	0.999664	-0.002928	5.674269	4.178399
Minimum	-0.450549	-10.58555	1.445401	0.538374
Std. Dev.	0.369302	1.758987	0.931030	0.969006
Skewness	-0.544974	-1.789287	0.553088	0.415806
Kurtosis	2.010418	7.048540	2.871607	2.149062
Jarque-Bera	14.89990***	200.7284***	8.525753**	9.732753***
Observations	165	165	165	165
Panel B: Correlation Matrix				
DELAY	1.000000			
INTEGRATE	-0.269019***	1.000000		
SIZE	-0.233714***	0.234058***	1.000000	
VOLUME	-0.106060	0.127461	0.606369***	1.000000

Notes: *** and ** indicate significance at 1 and 5 percent levels, respectively. Jarque-Bera is the Jarque-Bera Test Statistic. DELAY is a measure of the country-level price delay and serves as an inverse measure of informational efficiency, where a higher value indicates a lower degree of informational efficiency. INTEGRATE is a measure of the degree of market integration with the World, measured by the negative-sign pricing error. A higher value of INTEGRATE (that is a value closer to zero) shows a greater level of integration between the local market and the World equity market.

The unconditional correlations in Panel B indicate that all the regressors (INTEGRATE, SIZE and VOLUME) are negatively correlated with the dependent variable, stock price delay. This revelation is consistent with the firm-level evidence in the extant literature. Among the three explanatory variables, the highest correlation coefficient occurs between market integration and informational efficiency, followed by the correlation between market size and informational efficiency. The correlation between market size and trading volume is however the highest among all the correlation coefficients reported in Panel B. It is worthwhile pointing out that all of the reported correlation coefficients except two are statistically significant but the extent of association is weak generally. While this may be indicative of low co-movements among the stock markets, it also suggests that multicollinearity is not a major concern.

In Figures 5.1 and 5.2 we present a graphical illustration of the behaviour the two policy variables of market integration and informational efficiency. Figure 5.1 plots the average values of INTEGRATE and DELAY computed over the sample period from 2000 to 2014 for each of the 11 markets. As noted before, DELAY is the country-level stock price delay and an inverse measure of informational efficiency. Thus a higher value of DELAY (i.e. a value closer to one) signifies a lower degree of informational efficiency, while a lower value (i.e. a value closer to zero) indicates a higher degree of informational efficiency. Also, INTEGRATE is measured by the negative-sign pricing error, where a higher value (i.e. a value closer to zero) signifies a greater level of integration between the domestic stock market and the world.

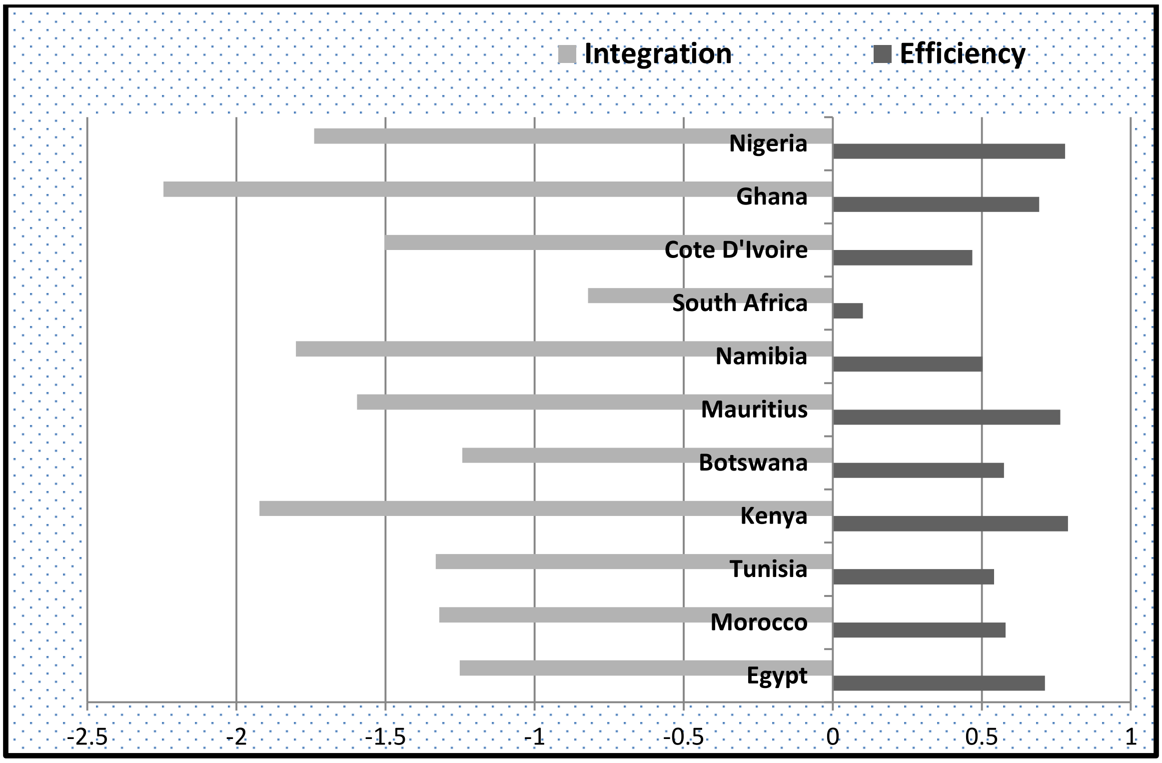


Figure 5.1: Cross-sectional variation in market integration and informational efficiency.
Notes: The figure plots the average values of INTEGRATE and DELAY over the sample period 2000-2014 for each of the 11 countries.

Figure 5.1 shows that only the South African stock market exhibits a greater level of market integration and hence is more integrated with the rest of the world market. Also, Africa's emerging markets of Egypt and Morocco as well as the frontier markets of Botswana and Tunisia exhibit a moderate degree of market integration and hence can be described as being moderately integrated with the world market.

Table 5.2 ranks African stock markets based on their level of integration with the world equity market, affirming the position of the South African market as the most integrated African market with the world. Next to South Africa are the stock markets of Egypt, Morocco, Botswana and Tunisia. The stock market in Ghana followed by the Kenyan stock market exhibit the lowest level of market integration, indicating that these markets remain relatively more segmented from the world stock markets. Similarly, the stock markets in Nigeria, Mauritius, Namibia and the West African regional stock market in Cote D'Ivoire also exhibit lower levels of market integration and hence remain partially segmented from the world stock market. A preliminary impression about the statistics reported in Table 5.2 is that, markets that are more integrated with the world equity market (i.e. have lower negative values) tend to be more efficient as well (also possess smaller positive values). Some exceptions however exist as a market may appear to be integrated with the world financial market, but remain relatively inefficient (as in the case of Egypt). Conversely, a market may seem to be efficient and yet appear to be partially segmented from the rest of the world (a good example is Namibia).

Table 5.2: Ranking of African Stock Markets based on Efficiency and Integration

Market	Efficiency	Ranking	Integration	Ranking
Egypt	0.711546698	8	-1.251205167	3
Morocco	0.580157427	6	-1.31949294	4
Tunisia	0.541552012	4	-1.331825353	5
Kenya	0.789157956	11	-1.9231469	10
Botswana	0.574664217	5	-1.2422309	2
Mauritius	0.763131764	9	-1.595543713	7
Namibia	0.502899942	3	-1.800180807	9
South Africa	0.101022315	1	-0.8202811	1
Cote D'Ivoire	0.468784937	2	-1.50375414	6
Ghana	0.692477573	7	-2.245318493	11
Nigeria	0.779357515	10	-1.73988026	8

Notes: Lower values of Efficiency (values closer to 0 than to 1) suggest the market may be more efficient, while less negative values of Integration (values closer to positive value) are indicative that the market may be more integrated with the rest of the world.

Barring the few instances of some exceptions, the general impression perceived from Figure 5.1 and Table 5.2 is that Africa's markets that have shown some improvement in their integration with the world market also appear to exhibit a higher degree of informational efficiency.

Also, Figure 5.2 plots the time-series evolution of the computed values of INTEGRATE (Panel A) and the computed values of DELAY (Panel B) averaged across all African countries over the sample period 2000-2014. We observe that African market integration with the world stock market is generally unstable over the entire fifteen-year sample period as periods of increasing integration are followed by periods of declining integration, but it has been at a pretty stable level since 2010 (see Panel A of Figure 5.2).

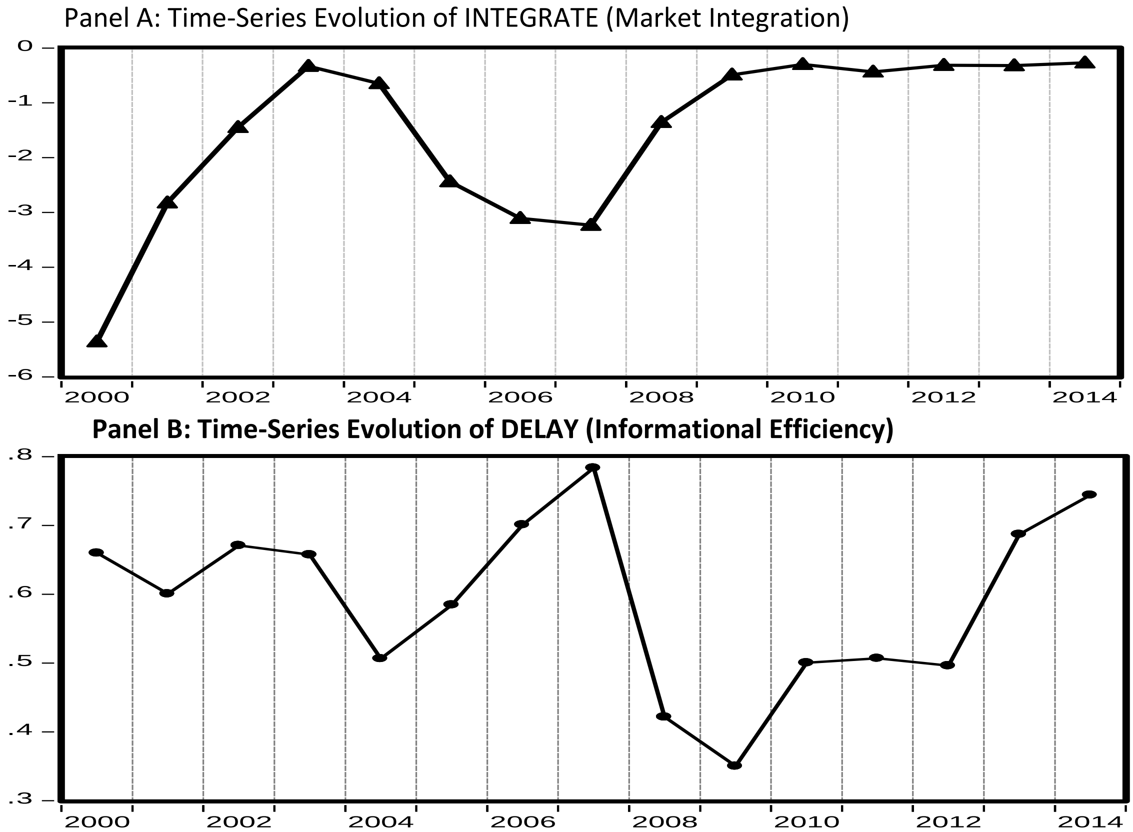


Figure 5.2: Time-series variations in market integration and informational efficiency. Notes: The figure plots the time-series evolution of the computed values of INTEGRATE in Panel A and DELAY in Panel B over the sample period 2000-2014, averaged across all 11 countries in Africa.

For example, the 2000-2003 periods saw a rising level of market integration in Africa as the curve moved closer to zero. The 2004-2007 periods however portrayed a sharp declining trend in integration which subsequently reverted in 2008. The integration of African stock markets with the world can however been said to have improved remarkably since 2008 which may be suggesting that the 2007-2009 global financial crisis has brought about greater levels of convergence among financial markets worldwide.

In Panel B of Figure 5.2, the degree of informational efficiency of African stock markets seems to exhibit more erratic behaviour over time compared to market integration in Panel A. A similar pattern to market integration can however be perceived as periods of improved informational efficiency are followed by periods of worsening market informational efficiency. In consequence, informational efficiency of African stock markets appears to follow a trend towards improvement amidst periods of worsening efficiency. It appears there was sharp improvement in informational efficiency around the 2006-2009 period. The 2010-2014 period, however, could be said to have exhibited low informational efficiency. Overall, the impression seems to suggest gradual improvement in market informational efficiency over time.

Given the presence of some instability and reversals over the period, it is difficult to establish or infer whether or not any long-term trend exists based on these graphical representations. Consequently, we sought a preliminary view of the relationship between the two key policy variables. In Figure 5.3, a scatter plot graphs the time-series averages of DELAY against the average values of INTEGRATE for each of the 11 stock markets.

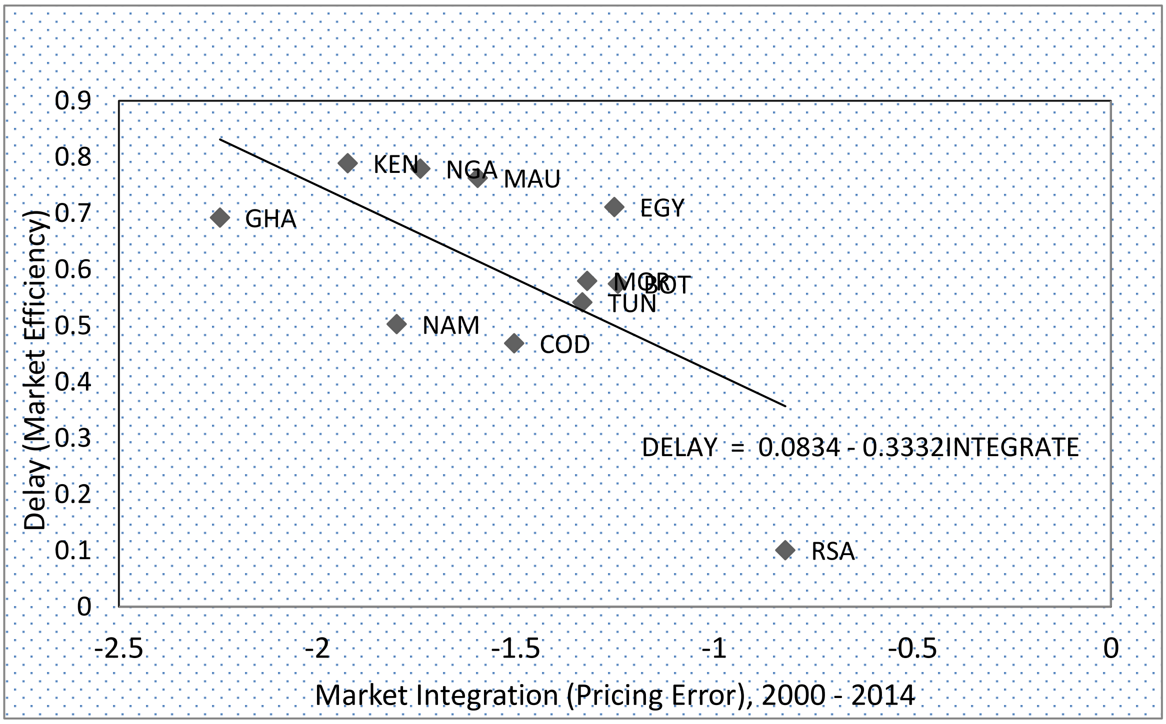


Figure 5.3: Scatter plots for informational efficiency and market integration.
The figure plots the time-series averages of DELAY against the average scores of INTEGRATE over the period 2000-2014.

The scatter plot clearly shows a moderate negative relationship between stock price delay (the dependent variable) and market integration (the independent variable). Since stock price delay is an inverse measure of informational efficiency, the negative relationship portrayed by the graph clearly implies a positive association between market integration and market informational efficiency. Also, the slope equation $DELAY = 0.0834 - 0.3332INTEGRATE$ lends further credence to the relationship between the two relevant policy variables. Subsequent formal panel analyses in the subsequent sections provide statistical support for this positive relationship between the variables.

5.4 Empirical Results and Discussion

In this section, we evaluate the hypothesis of the positive relationship between market integration and informational efficiency, which implies that stock markets that are more integrated with the world market are also more informationally efficient. This goal is accomplished under three main statistical analyses: first, in the next sub-section we estimated a baseline pooled OLS regression model and reported the results in Table 5.3; second, alternative estimation methods were applied to evaluate the hypothesis and the results reported in Table 5.4; and third, we undertook sub-sample analysis, which sought to provide robustness verification of the empirical estimates.

5.4.1 Results of Panel Unit Root and Stationarity Tests

Prior to performing the formal statistical analysis of the positive relationship between market integration and informational efficiency however, the panel-series properties of the two core policy variables and two control variables were verified using various panel unit root tests. The results of these panel unit root tests are reported in Table 5.2. The results of all the panel unit root tests (Levin-Lin-Chu, Im-Pesaran-Shin, ADF Fisher-Type) indicate that the two key policy variables are stationary at levels. The stationarity of the two control variables is also affirmed by both the LLC and IPS tests (refer to Table 5.2).

Table 5.3: Results of Panel Unit Root Tests

Variable	Levin-Lin-Chu (LLC) Test	Im-Pesaran-Shin (IPS) Test	ADF Fisher-Type (ADF-F) Test
DELAY	-8.8820***	-3.1769***	90.7210***
INTEGRATE	-10.1747***	-3.1517***	94.4750***
SIZE	-5.6285***	-1.7536**	18.3306
VOLUME	-6.4104**	-2.1777***	41.7006***

Notes: The *** and ** indicate statistical significance at 1 and 5 percent levels, respectively.

5.4.2 The Standard Pooled OLS Regression Results

Table 5.4 presents the results of baseline pooled OLS regression analysis reported based on five different scenarios (from Model 1 through to Model 5). In model 1 we performed a simple univariate pooled regression with the market integration measure (INTEGRATE) as the only explanatory variable. The result shows that INTEGRATE has a negative and statistically significant relationship with DELAY. In fact, the negative coefficient is statistically significant at the 1 percent level of significance. Since stock price delay is an inverse measure of informational efficiency, the negative coefficient indicates that a greater level of market integration is associated with a lower value of stock price delay, and a higher degree of informational efficiency. More specifically, a greater level of market integration leads to a higher degree of informational efficiency. In particular, a percentage point change in stock market integration leads to a change in the market's informational efficiency in the reverse direction by 0.0565 of a percentage point.

Next, we introduced a time trend in the initial model to ascertain whether or not the result in Model 1 may have been influenced by the common trend in the two variables. The results with the time trend are reported as Model 2. The inclusion of the time trend does not weaken the explanatory power of market integration because INTEGRATE still exhibits a statistically significant negative influence (with a coefficient of -0.0515) on stock price delay. Nonetheless, the time trend has a negative and significant coefficient (-0.0020), and its inclusion has contributed some 6.4 percent to the coefficient of determination (R^2 = 0.136).

Table 5.4: Baseline Pooled OLS Results: DELAY as Dependent Variable

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.5052	0.6754	0.8374	0.8269	0.8570
	(13.73)***	(11.11)***	(7.42)***	(8.28)***	(7.48)***
INTEGRATE	-0.0565	-0.0515	-0.0457	-0.0470	-0.0457
	(-3.57)***	(-3.35)***	(-2.91)***	(-3.04)***	(-2.91)***
Size			-0.0515		-0.0226
			(-2.36)***		(-2.21)**
Volume				-0.0546	0. 0398
				(-1.90)*	(-1.01)
Trend		-0.0020	-0.0017	-0.0022	-.0020
		(-3.46)***	(-3.02)***	(-3.84)***	(-3.13)***
Breusch-Pagan	1.42	1.01	1.70	1.60	2.85
[Chi2/Prob > Chi2]	[0.2328]	[0.3145]	[0.4267]	[0.4488]	[0.5835]
VIF > 4 / Max VIF	None/1.00	None/1.01	None/1.06	None/1.02	None/2.11
Observations	165	165	165	165	165
R^2	0.072	0.136	0.151	0.155	0.157

Notes: The *** and ** are significance at 1% and 5% levels of significance, respectively, t-statistics are displayed in parentheses, and square brackets contain p-values. The general rule of thumb is that VIFs greater than 4 require further investigation, while VIFs exceeding 10 signal the presence of serious multicollinearity in data necessitating correction.

In our subsequent analysis, we then added the control variables one after the other and reported the results in Models 3 and 4. Our variable of interest, INTEGRATE, still possesses its negative and statistically significant coefficient, suggesting that stock market informational efficiency is a positive function of stock market integration. The results further indicate that market size and trading volume respectively have negative and statistically significant relationship with stock price delay. The implication is that both the market size and trading volume positively influence market informational efficiency. This relationship is in accordance with economic intuition. Larger markets attract informed traders and sophisticated foreign investors whose superior activities keep the market active and efficient. Larger markets are also more liquid markets where foreign investors with global information facilitate market efficiency (Bae et al., 2012). On the theoretical front, Albuquerque et al. (2009) constructed a model in which global investors possess valuable global private information that enables the simultaneous trading in different markets. Their model principally assumes that stock returns are influenced by both local and global factors and that only global investors receive significant signals relating to the global factors. The presence of information asymmetry causes local investors to underreact to global news, leading to delayed price adjustment to global information in equities inaccessible to foreign investors. Empirically, evidence indicates that the removal of capital barriers and pursuance of liberalisation that promotes market integration can help improve the informational efficiency of emerging stock markets (Bae et al. 2012). Initially, Chordia and Swaminathan (2000) had found trading volume to be a significant determinant of the speed of stock price adjustment to common information.

In the last column in Table 5.4 (Model 5) we sought to evaluate the explanatory power of market integration (INTEGRATE) in the time-series and cross-sectional variation in informational efficiency (stock price delay) by entering INTEGRATE, the two control variables and the time trend simultaneously in the regression model. The results show conclusively that INTEGRATE has a negative and statistically significant effect on DELAY, suggesting that a greater level of market integration goes hand-in-hand with a higher degree of market informational efficiency. Specifically, a percentage increase in market integration leads to 0.0457 of a percentage point increase in informational efficiency. Market size also retains its explanatory power with a negative and statistically significant coefficient, while trading volume loses its explanatory power.

The findings in this study wholly corroborate prior evidence of the positive association between market integration and informational efficiency by Hooy and Lim (2013), Bae et al. (2012), Lim and Hooy (2010), and Li et al. (2004). In particular, Hooy and Lim (2013) and Lim and Hooy (2010) concluded that the positive association between the two variables is more associated with developing countries as most of them only started to liberalise their markets during the 1980s and 1990s.

5.4.3 Alternative Estimation Techniques as Robustness Check

The standard pooled OLS regression results provide strong evidence in support of our hypothesis of a positive relationship between market integration and market informational efficiency. Next, we determine whether our core findings are robust across different estimation approaches. These alternative estimation methods are: (1) a two-way fixed effect model which accounts for time-series and cross-sectional dependence; (2) a random effect model which allows for random intercepts and assumes uncorrelated regressors with the country effect and could yield more efficient estimates relative to the effect model; (3) the population-average GLS estimator which corrects for residuals correlation; and (4) the dynamic generalised method of moments, GMM, estimator which allows the dependent variable, stock price delay, to follow a dynamic process (with the inclusion of lagged delay as a regressor). The GMM estimation technique also uses the first-differences and the levels equations as instruments. It is expected to provide more robust estimates than the fixed effect and random effect models as it efficiently tackles econometric concerns such as the time-invariant unobserved country-specific, endogeneity and the absence of perfect instrumental variables. The results from these alternative estimators are reported in Table 5.5. Convincingly, our main findings remain unaffected by these different estimation techniques. Market integration and informational efficiency of African stock markets are positively related as the INTEGRATE retains its negative and statistically significant coefficient for all the models (i.e. fixed effect, random effect, population average GLS, and dynamic GMM). It is important to note that the Hausman specification test employed revealed that the random effect model is more appropriate than the fixed effect model. Specifically, in terms of the random effect model, the result shows that a percentage increase in market integration in Africa’s emerging and frontier markets leads to a 0.0438 percentage point increase in stock market informational efficiency. For the population average GLS estimation, stock market efficiency improves up to 0.0441 of a percentage point following a one percent increase in stock market integration. From the GMM estimation standpoint, a percentage increase in stock market integration is associated with a 0.0604 percentage point improvement in the informational efficiency of African stock markets.

Table 5.5: Alternative Estimation Techniques

	Fixed Effect	Random Effect	Population Average GLS	Dynamic GMM
Intercept	0.5775	0.7134	0.7219	0.6301
	(2.73)***	(4.50)***	(4.75)***	(3.01)***
INTEGRATE	-0.0422	-0.0438	-0.0441	-0.0604
	(-2.88)***	(-3.01)***	(-3.05)***	(-3.08)***
Size	-0.0401	-0.0721	-0.0743	-0.0390
	(-0.61)	(-1.38)	(-1.47)	(-0.62)
Volume	0.0362	0.0021	0.0204	-0.0385
	(0.57)	(0.42)	(0.42)	(-0.65)
Observations	165	165	165	154
R^2	0.089	0.114		
F-Statistic	3.12(0.028)	n/a		
Wald Statistics	n/a	12.33(0.006)	13.03(0.005)	20.93(0.000)
Lagged DELAY	n/a	n/a	n/a	0.1638(2.33)***

Notes: The Hausman specification with $_{H0}$: Random Effect is appropriate and $_{H1:}$ Fixed Effect is appropriate, yields the Hausman Statistics (3.00) and probability (Prob>chi2 = 0.3912) which supports the null hypothesis that the random effect model is appropriate against the alternative that the fixed effect model is appropriate.

Importantly, market integration (INTEGRATE) has a greater influence on informational efficiency than both control variables of market size (SIZE) and trading volume (VOLUME). It is also important to point out that stock price delay is found to be a dynamic process since the one period lag of DELAY is statistically significant. The positive and significant coefficient for the one period lagged delay suggests that delayed stock price adjustment to common information reinforces itself during the following period. A stock market that experienced a greater degree of delayed price adjustment to global news previously is likely to suffer an even greater delay in price adjustments during the next period. Specifically, previous informational inefficiency would cause further informational inefficiency during the next period. The implication is that once a stock market is slow to incorporate global common news into its prices, it would require exogenous interventions to improve its speed of price adjustment.

5.4.4 Sub-sample Analysis of Market Integration-Informational Efficiency Link

Financial crises do have a significant impact on stock market integration. The short-term damages associated with financial crisis include declining asset prices across different markets, occurrence of speculative runs and capital flight, and general instability in the affected regions (Chiang et al., 2007). A long-term impact is loss of investor confidence and eventual lower economic growth. It is also argued that the detrimental effects of an unanticipated event in one market are easily transmitted to integrated markets (Li and Majerowska, 2008). Neaime (2012) studies how the global financial crisis affected the global and regional financial linkages been MENA stock markets and the more advanced markets. An important deduction from Neaime (2012) is that the spillover effects of the global financial crisis on countries and the impact on their stock markets vary according to their degree of market integration with the crisis-originating market or the rest of the world. Based on the foregoing assertion, we sought to investigate whether the 2007-2009 sub-prime mortgage credit crunch and subsequent global financial crisis influenced the positive association between market integration and market efficiency in the African stock markets. To achieve this goal, we split the sample into two sub-periods comprising a crisis period (2007-2009)[25] and a non-crisis period (all other years excluding the crisis periods). The baseline pooled OLS regression method was then used to estimate the results reported in Table 5.6.

Table 5.6: Sub-sample Analysis of Market Integration-Informational Efficiency Link

	Non-Crisis Periods	Crisis Periods	Emerging Markets	Frontier Markets	Africa Excl. South Africa
Intercept	0.8389	0.4929	1.6248	0.2168	0.3920
	(6.64)***	(2.38)**	(6.23)***	(1.38)***	(3.04)***
INTEGRATE	-0.0347	-0.1488	-0.0387	-0.0509	-0.0507
	(-1.99)**	(-3.89)***	(-1.13)	(-3.12)***	(-3.29)***
Size	-0.1117	-0.0581	-0.3578	0.0662	0.0194
	(-2.49)**	(-0.84)	(-5.15)***	(1.39)	(0.45)
Volume	0.0353	-0.0069	0.0961	0.0797	0.0522
	(0.82)	(-0.11)	(1.19)	(1.72)*	(1.44)
Observations	132	33	45	120	150
R^2	0.099	0.367	0.474	0.1125	0.0851
F-Statistic	4.70	5.60	12.29	4.90	4.53
Prob > F	0.0038***	0.0037***	0.0000***	0.0030***	0.0046***

Notes: ***, ** and * are significance at 1%, 5% and 10% levels of significance, respectively, while t-statistics are displayed in parentheses.

[25] Filip, Pochea and Pece (2015) consider the global financial crisis to cover the 2007-2009 periods in analysing the herding effect of financial crisis.

The main findings in this study stay unaffected as the results for both crisis and non-crisis periods indicate that market integration and market efficiency are positively related. In particular, a percentage increase in market integration leads to a 0.1488 and a 0.0347 percentage point increase in market efficiency, respectively, for the crisis and non-crisis period sub-samples. These coefficients are statistically significant at the 1 percent level.

Subsequently, the sample is similarly split into three more additional sub-samples consisting of emerging markets (South Africa, Egypt and Morocco), frontier markets (the remaining 8 stock markets), and the rest of Africa excluding South Africa, which is the only truly advanced and sophisticated financial market in Africa (see Aawaar and Tewari, 2016:60). The key findings remain largely unchanged, except the emerging market sub-sample which shows the anticipated but statistically insignificant sign of the coefficient. It is important to note that frontier market integration with the world market is positively associated with their degree of informational efficiency. Specifically, the finding shows a percentage change in Africa's frontier market integration with the global stock market leads to a 0.0509 percentage point change in the same direction in informational efficiency. This finding is reinforced by the result of the sub-sample relating to the rest of Africa excluding South Africa. The findings thus suggest that as markets become increasingly integrated with the world stock market, the extent of informational efficiency of the markets also increases. Therefore, financial liberalisation policies in emerging and frontier equity markets remain a crucial factor in ensuring both the level of integration and efficient functioning of their stock markets. In Table 5.6, market size retains its explanatory power only in the non-crisis period and emerging markets sub-samples. Similarly, trading volume lost its explanatory power in all sub-sample analyses except for the frontier markets sub-sample. In brief, the positive association between market integration and informational efficiency remains persistent and robust across different sub-sample periods.

5.5 Chapter Summary and Concluding Remarks

The link between the market integration and informational efficiency of stock markets remains largely uncharted in the finance literature. In this chapter we ventured into this emerging research area by analysing empirically the association between market integration and informational efficiency with particular reference to stock markets in Africa. The relevant policy variables of market integration and information efficiency of stock markets were measured using the widely recognised International Capital Asset Pricing Model (ICAPM) proposed by Stehle (1977) in the form specified by Hooy and Lim

(2013). The dependent variable, market efficiency or informational efficiency was proxied by the country-level price delay measure which, by construction, captured the relative speed with which the aggregate stock market of a country reacted to global common information. The independent variable, market integration, was proxied by the adjusted pricing error from equilibrium ICAPM, which by formulation allows for both the direct and indirect forms of investment barriers. Our estimation methodology was based on the pooled panel OLS regression method and other panel modelling techniques. The empirical results based on the data from 11 African stock markets (mainly emerging and frontier markets) showed compelling evidence of significant positive association between market integration and informational efficiency. In short, the empirical findings suggested that a more integrated stock market is more informationally efficient, and the findings are robust across different estimation methods.

In keeping with Bae et al. (2012) and Hooy and Lim (2013), the positive link between market integration and informational efficiency is associated with developing stock markets, suggesting that the liberalisation policies undertaken in these countries led to increased market accessibility for foreign investors and improved market efficiency. We conclude in this study that market integration and informational efficiency are not independent policy goals, because a globally integrated stock market is also a globally informationally efficient market. Its pricing process swiftly responds and incorporates global common information rather than local market-specific common information. The two policy variables should therefore be pursued as common policy goals.

Even though greater market integration has significant implications for international diversification opportunities, the advantages of an efficiently integrated market (such as greater capital flows, international risk sharing, efficient prices, technology transfers, and growth) should serve as motivation for pursuing greater market integration in Africa. These emerging and frontier markets need to renovate their policy efforts to further integrate their capital markets with the rest of the world's financial system. It is however important to note that such policies should not be based just on *de jure* capital market integration, but rather should be implemented alongside the *de facto* lines of market integration. It is important to ensure that the integration-enhancing policies focus on creating an accessible and enabling investing environment in the domestic market for foreign investors. As highlighted by Hooy and Lim (2013), for a developing country to realise the efficiency-enhancing advantages of market integration, the focus of policy efforts should be the removal of both explicit and implicit investment barriers in the domestic financial markets. This, we suggest, should be the policy stance of African governments, policy makers, market regulators, and international development partners if the efficient and effective functioning of stock markets in Africa remains a need. The next chapter investigates investor herd behaviour in Africa's emerging equity markets.

CHAPTER 6

Investor Herd Behaviour in Africa's Emerging Stock Markets

"Men, it has been well said, think in herds; it will be seen that they go mad in herds, while they only recover their senses slowly and one by one." Charles Mackay (1841)

This chapter focuses on exploring behavioural finance by addressing the question of whether investors herd in Africa's emerging stock markets and achieves the fourth objective of the study *(i.e. to investigate investor herd behaviour in Africa's emerging stock markets).* The chapter is structured in nine main sections. Section one covers the introduction to herding in financial markets. A discussion of the herding theoretical literature in the fields of social psychology and behavioural finance is covered in section two and three, respectively. Section four presents a methodology review (taxonomy) of studies on herd behaviour, while section five surveys the empirical literature relevant to the present study. The estimation methodology and data used in this chapter are covered in section six. Section seven presents the data and preliminary analyses, while section eight presents and discusses the empirical results based on the CSAD measure. A summary of the chapter and concluding remark are outlined in section nine.

6.1 Introduction and Background

Until the resurgence of behavioural finance some three decades ago, the Efficient Market Hypothesis (hereafter referred to as the EMH) was the basis for several financial models from its inception in the 1960s (Shleifer, 2000). It was generally believed that financial markets are efficient, suggesting that asset prices fully reflect all available information on company share prices.[26] With the EMH it was impossible for an investor or group of investors to consistently "beat the market" and earn excess returns using their private information and superior technical analysis. Thus for the EMH only new information (news), which by definition is unforecastable and unpredictable, should influence changes in asset prices (Alagidede, 2008). Technically, with the EMH, successive changes in asset prices or returns are independent and identically distributed. Thus the EMH is consistent

[26] Three versions of the EMH exist: (1) the weak form of EMH states that asset prices fully reflect past information on the security, (2) the semi-strong form of EMH asserts that asset prices fully incorporate all publicly available information and future expectations, and (3) the strong form of EMH postulates that asset prices fully incorporate all kind of information, including private information about share prices (Fama, 1965, 1970).

with the random walk theory (Hall, 1978) which suggests that asset prices follow the erratic meandering movement of a drunkard.

At the dawn of the twenty-first century however, the validity of the EMH in terms of its theoretical foundations and empirical evidence came under sharp criticism. The grounds for the criticism included the fact that the EMH does not take into account investors' rationality assumption, and presence of arbitrage opportunities. In terms of the investor rationality assumption, market participants are rational and possess cognitive biases that influence their expectations and preferences over-time. Also, the fact that financial markets are constrained institutionally and structurally creates arbitrage opportunities for the informed and superior investor. Following from this, a number of market anomalies which create excess return opportunities for some market participants have been identified in the literature (see Schwert, 2003 for a summary of the different types of anomalies and Alagidede, 2008 for an extensive review). It is therefore unlikely that all investors will earn homogenous returns from their investment decisions and strategies. Indeed, theory suggests and empirical evidence has confirmed the presence of abnormal returns due to certain investment decisions and strategies including contrarian, herding and momentum (see for example Jegadeesh and Titman, 2001 for Momentum trading and Chang, Cheng and Khorana, 2000 for herding investing). The emergence of behavioural finance thus serves as an alternative view to the EMH. Ricciardi and Simon (2000) point out that the goal of behavioural finance is mainly to investigate the psychological and sociological issues affecting the decision-making processes of individuals, groups and businesses. Thus, a firm understanding of the investment behaviour of market participants and their impact on security prices is highly desirable.

One of the major concepts in behavioural finance that has received considerable academic research support is herd behaviour. Scharfstein and Stein (1991: 465) describe herd behaviour as a phenomenon where "managers simply mimic the investment decision of other managers, ignoring substantive private information". Banerjee (1992) prefers to describe herd behaviour as the situation in which "everyone is doing what everyone else is doing, even when their private information suggests doing something quite different." For Christie and Huang (1995:31), herding behaviour takes place when individuals suppress their own belief and follow the investment decisions of the majority of the market participants, regardless of whether the market consensus is contested. Bikhchandani and Sharma (2001) underscore that herd behaviour occurs when an investor decides to invest simply because other investors have decided to invest, but would not have made the investment if he/she had not known about the investment decision by the others. In the same way, the investor would not have made the investment if colleague investors had not made the decision to invest. Accordingly, an investor would only mimic others if he/she is aware of or influenced by their actions. Hirshleifer and Teoh (2003) similarly defined herding based on convergence due to actual interactions between market participants, highlighting that herding is the convergence of actions brought about by shared imitation. For Wang (2008), herding is defined as the "behaviour of an investor to imitate the observed actions of others or the movements of markets, instead of following his own beliefs and information". Essentially, the various studies have offered analogous definitions for herding or herd behaviour, to the effect that market participants (individual and institutional investors) herd when they disregard their private information and follow the investment decisions and actions of others. In brief, "investors and fund managers are portrayed as herds that charge into risky ventures without adequate information and appreciation of the risk-reward trade-offs and, at the first sign of trouble, flee to safer havens" (Bikhchandani and Sharma, 2001).

Theoretical and empirical research on herd behaviour has been undertaken in rather isolated fashion (Wang, 2008). While theoretical studies focus on the causes and implications of herd behaviour (Scharfstein and Stein, 1991; Banerjee, 1992; Bikhchandani et al., 1992; Welch, 1992), empirical studies typically attempt to measure the presence of herding in a purely statistical sense, and do not test any specific theoretical models of herding. The main consensus, nevertheless, is that herd behaviour can be construed as being either a rational or irrational form of investor behaviour (Chang et al., 2000). According to Devenow and Welch (1996), the irrational view emphasises investor psychology where investors ignore their private information and prior belief and blindly follow other investors. The rational view, on the contrary, focuses on the principal-agent problem in which institutional investors such as fund managers completely disregard their private information and imitate the actions of others for purposes of maintaining their reputational capital in the financial markets (see Scharfstein and Stein, 1990; Froot et al., 1992; Rajan, 1994). Bikhchandani et al. (1992) and Welch (1992) describe this investor behaviour as an informational cascade which can lead to wrong investment decisions for all investors in the herd. The rational form of investor behaviour may not however apply to individual investors since most individual investors are anonymous (Chen et al., 2003). Bikhchandani and Sharma (2001) and Kremer and Nautz (2012) refer to the consensus as herding types which can be either sentiment-driven intentional herding or unintentional (spurious) herding. The latter type of herding is driven by widespread identical response to public information and signals. In particular, intentional herding can destabilise security prices and impair the efficiency of financial markets (Scharfstein and Stein, 1990; Hirshleifer and Teoh, 2003; Hwang and Salmon, 2004). Kremer and Nautz (2012) argue that unintentional herd behaviour can also lead to market inefficiency if the correlated actions of market participants are not driven by fundamentals values. Thus, for all conceptual models on herd behaviour developed in the 1990s and beyond, investors are deemed to exhibit the tendency to herd (bunch up) on one side of the market.

On the empirical front, several studies have been conducted globally to test the presence of herd behaviour in financial markets. The literature either tests clustering of investors' decisions within a defined group in the market or examine herding at a broad market level (Wang, 2008). In a pioneering work on the first category, Lakonishok et al (1992) measure herding as the average tendency of fund managers to buy (sell) contemporaneously the same stocks as other fund managers buy (sell), relative to what would have been expected had these managers executed their transactions independently. Using a sample of 769 equity funds, the study finds no evidence of herd behaviour among fund managers in the US financial markets. Grinblatt et al (1995) apply the methods of Lakonishok et al. (1992) on the investment strategies of 155 mutual funds for the 1984-1994 period and find that 120 out of this sample were momentum traders. The study also documents evidence of high correlation between the tendency for a fund to herd in its investment decisions and its tendency to buy past winners (momentum stocks). Wermers (1995) suggests a portfolio-change measure of herding which measures the extent of clustering between portfolio weights assigned to various securities by fund managers.

The second strand of empirical research on herd behaviour adopts a market-wide approach which focuses on the collective behaviour of all market participants towards the market view, leading to a simultaneous purchase or sale of specific assets. In Christie and Huang (1995), the cross-sectional (market-wide) standard deviation of individual stock returns is regressed on a constant and a dummy variable that serves as a proxy for extreme positive and negative market returns. In their view, during periods of market stress (extreme price movements), a positive coefficient of the dummy variable would imply rational asset pricing, whereas a negative coefficient would suggest the presence of herding. It is worth noting that the Christie-Huang's study establishes the possibility of herding to be investigated using only stock price information instead of the rigorous task of obtaining detailed information of individual investment transactions. Extending the work of Christie and Huang (1995), Chang et al. (2000) specify a non-linear regression model to examine the relation between the level of stock return dispersion (measured as the cross-sectional absolute deviation, i.e. CSAD) and the overall market return. They argue that, in the presence of severe or moderate herd behaviour, the equity return dispersions would be expected to decrease (or increase at a decreasing rate) with an increase in market return. On the other hand, absence of herding in the market would imply that periods of extreme price movements are associated with increase in equity return dispersions. Hwang and Salmon (2004) employ the cross-sectional dispersion of beta to test herding towards the market index. They authors attempt to distinguish herding from "spurious herding" which refers to a common movement of asset prices and returns resulting from movements in economic fundamentals and does not necessary cause market inefficiency. In essence, studies on the investment behaviour of financial market participants have surged because of the link between such behaviours and security price movements, and their implications for the proper functioning of financial markets.

In the present study we investigate investor herd behaviour in Africa's equity market using the cross-sectional absolute deviation measure (CSAD) proposed by Chang, Chen and Khorana (2000). The study additionally examines whether or not asymmetric herd behaviour can be detected under different market conditions (i.e. during rising, falling and volatile markets). This study thus follows the second strand of empirical research and tests herding towards the market-wide index. A number of factors, such as the investment horizon of investors, the benchmark for measuring performance, the behaviour of other market participants, the extent of underlying market volatility, and the occurrence of fads and speculative trading activities in the financial markets have been suggested as influences investment behaviour (Chang et al., 2000). Definitely, herd behaviour in financial markets needs considerable research attention because of its perceived connection with price volatility, financial crisis, market inefficiency, and their policy implications.

The motivation for this study is threefold. First, dreadful policy implications are reported to be associated with investor herding. In particular, policy makers and financial market regulators often express concerns that herd behaviour by market participants or investors destabilises markets and increases the fragility of the overall financial system. For example, Herd behaviour has been heavily blamed for severe stock price movements (Tan et al., 2008) and is said to be closely associated with widespread financial crises (Bikhchandani and Sharma, 2001). As a market anomaly that contradicts the classical efficient market hypothesis, and as one of the founding pillars of modern behavioural asset pricing theories, the study of herd behaviour in Africa's equity markets would help to explain market-wide anomalies in the African financial markets. Consequently, the detection of the presence or otherwise of herd behaviour in Africa's markets will enable the design of appropriate market-oriented policies to curtail it.

Second, the unique features of the African stock markets qualify them as an appropriate location to investigate investor herding. Some stylised facts about African financial markets include the fact that none is a developed (an advanced) market, few are emerging markets (Egypt, Morocco and South Africa), while the majority of them are frontier markets. The markets are also characterised by moderately high volatility, illiquid stocks, and weak regulatory standards and accounting reporting systems. As a result, herd behaviour has been proven to be widespread in emerging markets and pervasive under severe market conditions (Tan et al., 2008). Studies on contagion and spillover effects show that volatility spillovers among markets are attributed to herd behaviour and other irrational investor behaviours such as momentum trading strategies[27] (Belke and Setzer, 2004). The existence of asymmetric information and lack of transparent accounting reporting systems in these developing and emerging markets compel investors to herd other market participants (Chang et al., 2000). Besides, African markets have witnessed increased foreign investor participation in recent times. The behaviour of some foreign investors is however to enter and exit emerging markets in herds, which can engender market inefficiency and uncertainty (Mendoza and Clavo, 1997). Evidence in Blasco et al. (2012) show a direct linear effect of investor herding on volatility; and Avramov et al. (2006) indicate significant impact of both herding and contrarian investors on intraday volatility. Also, market illiquidity prevents stock prices from quickly incorporating new information, resulting in stock prices deviating significantly from their intrinsic values. This situation is potential ground for herd behaviour.

Third, most asset managers in African markets adopt active investment strategies in which "so called" superior technical analyses are implemented with a view to out-performing the

[27]Momentum trading strategy is the tendency of buying securities which have performed well in the past and/or selling securities which have performed poorly in the past in the belief that they will maintain the same momentum into the future.

market. Unlike passive fund managers who seek to reflect or closely track the performance of a specific benchmark index, active fund managers attempt to predict future security price movements in order to beat the market. Thus, active fund managers' compensation and reputation are linked directly to their ability to outperform the market. This situation, nevertheless, is a breeding ground for herd behaviour, as lazy and self-centred fund managers may simply disregard their private information and initial investment decisions and imitate other fund managers. This behaviour converges with the belief that it is better to fail conventionally than to succeed defiantly (Scharfstein and Stein, 1990; Rajan, 1994; Trueman, 1994; Zwiebel, 1995). Of course, the active investment strategy contravenes the EMH which believes that it is a waste of time and resources to attempt to beat the market because the emergence of any mispricing would be eliminated immediately.

6.2. Theoretical Literature on Herd Behaviour in the Field of Social Psychology

Imitation of the actions of others is a very common behaviour among human beings. The thoughts, feelings, and actions of an individual can be influenced by other individuals in several ways including by words, by observing their actions, and by observing the consequences of their actions (Hirshleifer and Teoh, 2003). A good number of studies in social psychology have endeavoured to find the reasons behind this phenomenon. Rook (2006: 80) points out that the impetuous, irrational and primitive emotions of people could bring about a "collective consciousness crime". In one of the early studies, Asch (1951) indicates that the tendency of an individual to ensure convergence with a reference group should be viewed as a rational attempt to understand social reality. He contests the notion that conformity with a reference group is an accidental and irrational behaviour. Asch (1951), in a pioneering experiment, shows that conformity with others is deliberate and informed decisions that individuals make based on information revealed by the actions of other individuals. The outcome of Asch's experiment suggests that conformity can even be sought in situations where the wrong option would be followed.

Deutsch and Gerard (1955) attempt to explain the motives behind individuals' tendency to conform with others based on two types of social influence, namely normative and informational social influences. To them, normative social influence is a form of conformity caused by an internal drive to imitate the perceived rules of others. Conversely, informational social influence is conformity based on the acceptance of information from others, in the belief that others possess accurate information. Bikhchandani et al. (1992) indicate that informational social influence can result from local conformity, and fads and fashions caused by the individual's tendency to conform. Kelman (1961) prefers to explain the possible reasons for peoples' inclination to seek conformity or convergence with a reference group using three distinct processes that augment the two social influences: compliance, internalisation and identification. Kelman describes compliance as the situation where an individual conforms to others' expectations with the hope that he/she will be accepted by the group. Simply, in compliance, the individual goes exactly the way of the group. Regarding internalisation, Kelman (1961) describes it as the situation where an individual conforms to social influence because it is a behaviour that he/she accepts and perceives to be instrumental in accomplishing his/her goals. In short, the social influence is not only in line with the individual's value system, but also, is essentially beneficial. For instance, individuals are likely to adhere to experts' advice if they find them to be relevant to their own predicament and because it conforms to their own values (Kelman, 1961). Lastly, identification, according to Kelman (1961), occurs when an individual imitates the behaviour and actions of others in an effort to enhance his/her self-worth. Identification thus creates and upholds the requisite characteristics for a relationship with others.

Subsequently, Burnkrant and Cousineau (1975) manage to link each of the three processes put forward by Kelman (1961) to the two types of social influences identified by Deutsch and Gerard (1955). In the view of Burnkrant and Cousineau, informational influence is accomplished through the internalisation process. This is manifested in informational influence enhancing individuals' awareness about their environment. People accept informational influence when they are convinced that it can help them find a solution to their problems. Through the processes of compliance and identification the normative influence is accomplished. People give attention to behaviour and thoughts they identify as coming from sources they regard as their positive reference group. For compliance as a means of achieving normative influence, the individual is disposed to conform to the influence of a reference group as he/she expects a reward from the group. The linkage created by Burnkrant and Cousineau (1975) between a particular type of social influence, its process and the goal orientation relevant to each social influence process is shown in Figure 6.1. Bikhchandani et al. (1992) introduce the term "information cascade" which describes information social influence as the situation where a rational individual unreservedly imitates others by observing information contained in their actions, while disregarding alternative sources of information. Accordingly, information cascade develops suddenly on the back of very little information.

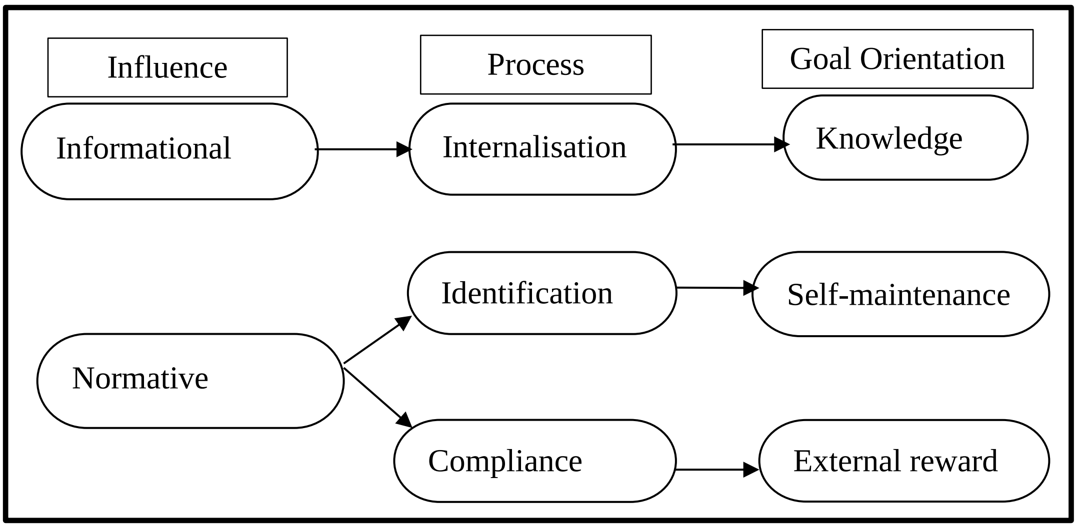


Figure 6.1: Social Influence and its Process and Goal Orientation
Source: Burnkrant and Cousineau (1975)

Banerjee (1992) expounds that investors observe the investment decisions of others prior to making their decisions. This according to him is a rational behaviour, since different people may be in possession of relevant information that the investor is not privy to. Inspired by the works of Banerjee (1992) and Bikhchandani et al. (1992), other studies prefer to describe this behaviour as "observational learning" to highlight the fact people learn by observing the actions of others and regard them as being informative (Celen and Kariv, 2004). Celen and Kariv (2004) analyse observational learning among decision-makers and document that convergence of beliefs is implausible when individuals only observe the actions of their immediate predecessors in arriving at their decisions. Nevertheless, Callander and Horner (2009) think that it might be more profitable to observe the actions of minority predecessors than to observe the general view.

As mentioned previously, normative social influence is a widespread source of conformity. Extensive academic research has established that people's behaviour can be greatly influenced by observing the actions of others. Social influences are rules and standards that are understood by members of a group, and that guide human behaviour without the use of law (Cialdini and Trost, 1998). Normative influence is adaptive in nature, a breach of which leads to sanctions and social disproval. Many studies have shown that normative influence can induce individuals to pursue falsehood (Deutsch and Gerard, 1955; Milgram *et al.*, 1969), to use illegal drugs (Maxwell, 2002), or to fail to heed to an impending danger (Latane and Darley, 1970). Normative social influence does not require direct observation of others to be effective, rather a descriptive norm conveyed through written information can induce conformity to the behaviour so communicated (Parks *et al.*, 2001). Evidence documented in Schultz (1999) indicates that households that received normative information emphasising the amount recycled by an average family in the neighbourhood increased the amount and frequency of their subsequent recycling behaviour. In a study of the persuasive effects of normative social influence on energy conservation, Nolan *et al.* (2008) conclude that normative social influence creates the greatest change in behaviour compared to informational social influence. People nonetheless regard normative information as the least motivating. In addition, Nolan et al. (2008) report that descriptive normative beliefs are more effective in predicting individual behaviour than any comparable beliefs. Individuals however view such norms as least important in their decision to conserve energy.

6.3 Theoretical Literature on Herd Behaviour in Behavioural Finance

Theoretical literature on herd behaviour in financial markets dates as far back as the 1930s, when John Maynard Keynes appeared skeptical about the ability of long-term investors to make sound investment decisions. According to Keynes, investors may be reluctant to invest using their private information and judgement for fear of damaging their reputation in the labour market with contrarian behaviour. In view of this, Keynes asserted that market participants such as professional money managers will "follow the herd" to safeguard their reputations. In a celebrated passage, John Maynard Keynes describes the pricing of shares on the stock market as follows:

> *"Professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole; so that each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one's judgement, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligence to anticipating what average opinion expects the average opinion to be. And there are some, I believe who practise the fourth, fifth and higher degrees." (Keynes, 1936: 156)*

However, it was not until the 1990s that herd behaviour received considerable research support from proponents of behavioural finance. For example, inspired by the work of Holmstrom (1982), Scharfstein and Stein (1991) developed a "learning" model in which the behaviour of two kinds of fund managers, the "smart" ones and the "dumb" ones is analysed. The smart managers receive good and useful information, while the dumb managers receive simply noisy information. The assumption is that, a manager’s reputation is assessed by the labour market based on whether he/she made a profitable investment or had behaved similarly to or differently from the investment decision of other managers. Thus an unprofitable investment by a manager may be overlooked when other managers committed similar investment mistake – they essentially share the blame. Consequently, smart managers receive correlated useful signals and tend to imitate each other, while dumb managers observe uncorrelated signals and tend to take contrarian positions. Notably, a manager may disregard their profitable private signal if he/she observes that other managers before him/her did not go that way. Conversely, he/she may pursue an investment with negative expected returns if other managers before him/her invested. Therefore, Scharfstein and Stein (1991) assert that a number of circumstances, such as reputation considerations, make fund managers ignore substantive private information and simply imitate the investment decisions of other fund managers.

Banerjee (1992) developed a model based on sequential decision which suggests that market participants make investment decisions by observing the decisions of other market participants. In his view, the behaviour of these market players is rational in the sense that the presence of information asymmetry means that other participants may possess useful information that they may not know about. In another sequential model, Bikhchandani et al. (1992: 994) explain why people conform to the actions and behaviour of others. The study further explains quick and short-lived phenomena such as trends, fads/fashion, and crashes that witness conformity by individuals. Rama and Bouchaud (2000) however disagree with the view of Bikhchandani et al. (1992), describing the sequential model as being unrealistic since the orders of market participants are often submitted simultaneously. Rama and Bouchaud (2000) proposed a model that assumes non-sequential decisions, random communication and independent decision-making processes in the market. They argue that these random interactions among market players create a market structure that is heterogeneous in nature.

Thus, herd behaviour can be construed as being either taking a rational or an irrational form. While irrational herding focuses on investor psychology and how investors ignore their initial beliefs and private information and blindly follow other investors, rational herding focuses on the principal-agent problem. Professional investors have reputational risk to contend with when they act differently from others. In view of this and for fear of losing their reputation and/or compensation, professional investors such as fund managers mimic the investment decisions of others, disregarding their own substantive private information in the process (Chang et al., 2000; Kremer and Nautz, 2012). Alemanni and Ornelas (2006) emphasise that, while herd behaviour may be rational at the individual level, it is irrational at the group level as herding brings about price uncertainty and market inefficiency. Bikhchandani and Sharma (2000) underscore the need to distinguish between sentiment-driven intentional herding and unintentional herding (which they also termed as spurious herding). On the one hand, intentional herding stems from an obvious intent by market participants to imitate others. On the other hand, spurious or unintentional herding occurs when groups of market participants facing "similar decision problems and information sets" make similar investment decisions (Yao et al., 2014). Figure 6.2 illustrates the two types of investor herding and their respective causes as discussed in the herding literature (see for example, Bikhchandani and Sharma, 2000; Gilmour and Smit, 2001). Distinguishing between the various types of herd behaviour, their causes and effects is useful for determining policy responses to mitigate herding and its implications.

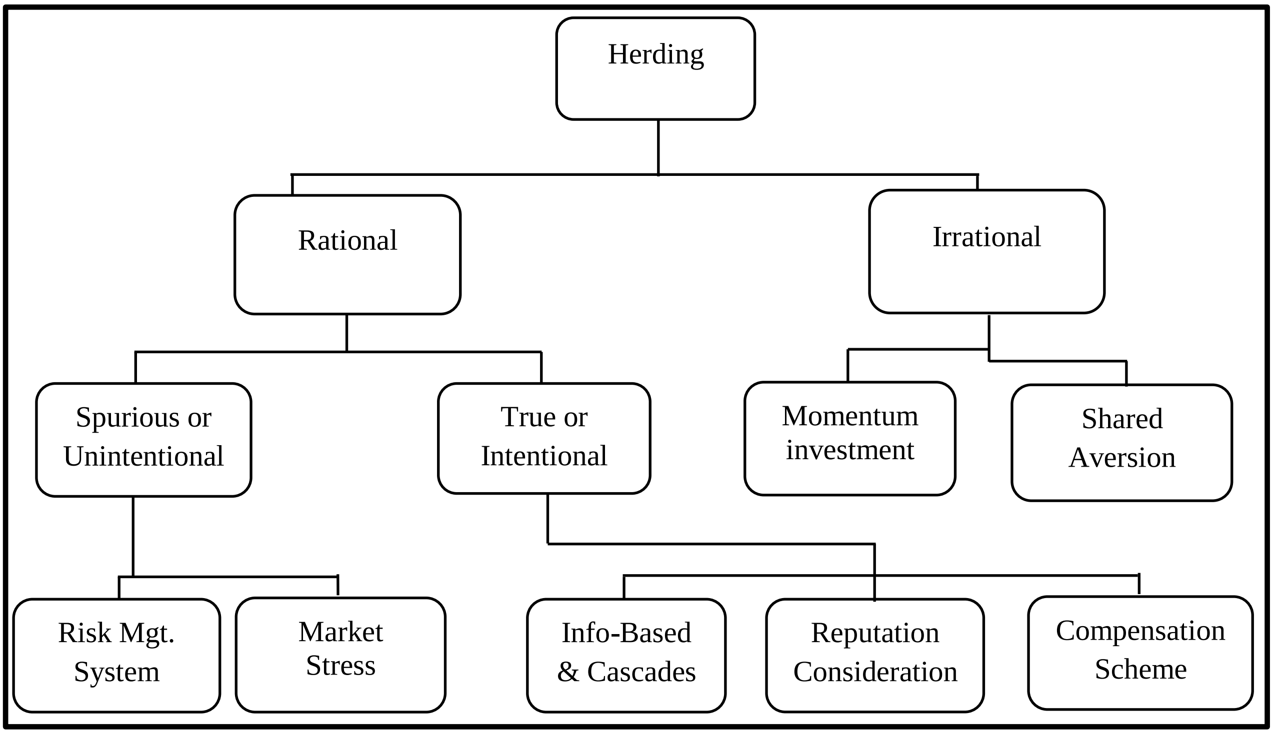


Figure 6.2: Taxonomy of Herding Types and Causes in Financial Markets
Source: Authors' Construct based on extant Literature *(see for example, Bikhchandani and Sharma, 2000; Gilmour and Smit, 2002; IMF, 2007, and Daníelsson, 2008).*

6.3.1 Irrational Herding

As mentioned previously, irrational herding behaviour occurs when market participants disregard all forms of analysis and blindly follow others. This type of herding, in the view of Devenow and Welch (1996), focuses on investor psychology and the tendency of individuals to align with reference groups. At least, two main sources of irrational herd behaviour are identified in the literature: (a) momentum-investment or positive-feedback strategies, and (b) shared aversion.

6.3.1.1 Momentum-Investment and Positive Feedback Strategies

Momentum-trading and positive-feedback strategies are similar investment strategies. In momentum investment strategy, investors buy past-winner stocks and sell past-loser stocks in the belief that stock prices will maintain their momentum in the future[28]. The positive-feedback trading strategy, on the other hand, involves buying securities when prices rise and selling when prices decline. Even though the two trading strategies are identical, Gilmour and Smit (2002) expound that momentum-investment strategies are more orientated towards the long term, whereas positive-feedback strategies focus more on short-term investment horizons. Both strategies are irrational behaviour since asset prices should already incorporate all forms of information (Belke and Setzer, 2004). Besides, these strategies drive asset prices away from fundamentals, increase price volatility and contradict the EMH. In their study of positive-feedback trading, De Long et al. (1990) disagree with the notion that, in an efficient market, the activities of rational speculators are enough to stabilise fluctuations in asset prices caused by noise trading. In their opinion, it is possible for noise traders to follow positive-feedback strategies, buying shares when prices rise and selling them when prices fall. In the presence of positive-feedback trading, rational speculators may find it profitable to jump on the bandwagon and buy securities ahead of noise traders in the hope of selling high in the future. Thus this early buying phenomenon by forward-looking rational speculators can trigger positive-feedback trading, which can undermine the efficiency of markets. Even though the literature generally admits that momentum-investment or feedback strategies are irrational investor behaviour and can aggravate price movements and volatility, positive-feedback strategies according to Bikhchandani and Sharma (2001) may be said to be a rational behaviour. According to the authors, to the extent that market participants delay in responding to new information, prices likewise delay in incorporating new information.

[28] Two main sources/causes of momentum profits have been identified in the literature: (1) risk factors according to risk-based models such as the CAPM explain the presence of momentum profits (see for example, Hon and Kaplanis, 2003; Copper et al., 2004; and Galariotis et al., 2007). (2) Behaviour-based models explain that the presence of momentum presence is due to investor underreaction or overreaction to news (Barberis, Shleifer and Vishny, 1998), investor overconfidence and self-attribution bias (Daniel, Hirshleifer and Subrahmanyam, 1998) and types of agents in the market, whether they are newswatchers or momentum traders (Hong and Stein, 1999).

6.3.1.2 Shared Aversion Sources of Herding

Shared aversion as a source of irrational investor behaviour is distinct from other causes of herding. Unlike other grounds for herding in which market participants follow the decisions of others, with shared aversion, investors search for securities with certain characteristics likely to guarantee them profitability. Describing shared aversion source of herding, Hirshleifer et al. (1994) indicate that a subset of stocks becomes the focus of some investors. Securities found to have the desired characteristics would be purchased by these investors who have committed resources to discover their preferred shares. Bhushan (1989) posit that analysts have preference for shares of firms with comparable characteristics in terms of ownership structure, firm size, number of business lines and returns variability. For example, Brown and Mitchell (2008) empirically studied the price clustering of Shanghai and Shenzhen stock exchange markets in China and report that investors in Chinese A-shares[29] prefer share prices containing the number 8 and have an aversion to stock prices with the number 4. This is because, for most Chinese, the digit 8 is a lucky number while 4 is a misfortune and must be circumvented.

6.3.2 Rational Herd Behaviour

Investment behaviour is deemed rational when market participants would consciously adopt similar behaviour if they found themselves in a similar situation again (Caparrelli et al., 2004). Rational herding views are concerned about how optimal decision-making in financial markets are influenced. Rational herd behaviour occurs in two forms: true or intentional herding and spurious or unintentional herding (Bikhchandani and Sharma, 2001). On the one hand, intentional herding results from an apparent intent to imitate the investment behaviour of other market participants. On the other hand, spurious or unintentional herding occurs where groups of investors facing similar decision problems and information sets end up taking similar investment decisions. For example, investors reacting to news on fundamentals could simply end up on the same side of the market. Sources of spurious or unintentional herding include market stress, risk management systems and the endorsement effect. Christie and Huang (1995) argue that during periods of market stress (unusual market movements), investors often supress their private belief in favour of the market consensus. The presence of high degree of government intervention and more speculators with short investment horizons as well as poor information disclosure can cause market stress (Chang et al., 2000). Also, market sensitivity risk management

[29] In the two Chinese stock exchanges of Shanghai and Shenzhen, A-shares refer to those stocks accessible by only Chinese nationals and organisations, with restricted access to foreigners.

systems, such as Value at Risk (VaR) adopted by banks requires them to sell as volatility rises, resulting in banks reacting similarly to common risk measures and thus acting as a herd (IMF, 2007; Daníelsson, 2008; Kremer and Nautz, 2012). Generally, spurious or unintentional herding should not result in inefficient outcomes, but rather lead to market efficiency since it results from changes in fundamentals (Yao et al., 2014). Consequently, the spurious category of herding is not a focal point in this study. On the other hand, true (intentional) herding is attributable to various factors such as imperfect information (including information cascades), reputation consideration, and compensation structures. Intentional herding may also occur on account of the individual's inherent preference for conformity. It must be pointed out that the presence of this type of herd behaviour in the market undermines price adjustment, impedes market efficiency and can lead to bubbles, crashes and crises (see Scharfstein and Stein, 1990).

6.3.2.1 Information-Based Herding and Information Cascades

Market participants face similar investment-decision problems under uncertainty and have private information which is distorted by imperfections such as inefficient information disclosure by companies. All information relevant to investment decisions is public, but its quality is uncertain (Bikhchandani and Sharma, 2001). Essentially though, individuals can observe the actions of their peers but not their private information or signals. The observation of individuals' actions, however, facilitates herding since the private information of participants may be inferred from their actions. Also, in the midst of imperfect information, market participants may deliberately imitate the decisions of their peers if the perceive others to have relevant information or news. Bikhchandani and Sharma (2001) describe this behaviour as being fragile, susceptible to the arrival of new information, and hence idiosyncratic. Consequently, information cascade (i.e. the situation where individuals with imperfect information make decisions in sequence) may arise. Initially, few decision-makers disclose their information by taking certain actions, and subsequent decision-makers utterly disregard their private information and merely follow an established pattern (Anderson and Holt, 1996). As a result, correlated investment decisions are made, which are a major ground for herd behaviour (Gilmour and Smit, 2002). In a model based on informational cascades, Bikhchandani et al. (1992) explain how individuals make their decisions sequentially after observing the decisions made by other people. The conclusion reached in their model suggests that localised conformity of behaviour and the fragility of mass behaviour can be caused by information cascades. Banerjee (1992) also develops a sequential model which views investors as acting rationally if they follow the herd believing that the actions by previous investors reveals important information in their possession. Nonetheless, Banerjee (1992: 798) suggests that such sequential actions by investors should be regarded as irrational behaviour because the information contained in the decisions of others is less informative to other decision-makers.

6.3.2.2 Reputational Concerns as a Source of Herding

Another important source of herding discussed in the literature relates to career or reputational concerns of fund managers or analysts. In a reputation-based model, Scharfstein and Stein (1990) assert that it could be rational for fund managers to ignore their private information and signals and follow the actions of other fund managers. Essentially, the principal-agent relationship may be such that an employer and manager are uncertain about the ability of the latter to make good investment decisions. In such situations, conformity with other professional fund managers is deemed a rational behaviour. Typically, a manager's reputation is tied to observers' assessment of their ingenuity, and it is less damaging reputationally if an unsuccessful investment decision is pursued by other fund managers. This basic principle thus concurs with Keynes' insight that "it is better to fail conventional than to succeed unconventional" and is aptly captured in the following quotation:

> *"Ninety percent of what we do is based on perception. It doesn't matter if the perception is right or wrong. It only matters that other people in the market believe it. I may know it's crazy, I may think it's wrong. But I lose my shirt by ignoring it. This business turns on decisions made in seconds. If I wait a minute to reflect on things, you're lost. I can't afford to be five steps ahead of everybody else in the market. That's suicide." Head of Foreign Exchange Operations at Manufacturers Hanover Trust, "Making Book on the Buck," Mossberg, Wall Street Journal, September 23, 1988.*

Trueman (1994) studied the reputational incentives for stock market analysts to herd in their forecasts of future earnings. Analysts do have an incentive to make their forecasts biased towards the prior expectation of the market. In a related study, Brandenburger and Polak (1996) demonstrate that a firm with superior information can enjoy a reputational incentive by making investment decisions that coincide with project choices that observers' prior belief deems as the more profitable project. Intuitively, the manager's reputation may be unaffected even though the market generally may feel disappointed that the prior-favoured project did not turn out to be the more profitable. Graham (1999) also shows that analysts herd to avoid their private forecasts becoming too different from results of the collective forecasts.

6.3.2.3 Compensation-Based Herding or Compensation Scheme Source

Another source of herd behaviour that emanates from the principal-agent problem is compensation scheme or more generally, career concerns. A fund manager whose compensation is dependent on how his/her performance compares with the performance of similar fund managers may have an incentive to imitate others. A risk-averse investor (fund manager) whose compensation is tied to a benchmark's performance is likely to be induced to skew his/her investment decision towards the benchmark, which may give rise to herd behaviour (Roll, 1992). Maug and Naik (1996) study a model with a risk-averse investment manager whose compensation increases with his/her own performance and decreases in comparison with a benchmark's performance, represented by either the return of an appropriate index or the performance of a distinct group of investors. In this model, both the agent and the benchmark have imperfect private information about the returns of the security. The model additionally assumes that the benchmark investor initially makes the investment decision, and the agent subsequently picks his/her portfolio after observing the actions of the benchmark investor. Maug and Naik (1996) explain that, by observing the benchmark investor's actions, the agent has an incentive to imitate the benchmark investor so that his/her optimal investment portfolio coincides with the benchmark portfolio. Moreover, the prevailing compensation scheme that governs the principal-agent contract provides additional ground for herding. The fact that the agent's compensation decreases if he/she underperforms the benchmark induces the agent even more to ensure that his/her investment moves closer towards the benchmark's portfolio.

6.4 Taxonomy of Methodologies and Herding Measures in Stock Markets[30]

Empirical studies on herd behaviour have been conducted in an isolated manner relative to the theoretical literature. While the focus of theoretical works is on the causes and implications of herd behaviour, the empirical literature, using various statistical approaches, focuses mainly on detecting whether clustering of decisions is occurring in financial markets or within certain investor groups. This section presents a methodology review of various measures developed over time to measure herd behaviour in financial markets. The empirical studies on herd behaviour are often carried out following two main approaches: (1) measuring investor herding by analysing a particular group of market participants, and (2) measuring investor herding using a market-wide approach. The Lakonishok, Shleifer and Vishny (LSV) Model and Portfolio-Change Measure (PCM) of

[30] This taxonomy is based on a review of various studies including Bikhchandani and Sharma (2001), Gilmour and Smit (2002), and Niyitegeka (2013).

correlated trading represent the pioneering works in this first strand of empirical research. In the second strand, the Cross-Sectional Standard Deviation, the Cross-Sectional Absolute Deviation, and Beta Herding Models are ground-breaking herding measures that have received widespread empirical research support.

6.4.1 The Lakonishok Shleifer and Vishny (LSV) Measure of Herding

The Lakonishok, Shleifer, and Vishny (1992) measure of herd behaviour (hereafter referred to as the LSV measure) is a pioneering model for measuring investor herd behaviour in financial markets. The LSV measure is based on trades executed by a given subset of market participants over time. It has been pointed out that the subset of participants generally represents a homogenous group of investors whose behaviour can seriously affect the market. A key assumption of the LSV Model is that herd behaviour results from a disproportionate number of fund managers who simultaneously buy or sell a given stock. The LSV measure is defined as follows:

$$\overline{HM}_{i,t} = \left|P_{i,t} - E\left[P_{i,t}\right]\right| - AF(i) \tag{6.1}$$

where $P_{i,t}$ is the proportion of all buying activities relative to all buy and sell activities, and $E\left[P_{i,t}\right]$ denotes an expected fraction of buyers for fund trading stock i during quarter t. LSV (1992) assume that $E\left[P_{i,t}\right]$ remains constant across all stocks for a given quarter, in line with their proposition for the use of a proportion of all stocks traded by buying fund managers during quarter t. $AF(i)$ is the adjustment factor, representing the probability that buying results from a random process. Thus $AF(i)$ equals the expectation $\mathrm{E}\left|P_{i,t} - E\left[P_{i,t}\right]\right|$ under the H_0 (null hypothesis) of no herding. $HM_{i,t}$ is zero when there is no herding in the market, but becomes non-zero in the presence of herding. The higher the value of $HM_{i,t}$, the more widespread herding is in the market.

It is however possible for herding to be more pronounced on one side of the market. For instance, in markets in which industry constitutes a minute portion of the overall stock holdings, it is plausible that the purchase or sale of a given asset in a particular industry such as financials would have the other counterpart coming from a different industry such as telecommunications. In consequence, Wermers (1999) proposed the conditional count herding measure which makes it possible for the overall measure of herding to be disaggregated into the buy-side (denoted by $BMH_{i,t}$) and sell-side (denoted by $SH_{i,t}$).

$$BMH_{i,t} = HM_{i,t} \left| P_{i,t} > E\left[P_{i,t}\right] \right| \tag{6.2}$$

and

$$SMH_{i,t} = HM_{i,t} \left| P_{i,t} < E\left[P_{i,t}\right] \right| \tag{6.3}$$

Thus $BMH_{i,t}$ can be averaged to produce $\overline{BMH}_{i,t}$which represents the average measure of herding on the buy-side of the market for all stocks i in all quarters t over a specified time period. Similarly, averaging $SMH_{i,t}$ would yield $\overline{SMH}_{i,t}$ which represents the average measure of herding on the sell-side of the market for all stocks i in all quarters t over a specified time period.

The LSV measure of herding is however deemed to have a number of defects. First, the LSV measure is incapable of identifying herding at the market-wide level, because for any given buy side there is a corresponding sell side, which the measure cannot factor in. Besides, in its specification as a binomial distribution, the measure can only deal with one side of the market at a time and may actually break down dealing with short-selling (Oehler and Chao, 2000). Second, the LSV measure only takes into account the numbers of investors buying or selling stocks but does not consider the volume of trades. The measure of herding could thus fail to detect herding while it exists, if the contribution of buyers in the market is comparatively greater than that of the sellers.

Subsequently, LSV empirically tested herd behaviour using the investment behaviour of 769 United States tax-exempt equity funds managed by 341 different fund managers. The panel data, which spanned the period 1985-1989, contains the number of shares of each stock held by each fund manager for each quarter. The conclusion reached by LSV shows that no significant herding could be detected by fund managers in their sample. The evidence however indicates that herding is more prevalent in stocks of small firms than in stocks of large firms. Using the LSV measure, Grinblatt, Titman and Wermers (1995) examine herd behaviour among fund managers and how herding is related to momentum investment strategies and performance. Using data on portfolio changes of 274 mutual funds, the authors find little evidence of significant herding in their sample. Specifically, the herding measure $HM_{i,t}$ averaged 2.5 over the period, which is similar to the one reported ($HM_{i,t}$ = 2.7) by LSV (1992).

Wermers (1999) employs the LSV measure and quarterly data on equity holdings for virtually all mutual funds that existed between 1975 and 1994. The results indicate that evidence of herding by mutual funds exists. In particular, the herding measure $HM_{i,t}$ computed over all stocks and quarters for the sample period averaged 3.4, which is significantly higher than those reported by both LSV (1992) and Grinblatt et al. (1995). In addition, Wermers reports the detection of greater herding in small, growth stocks. Unlike the finding by Grinblatt et al. (1995) to the effect that herding is more visible on the buy-side of the market, Wermers finds that herding is rather easily formed on the sell-side of the market. Similar to Grinblatt et al. (1995) however, in which mutual fund managers are found to widely adopt positive-feedback strategies, evidence in Wermers (1999) suggests that herding levels are greater among stocks with previous positive or negative returns.

6.4.2 Portfolio-Change Measure (PCM) of Herding

Wermers (1995) develops a measure of herding, namely the Portfolio-Change Measure of correlated trading (hereafter referred to as the PCM) deemed to be able to capture both the direction and intensity of the trading activities of investors. The PCM thus overcomes a major drawback of the LSV measure which relates to its inability to allow for the volume of trade in the market. The underlying principle of the PCM is to detect herding by measuring the extent to which different fund managers' portfolio weights allocations move in the same direction. The intensity of belief, in the view of Bikhchandani and Sharma (2001), is measured by the percentage change of the fraction explained by a stock in a fund portfolio. Wermers (1995) defines the cross-correlation PCM of lag τ between portfolios J and K as

$$\hat{p}_{t,\tau}^{J,K} = \frac{\left(\frac{1}{N_t}\right)\sum_{n=1}^{N}\left(\Delta\widetilde{\omega}_{n,t}^{J}\right)\left(\Delta\widetilde{\omega}_{n,t-\tau}^{K}\right)}{\sigma^{J,K}(\tau)} \tag{6.4}$$

where $\Delta\widetilde{\omega}_{n,t}^{J}$ represents the change in portfolio J's weight of stock n during quarter the $[t_{-1}, t]$, and $\Delta\widetilde{\omega}_{n,t-\tau}^{K}$ is the change in portfolio $K's$ weight of stock n during the quarter $[t-\tau-1, t-\tau]$. N_t denotes the number of stocks in the intersection of the set of tradable assets in portfolio J during quarter $[t_{-1}, t]$ and in portfolio K during quarter $[t-\tau-1, t-\tau]$. The $\sigma^{J,K}(\tau)$ is the time series average of the product of the cross-sectional standard deviations determined as follows:

$$\sigma^{J,K}(\tau) = \frac{1}{T}\sum_{t}\left\{\frac{1}{N}\left[\sum_{n}\left(\Delta\widetilde{\omega}_{n,t}^{J}\right)^{2}\sum_{n}\left(\Delta\widetilde{\omega}_{n,t-\tau}^{K}\right)^{2}\right]^{\frac{1}{2}}\right\} \qquad (6.5)$$

Accordingly, the PCM increases with the number of active stocks and can thus lead to large stocks being traded on only one side of the market. As pointed out by Bikhchandani and Sharma (2001), since the amount of stock traded determines the weights in the trading decisions, the PCM can lead to biased selection. Managers of larger funds may be preferred because they are likely to be allocated higher weights. Besides, the static nature of the fractional change in stock weight of a portfolio assumed by Wermers (1995) can cause spurious herding. Accordingly, the weight of stocks that experience price increase (decrease) tends to rise, irrespective of whether the buy (sell) has occurred. Moreover, the usage of net asset values as weight in computing PCM is vague (Bikhchandani and Sharma, 2001).

6.4.3 Cross-Sectional Standard Deviation (CSSD) Measure of Herding

Christie and Huang (1995) (hereafter referred to as CH) develop a model to detect herd behaviour in stock markets. In this model, the dispersion measure computed using the average individual returns to the realised market returns is regressed on a constant and two dummy variables designed to capture extreme positive and negative returns. Their measure of dispersion, namely the Cross-Sectional Standard Deviation (otherwise referred to as CSSD) is formulated as follows:

$$CSSD = \sqrt{\frac{\sum_{i=1}^{N}(R_{i,t} - R_{m,t})^2}{N-1}} \qquad (6.6)$$

where $R_{i,t}$ denotes the stock return of i at time t, and $R_{m,t}$ being the cross-sectional average of N the returns in the aggregate market portfolio at time t. The notion behind the CSSD measure is that the presence of herding in the market points to convergence towards the market consensus by investors. This means that individual returns would not be far away from the market returns. Intuitively, the dispersion between individual returns and market returns should measure the presence of herding. Thus the dispersion would be zero as individual returns converge with the market returns, but would increase in absolute value as individual returns diverge from the market returns. In keeping with the predictions of CAPM, Christie and Huang (1995) expound that CSSD will increase in absolute value during normal periods as individual private information becomes the basis for trading decisions. Conversely, during extreme market movements, the CSSD measure decreases as market participants disregard their private information and imitate others. To assess whether stock return dispersions are significantly lower than average during periods of intense market movement, Christie and Huang (1995) propose an empirical measure with the following specification:

$$S_t = \alpha + \gamma^L D_t^L + \gamma^U D_t^U + \varepsilon_t \tag{6.7}$$

where S_t is CSSD at time t, D_t^L is a dummy that takes the value 1 if the market return on day t is found in the extreme lower tail of the distribution, and zero otherwise. Similarly, D_t^U as a dummy variable takes the value 1 at day t if the market return on day t is found in the extreme upper tail of the distribution, and zero otherwise. The γ^L and γ^U, respectively, are parameters of D_t^L and D_t^U to be estimated to measure the existence of herding. In effect, the dummy variables are intended to capture variances in investor behaviour during extreme market periods versus normal market periods. Herd behaviour is said to exist when γ^L and γ^U are negative and statistically significant.

6.4.4 Cross-Sectional Absolute Deviation (CSAD) Measure of Herding

Chang, Chen and Khorana (2000) (hereafter referred to as CCK) develop an alternative measure of dispersion known as Cross-Sectional Absolute Deviation (hereafter referred to as CSAD). The model shows that rational asset pricing models not only predict that stock return dispersions are an increasing functions of market return but that there also exists a linear relationship between the two. The linear and increasing relation between dispersion and market return ceases to exist when market participants ignore their own beliefs and follow the aggregate market behaviour during periods of large average price movements. In such circumstance, CCK predict non-linear increasing or even decreasing relation between dispersion and market returns. In the initial analysis, CCK demonstrate the relation between CSAD and the market return within a CAPM framework. If R_i represents the return on a given asset i, R_m being the market portfolio return, and $E_t(\cdot)$ denotes the expectation in period t, the conditional version of CAPM based on Black (1972) can be specified as follows:

$$E_t(R_i) = \lambda_0 + \beta_i E_t(R_m - \lambda_0) \tag{6.8}$$

where λ_0 is the return on the risk-free portfolio, β_i is the measure of time-invariant systematic risk of the security, $i = 1,\ldots\ldots,N$ and $t = 1,\ldots..,T$. The β_m taken as the systematic risk of an equally-weighted market portfolio is defined as

$$\beta_m = \frac{1}{N}\sum_{i=1}^{N}\beta_{i.} \tag{6.9}$$

Chang et al. (2000) define the absolute value of the deviation (AVD) of the expected return of security i in period t from the t^{th} period portfolio as follows:

$$AVD = |\beta_i - \beta_m| E_t(R_m - \lambda_0) \tag{6.10}$$

Following the AVD, the expected cross-sectional absolute deviation of the returns (ECSAD) at time t can be expressed in the following specification:

$$ECSAD = \frac{1}{N}\sum_{i=1}^{N}|\beta_i - \beta_m| E_t(R_m - \lambda_0) \tag{6.11}$$

Chang et al. (2000) expound that prices are estimated based on the conditional CAPM in the absence of herd behaviour. In such conditions, a positive and linear relationship exists between $ECSAD$ and the time-varying market expected returns. In the presence of herd behaviour however, the relationship becomes negative and non-linear. The positive and linear relationship between dispersion and the market expected returns can then be described as follows:

$$\frac{\partial ECSAD_t}{\partial E_t(R_m)} = \frac{1}{N}\sum_{i=1}^{N}|\beta_i - \beta_m| > 0 \tag{6.12}$$

$$\frac{\partial ECSAD_t}{\partial E_t(R_m)^2} = \frac{1}{N}\sum_{i=1}^{N}|\beta_i - \beta_m| = 0 \tag{6.13}$$

From the preceding results, Chang et al. (2000)[31] suggested the Cross-Sectional Absolute Deviation (CSAD) which can be obtained by substituting the expected quantities $E_t(R_{m,t})$ for realised market returns $R_{m,t}$ and the ECSAD for CSAD$_t$ as in the following equation:

$$CSAD_t = \gamma_0 + \beta_1\left|R_{m,t}\right| + \beta_2 R_{m,t}^2 + \varepsilon_t \qquad (6.14)$$

where $R_{m,t}^2$ is the square of $R_{m,t}$, γ_0, β_1 and β_2 are parameters to be estimated, and ε_t is the error term. Accordingly, this proposition should capture any potential non-linear relationship between security return dispersions and the aggregate market return. The rationale behind this model is that market participants tend to herd during periods of extreme price movements, and the CSAD measure would be expected to increase (or even decrease) less than proportionately to the market return. The CCK model can also be applied to capture the possibility of whether the extents of herding are asymmetric across various market conditions. This aspect is explored and assessed, respectively, in the methodology and results sections in this chapter of the study.

6.4.5 The Concept of Beta Herding as a Measure of Herd Behaviour

A challenging aspect involved in attempts to measure herding by particular sub-groups of market participants is to effectively draw a distinction between rational and irrational herding. This represents a major drawback of the LSV and PCM measures of herd behaviour. As a result, Hwang and Salmon (2004) propose a nonparametric measure based on the concept of beta to solve the limitation. The idea behind the Hwang and Salmon measure is that in the presence of herding, investors' views about the risk-return relation become distorted, and individual security returns follow the direction of the aggregate market returns. Consequently, the CAPM betas of individual securities deviate from their equilibrium, suggesting that the betas become non-constant as they vary with time-varying investor sentiments. Thus the cross-sectional dispersions of asset betas would no long converge towards the market beta (i.e. towards unity). In the framework of equilibrium CAPM, Hwang and Salmon (2004) formulate the following relationship between the expected excess returns of asset i at time t, $E_t^b(r_{it})$ and the expected excess returns of the market at time t, $E_t(r_{mt})$ with β_{imt} being the corresponding beta at time t.

$$E_t^b(r_{it}) = \beta_{imt} E_t(r_{mt}) \qquad (6.15)$$

[31] The CSAD proposed by CCK to measure of the relation between security return dispersions and market returns is similar in spirit to the market timing model proposed by Treynor and Mazuy (1966).

According to Hwang and Salmon (2004), the above representation does not hold in the presence of herding, and beta as well as asset return will be biased. In such conditions, with $E_t(r_{mt})$ assumed to follow a market-wide perspective, a new relationship would emerge in the following form:

$$\frac{E_t^b(r_{it})}{E_t(r_{mt})} = \beta_{imt}^b = \beta_{imt} - h_{mt}(\beta_{imt} - 1) \qquad (6.16)$$

where $E_t^b(r_{it})$ is a behaviourally biased conditional expectation of excess returns of security i at time t, $E_t(r_{mt})$ denotes conditional expectation of the market excess returns at time t, β_{imt}^b represents the market beta with β_{imt} being the beta that indicates the presence of herd behaviour and h_{mt} being a time-variant herding parameter which takes the expression $h_{mt} \leq 1$. Essentially, it can be observed that when h_{mt} equals zero (0), β_{imt}^b equals β_{imt} and no herding can be perceived in the market. Also, when h_{mt} is 1, β_{imt}^b also equals 1, and perfect herding can be perceived towards the market portfolio. Thus it can be conjectured that as h_{mt} alternates between 0 and 1 $(0 < h_{mt} < 1)$, some degree of herding will be observed in the market with the greater extent of herding perceivable as h_{mt} approaches 1.

Hwang and Salmon (2004) emphasise the absence of irrational investor behaviour tendencies in their measure, since the effect of idiosyncratic news on individual betas is largely trivial. Besides, the model assumes that news about individual securities is readily available, suggesting that individual asset betas should move together in relation to the market with market movements being dependent exclusively on the arrival of new information.

However, the Hwang and Salmon (2004) measure of herding has been critiqued on two main grounds (Hachicha, 2010). The first criticism relates to the joint hypothesis problem. While the principles underlying Hwang and Salmon (2004) measure are based on market efficiency, the presence of herd behaviour prevails in inefficient market conditions. The second criticism relates to the measure of the market systematic risk, which Hwang and Salmon (2004) assume to be unity, but which is deemed unrealistic. Hachicha (2010) explains that several other factors, aside from herding, can cause the systematic risk to deviate from unity such as microstructure and investor psychology.

6.5 A Survey of Empirical Literature on Herd Behaviour in Stock Markets

As noted previously, empirical studies on herd behaviour have been conducted in an isolated manner relative to the theoretical literature. The empirical studies focus on detecting whether or not there is clustering of investor decisions in stock markets or within particular investor groups. As a result, the related empirical literature falls in two main strands. In the first strand, empirical studies focus on institutional investors and other specific investor groups (pioneered by Lakonishok et al., 1992), whereas in the second strand, empirical studies use aggregate market data to investigate herding towards the market index (due to Christie and Huang, 1995; and Chang et al., 2000). We follow the second strand of literature in the present study.

This section reviews related empirical studies on herd behaviour in stock markets. Empirical studies on investor herding are quite scarce, perhaps, due to the difficulty involved in quantifying the behaviour of stock market participants. Besides, the behaviour of market participants can be rational or irrational, either of which represents correlated movements in the market. Consequently, distinguishing empirically between rational and irrational herd behaviour or herding is innately demanding. The review of the empirical studies on herd behaviour in this section commences with studies undertaken in the developed stock markets, followed by those in emerging stock markets, and finally by those in the African stock markets. In all of these, particular attention is given to studies on the second strand of literature which focuses on the evolution of investor herding towards the market index rather than on a particular investor group.

6.5.1 Evidence of Herd Behaviour in Developed Stock Markets

Empirical evidence on herd behaviour in developed stock markets is inconclusive. Besides, markets with greater informational efficiency are said to experience low herding behaviour (Christie and Huang, 1995). Consequently, a number of early studies (Christie and Huang, 1995; Chang et al., 2000) have found low levels of herding in developed equity markets. In a pioneering study, Christie and Huang (1995) examined the investment behaviour of market participants in the United States equity market using the cross-sectional standard deviation (CSSD) of returns as a measure of herding. Using both daily and monthly data they analysed investor behaviour under various market conditions. The findings are inconsistent with the presence of herding during periods of extreme price movements. In an alternative model, Chang et al. (2000) examined herd behaviour in different international markets (Hong Kong, Japan, South Korea, Taiwan, and US) using their cross-sectional absolute deviation (CSAD) measure. The findings were quite consistent with those documented by Christie and Huang (1995) as they showed no evidence of herding in the US and Hong Kong and only partial evidence in Japan. The study however documented significant evidence of herd behaviour in South Korea and Taiwan, the only emerging markets in their sample. The conclusion by Chang et al (2000) suggested that equity return dispersions for developed markets tend to increase during periods of intense price movements and that herd behaviour is significantly present in emerging markets.

The herding literature also suggests that investment behaviour of market participants differs between market periods, and periods of market stresses are recognised as turning points in herding behaviour. At the same time, herding-spillover effects have been investigated in some studies as well. In the spirit of Christie and Huang (1995), Hwang and Salmon (2004) proposed a new approach to detecting and measuring herd behaviour based on the cross-sectional dispersion of asset sensitivity (beta) towards the market index. Analysing herd behaviour using the US and South Korean stock market data, the study detected herding towards the market that exhibited significant and persistent movements. Evidence of herding towards the market portfolio was perceived under both upward and downward market movements. Contrary to common belief that herd behaviour propagates crisis, their study observed that the Asian and Russian crises had caused a decline in herding and served as turning points in herd behaviour. Thus unlike the evidence in Christie and Huang (1995), the findings in Hwang and Salmon (2004) corroborated the presence of herding in advanced markets.

Wang (2008) applied the cross-sectional variance of the betas as a herding measure to examine herding towards the market consensus in major developed and emerging markets. A robust regression technique which effectively reduced the impact of multivariate outliers in the stock return data was used to compute the betas of the CAPM and Fama-French three-factor model (see Fama and French, 1993). Obtaining estimates from a state space model, the study then examined the evolution and cross-sectional nexus of the herding measures with particular focus on the herding patterns during sudden events such as financial crisis. The study perceived a higher level of herding in emerging equity markets than those in developed countries. The study also observed that the correlation of herding between markets in the same group (developed market group, and emerging market group) was higher than the correlation between markets from different groups.

Also, Zhou and Lai (2009) tested the presence of herding behaviour in a transparent and order-driven (Hong Kong) market using intraday data within the framework of a modified LSV herding measure. The study suggested that investors are inclined to herd more based on informational analysis compared to technical analysis, and that informational asymmetric can be detected using the information cascade model to measure herding. The findings in Zhou and Lai (2009) are largely consistent with the existing evidence that herding tends to be widespread with small stocks and during economic downturns. The finding further supported the suggestion that investors tend to herd more when selling than when buying stocks. Also, informational cascades existed in the market which underscores the role of so-called fashion leaders and "noisy informed traders" in instigating herd behaviour. This finding however contradicted Hwang and Salmon (2004) in which herd behaviour was said to have declined in crisis periods.

In an international study, Chiang and Zheng (2010) applied a modified CCK herding measure to examine herd behaviour in eighteen international stock markets using daily data spanning the period 1998-2009. The study found evidence of herd behaviour in developed stock markets (except the United States) and in Asian stock markets. No evidence of herding was detected in the Latin American stock markets. Also, except in the US and Latin American markets, herding was detected in both bull and bear markets, though asymmetric herding was more profound in Asian markets in rising market conditions. The evidence further showed that stock return dispersions in the United States are a major source of herding behaviour in non-US markets. Moreover, the study perceived that herding activities are triggered by crisis, first in the crisis market, which is subsequently propagated to neighbouring markets.

Inspired by the Hwang and Salmon (2004) model, Hachicha (2010) proposed a new approach to measuring and testing herd behaviour based on the cross-sectional dispersion of trading volume instead of asset returns. Using data from the Canadian stock market, the findings indicated that the herd phenomenon involves three essential components: stationary herding signals the phenomenon regardless of the market conditions; the phenomenon is due to intentional herding rather than the expectations of investors regarding the totality of assets; and that the phenomenon is mainly due to feedback herding where the current herding is dependent on herding in the previous period.

Mixed findings of the presence of herd behaviour had been reported in the European advanced stock markets. Economou et al. (2011) applied the non-linear herding measure to test the presence of herding effects in four southern European stock markets anecdotally termed "PIGS" (i.e. Portugal, Italy, Greece, and Spain). Using a survivor-bias-free data of daily returns for all stocks listed in the four markets for the period 1998-2008, the study observed evidence consistent with the presence of herding largely in the Greek and Italian markets. The study however perceived no evidence of herding in the Spanish market, while mixed evidence was detected for the Portuguese market. Moreover, the evidence suggests the existence of significant herding asymmetries regarding various market conditions: rising versus falling markets, high versus low trading volumes, and high versus low market volatility.

Also, studies have recently examined the time-variations of herd behaviour and the propagation of herding-spillover effects. Indeed, the tendency to herd is closely linked to market sentiment (Devenow and Welch, 1996; Hwang and Salmon, 2009) which in turn is time-varying (Baker and Wurgler, 2006; Klein, 2013). Klein (2013) tested the time-varying nature of herd behaviour by analysing how investors' behaviour varies between periods of market turmoil and tranquil periods. Specifying the model according to the approach by Chang et al. (2000), the study took into account unconditional herding which arises independently of market volatility. A Markov switching approach with two regimes also enabled the assessment of international spillovers in herding formation. The findings largely corroborate the existing evidence that herding effects are time-varying. Specifically, the evidence for the US and Euro area suggests that herd behaviour is more persistent during periods of high volatility involving profound spillover effects between the markets. Overall, the findings indicate that stock prices are driven by behavioural effects much more during crisis periods than tranquil periods.

Mobarek et al. (2014) examined country specific herd behaviour using liquid constituent indices in 11 developed European stock markets for the period 2001-2012. Using the cross-sectional absolute deviation measure by Chang et al. (2000), the main findings of their study indicated that herding effects were virtually absent in Europe during normal market conditions. The study however observed significant herding effects during asymmetric market conditions and crisis periods. In particular, a significant and profound herding effect was perceived in continental Europe during the global financial crisis, in Nordic markets during the Eurozone crisis, and in the PIIGS markets during both crises. The

German market was observed to exhibit the greatest influence on the regional cross-country herding behaviour. To a large extent, the findings in Mobarek et al. (2014) corroborated earlier evidence of herding effects reported in Chiang and Zheng (2010) and Economou et al. (2011). Moreover, Khan et al. (2011) employed Hwang and Salmon's (2004) herding measure and found the presence of herd behaviour in major European markets (France, Germany, Italy and UK). Lindhe (2012) perceived herding behaviour in Denmark, Finland, Norway and Sweden based on the modified CCK measure by Chiang and Zheng (2010).

Furthermore, herd behaviour in developed stock markets has also been found to be period-and-country specific. For instance, Galariotis et al. (2015) had recently investigated herding towards the market index for US and UK leading stocks and reveal interesting findings. The authors applied the CCK herding measure which suggests a non-linear regression model to estimate the CSAD returns and the market return. The results showed that US investors tend to herd during days coinciding with the release of important macro data, and that herding-spillover effects spread from the US to the UK during the previous financial crisis which originated in the United States. Also, herding behaviour was observed to differ between the two markets. Whereas US investors herded because of both fundamentals and non-fundamentals during crisis periods, UK investors herded only because of fundamentals and only during the Dotcom bubble burst.

Also, Vieira and Pereira (2015) recently analysed herding behaviour in the Portuguese stock market applying two different herding intensity measures based on Patterson and Sharma (2006) on the one hand, and Chang et al. (2000) and Christie and Huang (1995) on the other. Using daily closing prices of the PSI-20 index spanning the period 2003-2011, the authors found evidence which suggested that the presence of herd behaviour may be dependent on the methodology used. Specifically, while the results based on Patterson and Sharma's (2006) herding intensity indicated the existence of herding, those based on the measures by Chang et al. (2000) and Christie and Huang (1995) suggested no evidence of herd behaviour.

6.5.2 Evidence of Herd Behaviour in Emerging and Frontier Stock Markets

A number studies have focused on investor herding in emerging and frontier stock markets applying various approaches. Contrary to inconclusive evidence documented about herding in advanced markets, there is a general consensus that investor herding exists in emerging stock markets (Chang et al., 2000; Tan et al., 2008, and Balcilar et al., 2013) although some exceptions exist. For example, as pointed out previously, the emerging markets included in Wang (2008) were found to exhibit more profound herding effects than the developed markets. Also, the emerging Asian markets in the study by Chiang and Zheng (2010) were observed to exhibit herd behaviour (except the emerging Latin American markets). Informational asymmetry is a major common source of the high tendency for investors in emerging markets to engage in herding activities (Wang, 2008). In fact, information gathering for fundamental analysis in emerging and frontier markets is inherently problematic and very expensive. In such circumstances, it is relatively cheap, easy and "rational" to observe and imitate the market view or other investors' decisions, which tends to create herding in financial markets. Besides, lack of transparency in corporate reporting and the behaviour of foreign investors (such as entering and exiting emerging markets in herds and causing market inefficiency) encourage herding tendencies among market participants in emerging and frontier markets (Mendoza and Clavo, 1997).

A substantial number of studies have investigated herd behaviour in emerging and frontier stock markets in different continents (Asia, Europe and Latin and Southern Americas). Tan et al (2008) examined herd behaviour using daily data from dual-listed Chinese A- and B-shares. The results showed evidence of herd behaviour in both share types (A- and B-shares) on the Shanghai and Shenzhen stock exchanges. Testing for potential asymmetric herding relating to market returns, trading volume and volatility, Tan et al (2008) additionally observed asymmetric herding during rising markets, periods of high trading volumes and high market volatility but only in relation to the Shanghai A-shares. The difference in the evidence between the stocks in Shanghai and Shenzhen exchanges is partly attributed to differences in the characteristics of the investors in the two share types.

Still in the Chinese markets, Yao et al. (2014) recently examined the presence and prevalence of investor herding in two Chinese market segments involving the A and B shares. In a CSSD methodology adjusted to correct autocorrelation and multicollinearity problems, the findings indicated that investors display different levels of herd behaviour and that significant herding exists in the B-share markets. Yao et al. (2014) also found widespread herd behaviour at the industry-level across markets, which is stronger for large and small stocks and stronger for growth stocks compared to value stocks. Moreover, they detected profound herding behaviour during declining market conditions. Yao et al. (2014) however found herding behaviour to have diminished over time throughout the sample period on account of effective regulatory reforms in China. In part, the results in Yao et al. (2014) lend credence to evidence previously reported in Tan et al. (2008) to the effect that herding exits in both A and B segments of the Chinese Shanghai and Shenzhen markets.

In the Indian market, Bhaduri and Mahapatra (2013) applied a modified CCK herding measure using symmetric properties of the cross-sectional return distribution to detect herding behaviour. Using daily prices of the Bombay Stock Index spanning the periods 2003-2008, the study found evidence of investor herding in the Indian equity market. In particular, pronounced herding was detected during the 2007 market crash. Also, the rate of increase in the stock return dispersion was found to be lower in the up market relative to the down market. The results in Bhaduri and Mahapatra are however inconsistent with the findings by Garg and Gulati (2013). Garg and Gulati (2013) examined herd behaviour in the Indian equity market using both the CH and CCK herding measures with daily, weekly and monthly index prices spanning the period 2000-2013. Their evidence showed that equity return dispersions tend to increase instead of decrease during periods of extreme price movements, indicating the absence of herd behaviour. The results remained essentially the same (no incidence of herding) even during days of extremely high and low trading volumes. Garg and Gulati (2013) thought that regulatory reforms coupled with strong foreign institutional investor presence in the Indian equity market may have improved investor rationality and efficient pricing.

Furthermore, the presence of investor herding has been reported in studies involving frontier markets. My and Truong (2011) examined the presence of herd behaviour in the Vietnamese stock market and herding asymmetry that potentially exists conditional upon the direction of market movements. The methods by both Chang et al. (2000) and Tan et al. (2008) were applied using daily prices of the main stock market index in Vietnam spanning the period 2002-2007. The study perceived evidence that supports the presence of investor herding in the Vietnamese stock market across different market periods and alternative model specifications. Moreover, My and Truong (2011) observed that the herding effects in the Vietnamese market, like most frontier markets, are explained by microstructure characteristics such as thin trading, lack of transparency in corporate reporting, and high degree of volatility. Also, a test of herding asymmetry indicated that herd behaviour is stronger in rising markets than in declining markets.

Also, Balcilar et al. (2013) examined the dynamic relationship between global factors and herd behaviour in 5 GCC stock markets (Abu Dhabi, Dubai, Kuwait, Qatar and Saudi Arabia) using time-varying transition probability Markov-switching model (TVTP-MS) to account for time variations in herding behaviour. The study detected evidence of herd behaviour in all considered GCC stock markets during the crash regime with the evidence in Abu Dhabi, Kuwait and Qatar being persistent and more profound over long periods. The evidence further indicated that GCC frontier markets respond considerably to global macroeconomic conditions in two distinct manners (1) they are directly driven by global fundamentals and market factors such as the US market performance and crude oil prices, and (2) volatility regimes and transitions in GCC frontier markets are significantly determined by global financial risk factors.

In the European emerging and frontier markets, Angela-Maria et al. (2015) recently investigated investor herding in 10 Central and Eastern European (CEE) stock markets for size-ranked portfolio. The herding measure of Chang et al. (2000) was modified after Yao et al. (2014) and applied to test herd behaviour using daily stock prices for the period from January 2003 to December 2013. The results showed that, except for Poland, investors herd in the CEE markets and that herd behaviour was manifested in both upward and downward trends but was more profound in declining periods. Also, the behaviour of investors differed in the pre and post crisis periods compared with the crisis periods.

6.5.3 Evidence of Herd Behaviour in the African Stock Markets

Studies on herd behaviour in stock markets are not common in the Africa. The few studies (Gilmour and Smit, 2002; El-Shiaty and Badawi, 2014; Niyitegeka and Tewari, 2015) that examined herd behaviour had focused on individual countries such as South Africa and Egypt. In a pioneering study, Gilmour and Smit (2002) examined herd behaviour among fund managers in the South African Unit Trust Industry during the period 1992-1999 using LSV's herding measure in the form specified in Wermers (1999). The results suggested the presence of herd behaviour among institutional investors. In particular, the study recorded an average herding value of 0.024, signifying that two more managers were on the same side of the market over and above what was expected had they made independent trading decisions. Moreover, the discovery of a conditional count herding measure of 0.002 led Gilmour and Smit (2002) to conclude that herding is more prevalent on "the buy side" than on "the sell side" of the market during the sample period. Also, a disaggregation of herding measures by the fund risk profile revealed that herding is directly proportional to the risk profile of funds. Consequently, Gilmour and Smit (2002) further concluded that herding tends to increase with greater volatility with higher prevalence in aggressive growth funds (0.077 herding measure) followed by growth funds (0.073 herding measure) and then by income growth funds (0.067 herding measure).

Also, El-Shiaty and Badawi (2014) applied the CH and CCK herding measures to examine herd behaviour in the Egyptian stock market over the five-year period 2006-2010. Using the daily returns of the most actively traded 20 stocks and those of the market index EGX100, the study found no evidence of herding behaviour in the Egyptian stock market. In the context of previous studies, the result in El-Shiaty and Badawi (2014) presents some corroboration. For instance, Demirer et al. (2007) reported evidence of herd behaviour only in the Asian and Middle Eastern regional markets, although no herding was observed for the remaining regions of Africa, Central and Eastern Europe, Latin America, Western Europe, and the United States.

Also, Niyitegeka and Tewari (2015) recently investigated the presence of herd behaviour in the Johannesburg Stock Exchange using the ARDL model and the CCK herding measure for the period 2006-2011. The results based on the ARDL model confirmed the presence of herd behaviour in the South African market and that herding is a transitory phenomenon. The study additionally examined the asymmetry of herding and found herd behaviour to be prevalent only in rising markets, with no presence of herding during declining markets. Thus the evidence from the few studies focusing on some individual African markets is mixed. Only the South African market has been said to exhibit herd behaviour both within specific investor groups (institutional investors) and on a market-wide basis. Up to the present, no study has investigated herding in Africa's emerging markets or undertaken a cross-country analysis of herd behaviour in Africa's emerging markets. Filling this gap is essential given that African markets have become an important marketplace in the world owing to improved levels of regional and global integration.

6.6 Methodology and Data

This section presents the methodology adopted and data used to investigate the presence of herd behaviour in Africa's emerging stock markets. First, we describe the analytical framework used to test investor herding in the selected stock markets. Then we explain the dataset, analyse the summary statistics of the variables of interest and test the stationary properties of the series.

6.6.1 Methodology

The extant literature in this area of inquiry provides a number of alternative approaches to testing investor herd behaviour in capital markets. Prominent among these alternative methodologies are those by Lakonishok et al. (1992), Christie and Huang (1995), Chang et al. (2000), and Hwang and Salmon (2004). In this study, the methodology applied to investigate investor herd behaviour in Africa's emerging stock markets is the widely implemented Cross Sectional Absolute Deviation (CSAD) measure proposed by Chang, Cheng and Khorana (2000), also known as the CCK model. Thus the estimation methodology of the present study is based on Chang et al. (2000). As noted in the literature review sections, the CCK model is mainly concerned with the relationship between equity return dispersions and market return. The prediction of the CCK model is that, the relationship between equity return dispersions and the absolute value of market return is decreasing and non-linear. While the CCK model concurs with the predictions of standard capital asset pricing models that equity return dispersions increase with market returns, the model also assumes a linear relationship between return dispersions and market return in normal market periods. Within equilibrium CAPM framework in the form consistent with Black (1972) and taking R_i to represent the return on a given security i, R_m being the market portfolio return and $E_t(\cdot)$ denoting the expectation in period t, the CCK model initially specifies the following equation:

$$\mathrm{E}_t(R_i) = \gamma_0 + \beta_i \mathrm{E}_t(R_m - \gamma_0) \tag{6.17}$$

where γ_0 is the return on the risk-free portfolio, β_i is the measure of time-invariant systematic risk of the security, $i = 1,\ldots\ldots,N$ and $t = 1,\ldots..,T$. The β_m denoting the systematic risk of an equally-weighted market portfolio is defined as

$$\beta_m = \frac{1}{N}\sum_{i=1}^{N} \beta_i . \tag{6.18}$$

The absolute value of the deviation (AVD) of the expected return of asset i in period t from the t^{th} period portfolio expected return can be expressed as follows:

$$AVD = |\beta_i - \beta_m| \mathrm{E}_t(R_m - \Upsilon_0) \tag{6.19}$$

Thus the expected cross-sectional absolute deviation of the returns (ECSAD) at time t based on AVD equation can be expressed in the following equation:

$$\mathrm{E}CSAD_t = \frac{1}{N}\sum_{i=1}^{N} AVD_{i,t} = \frac{1}{N}\sum_{i=1}^{N} |\beta_i - \beta_m| \, \mathrm{E}_t(R_m - \Upsilon_0) \tag{6.20}$$

As note previously, there is a positive and linear relationship between $ECSAD$ and the time-varying market expected returns in conditions of equilibrium CAPM (Chang et al., 2000). The positive and linear relationship between the two can be computed as follows (taking the first and second order derivatives which, respectively, are positive and equal to zero):

$$\frac{\partial \mathrm{E}CSAD_t}{\partial(R_m)} = \frac{1}{N}\sum_{i=1}^{N} |\beta_i - \beta_m| > 0 \tag{6.21}$$

and

$$\frac{\partial^2 \mathrm{E}CSAD_t}{\partial(R_m)^2} = \frac{1}{N}\sum_{i=1}^{N} |\beta_i - \beta_m| = 0 \tag{6.22}$$

In the presence of herd behaviour however, CCK predicted the disappearance of the positive and linear relationship between return dispersions and market expected return giving way to a negative and non-linear relationship instead. Consequently, letting $CSAD_t$ and $R_{m,t}$ stand proxy for the unobservable variables $ECSAD_t$ and $E_t\left(R_{m,t}\right)$, the CCK model is presented formally as follows:

$$CSAD_t = \gamma_0 + \gamma_1 \left|R_{m,t}\right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \tag{6.23}$$

where $CSAD_t$ is the average AVD_t of each security in relation to the equally-weighted market portfolio return, $R_{m,t}^2$ is the square of $R_{m,t}$, γ_0, γ_1 and γ_2 are parameters to be estimated, and ε_t is the error term. The values of $CSAD_t$ can be computed using $CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right|$, where $R_{m,t}$ is the average return of an equally weighted market portfolio at period *t*, $R_{i,t}$ is the individual stock return of firm *i* at period *t*, with N being the number of firms. Accordingly, this proposition should capture any probable non-linear relationship between security return dispersions and the aggregate market return (Chang et al., 2000). It must be noted that CSAD in itself does not measure herding, but rather the relationship between $CSAD_t$ and $R_{m,t}$ is used to detect herd behaviour. The prediction is that in normal periods, the absolute market portfolio return $|R_{m,t}|$ increases resulting in an increase in $CSAD_t$ with γ_1 and γ_2 being positive and zero, respectively. Conversely, in periods of large market movements, investors become more apprehensive and the value of $CSAD_t$ declines (or increases at a decreasing rate) resulting in a significantly negative γ_2. This situation signals the presence of herd behaviour, but a significantly positive γ_2 is indicative of anti-herding behaviour or exaggeration of difference as the prevailing market conditions produce greater dispersion in stock returns (Tessaromatis and Thomas, 2009). In simple terms, in the absence of herding in equation (6.23), we anticipate $\gamma_1 > 0 \; and \; \gamma_2 = 0$, whereas in the presence of herding we anticipate $\gamma_2 < 0$ which should be statistically significant.

The CCK model is also implemented in this study to test whether herd behaviour in our considered markets can be said to intensify during financial crisis periods. Indeed, herd behaviour has been found to be pronounced during periods of market stress (Economou et al., 2010; Balcilar et al., 2013; Mobarek et al., 2014; Galariotis et al., 2015). In particular, financial crisis has been found to trigger investor herding first in the crisis market, which is then subsequently propagated in other markets (Chiang and Zheng, 2010). As a result, the present study additionally tests whether the global financial crisis[32] in the 2007-2009 periods produced and intensified herding behaviour in Africa's stock markets. To accomplish this, the equation (6.23) is extended by including a dummy variable for the squared market return. Hence, the following equation is specified as:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 D^{CRISIS} R_{m,t}^2 + \varepsilon_t \qquad (6.24)$$

where D^{CRISIS} is the 2007-2009 global financial crisis dummy, taking the value of 1 on trading days during the crisis and 0 on all other days outside the crisis period. A significantly negative value of γ_3 is indicative of the presence of herd behaviour during the financial crisis period. Herd behaviour will be said to have intensified in the crisis period if $\gamma_3 > 1$ in absolute terms. A significantly positive value of γ_3 is an indication that the crisis period did not intensify herding in the stock markets.

[32] The global financial crisis covers the period 2007-2009 to take care of investors' apprehension during the sub-prime mortgage securities bubbles as well as any second round effect during the latter part of 2009.

6.6.2 Testing the Presence of Herding Asymmetry in various Market Conditions

A number of empirical studies have found asymmetric herd behaviour in different market conditions (Garg and Gulati, 2013; Mobarek et al., 2014; Niyitegeka and Tewari, 2015). Motivated by the evidence, the present study further examines whether asymmetric herding behaviour can be detected in Africa's emerging markets during different market conditions relating to market returns, trading volume, and return volatility. Essentially, the goal here is to test whether herd behaviour differs depending on whether market returns are positive or negative, whether trading volumes are high or low, and whether return volatility is high or low.

First, the asymmetric effects of market return are detected by testing whether the direction of market return (rising or declining markets) has an influence on the behaviour of market participants. These asymmetries are ascertained by estimating two separate regression equations, one for positive market returns and the other for negative market returns, specified as follows:

$$CSAD_t{}^{UP} = \gamma_0 + \gamma_1{}^{UP}\left|R_{m,t}^{UP}\right| + \gamma_2{}^{UP}\left(R_{m,t}^{UP}\right)^2 + \varepsilon_t \qquad if\ R_{m,t} > 0 \tag{6.25}$$

$$CSAD_t{}^{DOWN} = \gamma_0 + \gamma_1{}^{DOWN}\left|R_{m,t}^{DOWN}\right| + \gamma_2{}^{DOWN}\left(R_{m,t}^{DOWN}\right)^2 + \varepsilon_t \quad if\ R_{m,t} < 0 \tag{6.26}$$

where equation (6.25) denotes days of positive market returns while equation (6.26) represents days of negative market returns. The regressors $R_{m,t}^{UP}$ and $R_{m,t}^{DOWN}$ are the equally-weighted market portfolio returns at period t when the market rises and declines, respectively. The variables $CSAD_t{}^{UP}$ and $CSAD_t{}^{DOWN}$ are CSADs at periods corresponding to rising markets and declining markets, respectively. It is expected that in the presence of asymmetric herding behaviour during bullish and bearish markets, significantly negative parameters of $\gamma_2{}^{UP}$ and $\gamma_2{}^{DOWN}$ will be observed. A significantly more negative value of $\gamma_2{}^{UP}$ ($\gamma_2{}^{DOWN}$) will be an indication that investor herding is more prevalent in bullish markets (bearish markets).

In an alternative, but CCK-modified estimation technique, Chiang and Zheng (2010) have found that investor herd behaviour is affected by the direction of market returns. Thus in the spirit of Chiang and Zheng (2010) and as a robustness check to the results in the present study, a revised CCK model is estimated. This is accomplished by including an additional term $R_{m,t}$ on the right-hand side of the original CCK model in equation (6.23) in order to allow for the detection of asymmetric herding under different market conditions. The modified CCK model is specified as follows:

$$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R^2_{m,t} + \varepsilon_t \quad (6.27)$$

In equation (6.27), it can be shown that $\gamma_1 + \gamma_2$ captures the relation between return dispersions and market return when market is rising $R_{m,t} > 0$, whereas $\gamma_1 - \gamma_2$ indicates the relation between the two when market is falling $R_{m,t} < 0$. Also, the ratio of $\frac{\gamma_2 + \gamma_1}{\gamma_2 - \gamma_1}$ can be regarded as a measure of the relative amount of asymmetry between return dispersion and market return.

Second, the present study also examines the asymmetric effects of trading volume by testing whether days of high and low trading volumes exhibit different investor behaviour and their tendency to herd around the market consensus. Following Tan et al. (2008), the trading volume V_t on day *t* will be considered to be high if it is greater than the previous 30 days' moving average. On the other hand, the trading volume V_t on day *t* will be described as low if it is less than the prior 30 days' moving average. The possibility of the presence of these asymmetries is detected using the following specifications:

$$CSAD_t^{V-HIGH} = \gamma_0 + \gamma_1^{V-HIGH} |R_{m,t}^{V-HIGH}| + \gamma_2^{V-HIGH} \left(R_{m,t}^{V-HIGH}\right)^2 + \varepsilon_t \quad (6.28)$$

$$CSAD_t^{V-LOW} = \gamma_0 + \gamma_1^{V-LOW} |R_{m,t}^{V-LOW}| + \gamma_2^{V-LOW} \left(R_{m,t}^{V-LOW}\right)^2 + \varepsilon_t \quad (6.29)$$

Equations (6.28) and (6.29) respectively represent high and low trading volumes with $R_{m,t}^{V-HIGH}$ and $R_{m,t}^{V-LOW}$ their corresponding equally-weighted market returns at period t when trading volumes are high and low. The variables $CSAD_t^{V-HIGH}$ and $CSAD_t^{V-LOW}$ represent CSADs at periods corresponding to high and low trading volumes, respectively. It is anticipated that in the presence of asymmetric herding behaviour during high and low volumes, significantly negative parameters of γ_2^{V-HIGH} and γ_2^{V-LOW} will be detected. Also, a significantly more negative value of γ_2^{V-HIGH} (γ_2^{V-LOW}) is suggestive of more prevalent herding behaviour during high trading volume (low trading volume).

In the third and final measure of herding asymmetry, the present study investigates whether herding behaviour varies depending on the degree of volatility in the market. Similar to the preceding analysis on trading volume, the volatility σ_t^2 of day t is described as high (low) if it is greater (less) than the prior 30 days' moving average. The possibility of the presence of herding asymmetries based on price volatility is detected using the specifications below:

$$CSAD_t^{\sigma^2 HIGH} = \gamma_0 + \gamma_1^{\sigma^2 HIGH}\left|R_{m,t}^{\sigma^2 HIGH}\right| + \gamma_2^{\sigma^2 HIGH}\left(R_{m,t}^{\sigma^2 HIGH}\right)^2 + \varepsilon_t \qquad (6.30)$$

$$CSAD_t^{\sigma^2 LOW} = \gamma_0 + \gamma_1^{\sigma^2 LOW}\left|R_{m,t}^{\sigma^2 LOW}\right| + \gamma_2^{\sigma^2 LOW}\left(R_{m,t}^{\sigma^2 LOW}\right)^2 + \varepsilon_t \qquad (6.31)$$

From the specifications above, equations (6.30) and (6.31) represent high and low volatility with $R_{m,t}^{\sigma^2 HIGH}$ and $R_{m,t}^{\sigma^2 LOW}$ as corresponding equally-weighted market returns at period t during which volatility is high and low, respectively. The regressands $CSAD_t^{\sigma^2 HIGH}$ and $CSAD_t^{\sigma^2 LOW}$ respectively represent CSADs at periods of high and low volatility. The expectation is that the parameters $\gamma_2^{\sigma^2 HIGH}$ and $\gamma_2^{\sigma^2 LOW}$ will be significantly negative if asymmetric effects of herding exist and otherwise if they do not exist. Moreover, if herd behaviour is more prevalent during high volatility compared to low volatility, the value of $\gamma_2^{\sigma^2 HIGH}$ must be more negative than the value of $\gamma_2^{\sigma^2 LOW}$.

6.6.3 Testing Stationarity of the Series

Empirical analysis involving time series data requires that the underlying time series be stationary (Brooks, 2014: 361). However, the autocorrelation function (acf) and partial autocorrelation functions (pacf) may not be appropriate approaches to test unit root since it is easy to establish fault stationarity in the presence of unit roots. Consequently, Brooks (2014: 361) recommends the application of formal hypothesis testing procedure to address the issue of stationarity. A stationary stochastic process has constant mean $[\mathrm{E}(S_t) = \mu]$and variance $[\mathrm{E}(S_t - \mu)^2 = \sigma^2 > \infty]$, with a serially uncorrelated covariance $\psi\mathrm{k} = \mathrm{E}[(S_t - \mu)(S_{t+k} - \mu)]$ (Gujarati, 2003: 797). A stationary time series circumvents spurious regression estimates and is required for forecasting purposes (Chinzara, 2006; Chinzara and Aziakpono, 2009). In this study therefore, we follow the conventional augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test procedures[33]. The augmented Dickey-Fuller models can be expressed in the following forms:

[33] Other alternative test procedures also exist such as the Dickey-Fuller (1979, DF), Kwiatkowski et al. (1992, KPSS), and Elliot et al. (1996, DF-GLS) unit-root tests.

$$\Delta s_t = \phi S_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta s_{t-1} + u_t \quad (6.32)$$

$$\Delta s_t = \beta_1 + \phi s_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta s_{t-1} + u_t \quad (6.33)$$

$$\Delta s_t = \beta_1 + \beta_2 t + \phi s_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta s_{t-1} + u_t \quad (6.34)$$

where t is the time or trend variable. The lag length is determined empirically using the Schwarz Bayesian Information Criterion, $SBIC = ln(\hat{\sigma}^2) + \frac{k}{\mathrm{T}} \ln \mathrm{T}$, with $\hat{\sigma}^2$ being the residual variance, $k = p + q + 1$ being the total number of parameters estimated, and T representing the sample size)[34]. Also, the ADF test includes the lagged difference terms of the dependent variables to deal with serial correlation in the error terms.

The PP test procedure, however, differs from the ADF approach regarding how to deal with likely serial correlation in the error terms. The procedure involves nonparametric statistical methods without lagged difference terms and is specified as follows:

$$\Delta s_t = \Omega D_t + \delta s_{t-1} + \mu_t \quad (6.35)$$

where D_t is a vector of deterministic terms such as constant, trend, etc., $\Delta s = s_t - s_{t-1}$ and μ_t is I(0) white noise which may be heteroscedastic. To correct for possible serial correlation and heteroscedasticity in the errors μ_t, the PP modifies ADF test statistics and calculates the test statistics (Z_t *and* Z_π) using the following equations:

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\sigma}^2}\right)^{\frac{1}{2}} \times t_\pi = 0 - \frac{1}{2}\left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2}\right) . \left(\frac{\mathrm{T} \times SE(\hat{\pi})}{\hat{\sigma}^2}\right) \quad (6.36)$$

$$Z_\pi = \mathrm{T}_\pi - \frac{1}{2}\frac{\mathrm{T}^2 \times SE(\hat{\pi})}{\hat{\sigma}^2}\left(\hat{\lambda}^2 - \hat{\sigma}^2\right) \quad (6.37)$$

The terms σ^2 and λ^2 in equations *(6.36)* and *(6.37)* are consistent estimates of the variance parameters

[34] The SBIC is strongly consistent and asymptotically delivers the correct model order (Brooks, 2014), even though it is not necessarily superior to the Akaike information criterion (AIC) and the Hannan-Quinn information criterion (HQIC).

$$\sigma^2 = \lim_{n\to\infty} \mathrm{T}^{-1} \sum_{t=1}^{T} E[\mu_t^2] \tag{6.38}$$

$$\lambda^2 = \lim_{n\to\infty} \sum_{t=1}^{T} E[\mathrm{T}^{-1} S_T^2] \tag{6.39}$$

where $S_T = \sum_{t=1}^{T} = \mu_t$ with the sample variance of the least squares residual $\hat{\mu}^2$ being a consistent estimate of σ^2 and the Newey-West long-run variance estimate of μ_t using $\hat{\mu}^2$ is a consistent estimate of λ^2.

6.7 Data and Preliminary Analyses

The daily closing prices and trading volumes of the most actively traded stocks in each of the considered stock exchanges retrieved from McGregor BFA are used in this study. The choice of daily frequency data was guided by evidence to the effect that herd behaviour is often a momentary phenomenon and is easily captured with high frequency data (Christie and Huang, 1995). Besides, evidence has shown that the detection of herding becomes more obvious with daily data than data with weekly and monthly frequency (Tan et al., 2008; Bhaduri and Mahapatra, 2013). Also, the use of the most liquid stocks is intended to help circumvent potential bias in the estimators that could arise due to thin trading (Brooks et al., 2006) which is a stylised fact about emerging and frontier market data. The data are all denominated in US dollar terms to ease comparison and all infrequently traded stocks were filtered out. The number of constituent firms used include 60 listed firms for South Africa, 58 firms for Egypt, 40 firms for Morocco, 36 firms for Kenya, and 30 firms for Nigeria. The sample periods differ across markets and are determined mainly by availability of quality data. Although Kenya and Nigeria are not classified as emerging markets[35], they are included in the present study because of their leading role in the East and West African stock markets, respectively. The data was analysed using STATA 13 after initial preparations using MS Excel. Prior to the analysis however, the daily closing prices were transformed into continuously compounded daily returns using the equation the below:

$$R_t = (lnS_t - lnS_{t-1}) \times 100 = \left(\frac{lnS_t}{lnS_{t-1}}\right) \times 100 \tag{6.40}$$

[35] The cclassification is based on S&P/Dow Jones Indices (2014).

where R_t is the continuously compounded daily closing stock return, lnS_t is the natural logarithm of day t or current day's closing share price, and lnS_{t-1} is the previous day's closing share price. Table 6.1 presents a summary of the descriptive statistics of the main variables of interest comprising the cross-sectional absolute deviation ($CSAD_t$), the weighted market return $R_{m,t}$, and the squared value of weighted market return $R^2_{m,t}$. The total observations for each of the considered stock markets are also reported and are generally large enough for the empirical analysis. From Table 6.1, the $CSAD_t$ and the squared value of weighted market return both exhibit a positive mean value for all five markets.

Table 6.1: Summary Statistics for Market Returns and CSAD

Market/ Variable	Obser-Vations	Mean (%)	S.D (%)	Min. (%)	Max. (%)	Skew-ness	Kur-Tosis	Jarque-Bera Statistic
Egypt								
$CSAD_t$	1233	1.544	1.092	0.246	10.060	2.500	17.258	11729.09***
$R_{m,t}$	1233	-0.002	1.549	-0.572	10.450	-0.505	9.682	2346.01***
$R^2_{m,t}$	1233	2.398	7.069	0.000	118.21	8.619	112.57	632073.7***
Kenya								
$CSAD_t$	1661	1.416	0.875	0.834	13.952	7.665	96.673	623542.3***
$R_{m,t}$	1661	-0.014	0.977	-5.324	8.253	0.585	13.869	8270.12***
$R^2_{m,t}$	1661	0.953	3.416	0.000	68.104	10.875	161.56	1772810***
Morocco								
$CSAD_t$	1458	3.495	0.509	2.108	9.176	2.668	24.378	29495.87***
$R_{m,t}$	1458	-0.018	0.772	-3.787	2.811	-0.045	4.542	145.09***
$R^2_{m,t}$	1458	0.596	1.123	0.000	14.345	4.592	34.82	66643.27***
Nigeria								
$CSAD_t$	1661	2.537	1.243	0.765	23.647	11.233	184.86	2323907***
$R_{m,t}$	1661	-0.054	1.412	-8.919	6.396	-0.371	6.757	1015.070***
$R^2_{m,t}$	1661	1.996	4.810	0.000	79.555	7.395	88.052	515779.7***
S. Africa								
$CSAD_t$	2346	1.454	0.686	0.562	7.201	2.084	10.284	6884.456***
$R_{m,t}$	2346	0.016	1.969	-12.85	12.889	-0.239	8.063	2528.104***
$R^2_{m,t}$	2346	3.878	10.304	0.000	166.14	8.419	102.98	1004821***

Notes: The samples comprise Egypt (09/02/2010-31/12/2014); Kenya (19/08/2008-31/12/2014); Morocco (29/05/2009-31/12/2014); Nigeria (19/08/2008-31/12/2014); and South Africa (03/01/2006-31/12/2014). ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively, while t-statistics are in parentheses.

The lowest value of the $CSAD_t$ is observed in Kenya while the highest $CSAD_t$ is recorded in Morocco. The values of weighted market return are negative for all markets, except the South African stock market. Volatility as measured by the standard deviation appears fairly high for most variables in all markets. With the exception of the weighted market return $R_{m,t}$, the distributional properties of the variables of interest, as shown by the third and fourth moments (i.e. skewness and kurtosis) seem to exhibit extreme observations.

In particular, the $CSAD_t$ and $R^2_{m,t}$ are positively skewed for all the markets with generally large values of skewness. The skewness indicators for the weighted market returns are negative (except for Kenya) and less than 1 in all cases. Positive skewness is an indication that the distribution has an asymmetric tail that extends towards more positive values, while negative skewness shows a distribution with an asymmetric tail that extends towards more negative values. Thus the values of skewness suggest that most of the actual series of the $CSAD_t$ and $R^2_{m,t}$ variables are greater than their respective means, while the $R_{m,t,}$ has actual values substantially smaller than the mean. Normally, investors prefer positively skewed return distribution over negatively skewed return distribution because of relative risk aversion. Also, the substantially large values of kurtosis suggest that the daily returns distributions of the considered variables are leptokurtic (i.e. having slim and long-tailed distributions). The kurtosis is greater than 3 for all variables and for all stock markets. Moreover, the Jarque-Bera test statistics and corresponding probability values reinforce the excess kurtosis and skewness measures, and thus suggest evidence against normal distribution for all the market returns.

6.8 Empirical Results and Discussion

This section presents and discusses the empirical results on investor herd behaviour and asymmetric herding in different market conditions in Africa's emerging markets. First, the presence of herd behaviour in Africa's emerging stock markets is investigated using the cross-sectional absolute deviation (in subsection 6.7.2). The herding effect of the 2007-2009 global financial crisis is also examined in this section. Second, the CCK herding measure is modified and used to analyse asymmetric effects on herd behaviour in Africa's emerging markets under various market conditions (in subsection 6.7.3). By these analyses, the objectives of this chapter are accomplished. The empirical analyses are however preceded by an analysis of the stationary properties of the time series (in subsection 6.7.1).

6.8.1 Results of Unit Root Tests

Prior to analysing the empirical results, the stationary properties of the return series are verified using the two classical unit root tests; the augmented Dickey-Fuller and Phillips-Perron. Table 6.2 presents the results of unit root tests from the augmented Dickey-Fuller and Phillips-Perron procedures. Compelling results are observed as both the weighted market return and cross-sectional absolute deviation series were stationary at levels for all methods and for all countries. In the rare instances where some series are not stationary at level, they all turned to stationarity after first differencing. The results largely became more significant after the first differencing. Hence, the null hypothesis of the presence of unit root is rejected at the 1 percent significance level in most cases. Stationarity of data is an important requirement in time series analysis such as the one in this study. The stationarity of the series means the existence of a stationary stochastic process containing constant mean and variance over time with a non-serially correlated covariance. Moreover, stationary data is appropriate for forecasting and also minimises the likelihood of producing spurious regressions and misleading conclusions (Chinzara, 2006).

Table 6.2: Results of Unit Root Tests

Stock Market (Variable)	*Test Equation*	ADF Unit Root Test		PP Unit Root Test	
		CSAD/Returns($R_{m,t}$)		*CSAD/Returns ($R_{m,t}$)*	
		Levels	*1st Difference*	*Levels*	*1st Difference*
Egypt *(CSAD)*	*None*	*-1.988977***	*-15.73623****	*-15.47571****	*-224.9222****
	Intercept only	*-10.78126****	*-15.72999****	*-26.37700****	*-224.8527****
	Intercept & Trend	*-11.41479****	*-15.72563****	*-26.19959****	*-224.5467****
Egypt *(Returns)*	*None*	*-32.46232****	*-18.73603****	*-32.59365****	*-420.6553****
	Intercept only	*-32.44919****	*-18.72831****	*-32.58102****	*-420.3542****
	Intercept & Trend	*-32.49164****	*-18.72055****	*-32.59573****	*-420.8042****
Kenya *(CSAD)*	*None*	*-2.637397****	*-24.70208****	*-22.59987****	*-604.4678****
	Intercept only	*-24.17646****	*-24.69457****	*-36.99530****	*-604.3518****
	Intercept & Trend	*-24.33710****	*-24.68736****	*-36.84118****	*-605.6674****
Kenya *(Returns)*	*None*	*-20.57062****	*-18.94869****	*-25.70467****	*-322.9084****
	Intercept only	*-20.56713****	*-18.94343****	*-25.69735****	*-323.6983****
	Intercept & Trend	*-20.61983****	*-18.93845****	*-25.72865****	*-323.3837****
Morocco *(CSAD)*	*None*	*-0.335354*	*-20.23770****	*-2.009283***	*-580.9391****
	Intercept only	*-23.35448****	*-20.23109****	*-36.82707****	*-581.4089****
	Intercept & Trend	*-23.47334****	*-20.22390****	*-36.66750****	*-580.5243****
Morocco *(Returns)*	*None*	*-35.29195****	*-17.97859****	*-35.19078****	*-368.0392****
	Intercept only	*-35.30093****	*-17.97276****	*-35.20098****	*-368.3611****
	Intercept & Trend	*-35.29021****	*-17.96652****	*-35.18931****	*-367.9821****
Nigeria *(CSAD)*	*None*	*-1.721536**	*-17.39038****	*-7.582778****	*-188.3122****
	Intercept only	*-10.14398****	*-17.38473****	*-26.06094****	*-188.2277****
	Intercept & Trend	*-10.31894****	*-17.37719****	*-25.99525****	*-187.9288****
Nigeria *(Returns)*	*None*	*-25.83167****	*-358.3743****	*-25.86997****	*-358.3743****
	Intercept only	*-25.85017****	*-358.2307****	*-25.88945****	*-358.2307****
	Intercept & Trend	*-25.89101****	*-366.9693****	*-25.89101****	*-366.9693****
South Africa *(CSAD)*	*None*	*-1.590337*	*-24.10713****	*-12.41158****	*-341.1161****
	Intercept only	*-4.704401****	*-24.10208****	*-52.48266****	*-341.0242****
	Intercept & Trend	*-5.096800****	*-24.09693****	*-53.36368****	*-340.9637****
South Africa *(Returns)*	*None*	*-47.62803****	*-22.90325****	*-47.85729****	*-517.9314****
	Intercept only	*-47.62077****	*-22.89831****	*-47.85147****	*-517.7866****
	Intercept & Trend	*-47.61137****	*-22.89369****	*-47.84155****	*-517.6404****

Notes: For each country, the unit root test results are reported for both CSAD and $R_{m,t}$, for three different test methods, and at level and first difference. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

6.8.2 Evidence of Herd Behaviour using Cross-Sectional Absolute Deviation (CSAD)

In the first part of the analysis, the CCK model (equation 6.23) was estimated to investigate the presence of herd behaviour in Africa's emerging markets and the results reported in Table 6.3. The results in Panel A are based on estimation with an intercept, while those in Panel B are based on estimation without an intercept but with a time trend. It should be recalled that the decision rule to confirm the presence of herd behaviour is that the herding coefficient γ_2 must be negative and statistically significant (i.e. $\gamma_2 < 0$). The results in Panel A show positive herding coefficients for all markets, with the exception of the Nigerian market which depicts a negative and statistically significant herding parameter. A statistically significant positive herding coefficient signifies that the cross-sectional absolute dispersion (CSAD) and market return are linearly related and that an increase in average market return is associated with a more than proportionate increase in CSAD. This situation is consistent with the prediction of the standard capital asset pricing model (CAPM). The results in Panel A are however inconclusive since γ_2 is not statistically significant. Besides, the very low adjusted R^2 points to poor model fit.

As a result, and given the nonlinearity of the CCK herding measure and in particular, the indication of poor model fit based on the R^2 and adjusted R^2, the model was then rerun without an intercept but with a time trend, leading to improved model fit. It is important to note that similar treatments have been done throughout the analyses where the suppression of the intercept and inclusion of a time trend following the classical regression (with an intercept) resulted in a better model fit. Indeed, investigating herd behaviour using the market-wide approach implies that market participants are said to imitate the market consensus by following the direction of the market. Since the direction of the market reflects investment decisions, no herding tendency would exist when there are no investing activities in the market. Hence, no imitation takes place when investment decisions are not taken in the market, meaning that stock return dispersions should be zero when market returns are zero, albeit theoretically. Besides, supressing the intercept is sufficiently justifiable in situations where it is understood that the response function would equal zero when the predictor is zero (Eisenhauer, 2003: 77). Consequently, the results in Panel B represent a better model fit as the coefficients of determination improved tremendously.

The results in Panel B indicate compelling evidence of the presence of herd behaviour in Africa's emerging markets. The herding coefficient γ_2 is negative and statistically significant at the 1 percent significance level for all the markets. In terms of cross-country comparison, the Nigerian and Moroccan stock markets exhibit the greatest intensity of herd behaviour followed by the stock markets in Kenya and Egypt. The South African stock market is however perceived to exhibit less herding behaviour (which to some extent is indicative of its degree of market efficiency). In keeping with Chang et al. (2000), these results imply that the linear and increasing relation between stock return dispersions (as measured by CSAD) and market return does not hold during periods of large market movements in Africa.

Table 6.3: Regression estimates of herd behaviour (daily CSAD)

Panel A: Model containing intercept only						
Market	Obs.	γ_0	γ_1	γ_2	R^2	Adj. R^2
Egypt	1233	1.526*** (0.000)	-0.009 (0.860)	0.011 (0.202)	0.0040	0.0024
Kenya	1661	1.269*** (0.000)	0.215*** (0.000)	0.011 (0.365)	0.0483	0.0472
Morocco	1458	3.462*** (0.000)	0.030 (0.641)	0.027 (0.354)	0.0077	0.0063
Nigeria	1661	2.194*** (0.000)	0.423*** (0.000)	-0.036*** (0.006)	0.0539	0.0528
S. Africa	2346	1.031*** (0.000)	0.283*** (0.000)	0.008*** (0.000)	0.4664	0.4660
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	1233	0.0013*** (0.000)	0.533*** (0.000)	-0.050*** (0.000)	0.5079	0.5067
Kenya	1661	0.0008*** (0.000)	1.016*** (0.000)	-0.099*** (0.000)	0.6513	0.6507
Morocco	1458	0.0022*** (0.000)	3.703*** (0.000)	-1.177*** (0.000)	0.8571	0.8568
Nigeria	1661	0.0013*** (0.000)	1.528*** (0.000)	-0.192*** (0.000)	0.7127	0.7121
S. Africa	2346	0.0004*** (0.000)	0.682*** (0.000)	-0.029*** (0.000)	0.8264	0.8262

Notes: The results in this table are based on the estimation of equation (6.23): $CSAD_t = \gamma_0 + \gamma_1|R_{m,t}| + \gamma_2 R_{m,t}^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0$ and $\gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

The presence of investor herding means that market participants ignore their private information and prior evaluation and follow the aggregate market view during periods of market stresses. As a result, the linear and increasing relationship between the variables disappear giving way to a non-linear relationship where dispersions decrease or increase at a decreasing rate with higher market returns.

The findings in this study are consistent with prior studies. Niyitegeka and Tewari (2015) and Gilmour and Smit (2002), respectively, found evidence of herding in the Johannesburg stock exchange and Unit Trust Industry in South Africa. The evidence of herd behaviour in the present study further corroborates studies in other markets elsewhere (see for instance, Angela-Maria et al., 2015 for the CEE stock markets; Galariotis et al., 2015 for markets in the US and UK; Yao et al., 2014 for the Chinese stock markets; Balcilar et al., 2013 for GCC stock markets; and Bhaduri and Mahapatra, 2013 for Indian stock markets). However, the evidence of herd behaviour in this study is inconsistent with the evidence of no herding reported in El-Shiaty and Badawi (2014) and Demirer et al. (2007) concerning the Egyptian stock market.

In the second part of the analysis, the study examined whether the herding behaviour in Africa's emerging stock markets is influenced by the inception of the global financial crisis. A number of studies have found evidence to the effect that financial crises affect the behaviour of investors stimulating them to herd. To confirm or reject this assertion, the CCK model (equation 6.24) was estimated and the results reported in Table 6.4. In Panel A the herding coefficient $\gamma_3 D^{CRISIS}$ indicates presence of moderate herding during the global financial crisis periods only in the Moroccan stock market (with $\gamma_3 D^{CRISIS} = -0.076$). The crisis-herding coefficients are however positive and statistically significant in some cases (Nigeria and South Africa) suggesting the presence of anti-herding behaviour or exaggeration of differences. The implication of such behaviour is that periods of intense market movements tend to cause more dispersion in stock returns rather than what is normally expected by rational pricing models (Tessaromatis and Thomas, 2009).

However, the results in Panel A may represent poor model fit as the adjusted R^2 is very low in most cases. As a result, the model was re-estimated suppressing the intercept and adding a time trend and the results are presented in Panel B in Table 6.4. The results provide no evidence of herding behaviour, instead, anti-herding behaviour overwhelmingly showed during the global financial crisis as positive and a statistically significant crisis-herding coefficient $\gamma_3 D^{CRISIS}$ is perceived for all the markets. This implies that stock return dispersions (CSAD) and average market return are linearly related so that dispersion increases with increasing market return. The crisis effect of anti-herding behaviour in Africa's emerging markets is quite strong as the crisis-herding coefficients are either close to or greater than unity. Specifically, the crisis-herding coefficients for Morocco (2.079) and Nigeria (1.601) are both greater than unity, signifying that the subprime-global financial crisis did intensify anti-herding behaviour in these markets. In comparison, a number of studies previously found herding behaviour to have declined or to have been entirely absent during crisis. For example, Hwang and Salmon (2004) observed herding behaviour to have declined during the Asian and Russian crisis periods. Tessaromatis and Thomas (2009) reported evidence of exaggeration of differences in the Athens stock exchange in some years as investors diverged from the market consensus. Garg and Gulati (2013) found equity return dispersions to have increased during periods of extreme price movements. Garg and Gulati (2013) concluded that regulatory reforms and strong foreign investor presence in the Indian market may have led to improved rationality among market participants.

Table 6.4: Regression estimates of herd behaviour during global financial crisis

Panel A: Model containing intercept only							
Market	Obs.	$\boldsymbol{\gamma_0}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\gamma_2}$	$\boldsymbol{\gamma_3^{CRISIS}}$	R^2	Adj. R^2
Egypt	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Kenya	1661	1.260***	0.200***	0.012	0.083	0.0497	0.0480
		(0.000)	(0.000)	(0.337)	(0.119)		
Morocco	1458	3.469***	0.033	0.025	-0.076*	0.0098	0.0077
		(0.000)	(0.605)	(0.382)	(0.078)		
Nigeria	1661	2.176***	0.405***	-0.036***	0.167**	0.0567	0.0550
		(0.000)	(0.000)	(0.006)	(0.026)		
S. Africa	2346	0.964***	0.247***	0.009***	0.332***	0.5153	0.5146
		(0.000)	(0.000)	(0.000)	(0.000)		
Panel B: Model without intercept but with time trend							
Market	Obs	Trend	γ_1	γ_2	γ_3^{CRISIS}	R^2	Adj. R^2
Egypt	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Kenya	1661	0.0009***	0.608***	-0.051***	0.904***	0.6952	0.6944
		(0.000)	(0.000)	(0.000)	(0.000)		
Morocco	1458	0.0025***	2.799***	-0.833***	2.079***	0.8883	0.8880
		(0.000)	(0.000)	(0.000)	(0.000)		
Nigeria	1661	0.0016***	0.974***	-0.131***	1.601***	0.7590	0.7584
		(0.000)	(0.000)	(0.000)	(0.000)		
S. Africa	2346	0.0004***	0.466***	-0.013***	0.753***	0.8743	0.8741
		(0.000)	(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.24):
$CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 D^{CRISIS} R_{m,t}^2 + \varepsilon_t$. The decision rule is that herding is present if $\gamma_3 < 0$, herding intensified during crisis if $\gamma_3 < -1$, and herding did not intensify during crisis if $(0 > \gamma_3 > -1)$. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively. As noted in Table 6.1, the start date for the Egyptian stock market data is 09/02/2010.

Also, the results in this study are consistent with those by Philippas et al. (2013) who concluded that the global financial crisis did not intensify herding in the Real Estate Investment Trust (REIT) in the United States. However, the findings regarding the herding effects of financial crisis are inconsistent with evidence documented in some previous studies including Balcilar et al. (2013), Klein (2013), Mobarek et al. (2014), Angela-Maria et al. (2015), and Galariotis et al. (2015). The conclusion in these studies, including Tan et al. (2008) and Economou et al. (2011), is that herding is more pronounced in periods of extreme market stress (including crisis periods). A possible reason for the profound anti-herding behaviour in the present study is effective institutional reforms and continual efforts to achieve greater market integration with major global stock markets. These reform efforts and the associated market integration and greater informational efficiency may have improved the sophistication of market participants in Africa's emerging markets. For example, the World Economic Forum Competitiveness ranked the Johannesburg stock exchange (JSE) in South Africa as the number one regulated stock exchange worldwide for the two consecutive times in 2010 and 2011 (ASEA, 2014).

6.8.2 Asymmetric Effects of Different Market Conditions on Herding Behaviour

Empirical studies (Tan et al., 2008; Chiang and Zheng, 2010; Economou et al., 2011) have provided evidence in support of asymmetric herding behaviour under various market conditions. The market direction depict periods when the market is rising or falling, when trading volume is high low, and when volatility is high or low. The present study thus sought to analyse the asymmetric effects on herd behaviour in Africa's emerging stock markets in relation to these different market conditions. This accomplishes the final specific objective in this chapter which is to analyse asymmetric effects on herd behaviour during various market conditions (i.e. rising versus declining markets, high versus low trading volumes, and high versus low volatility). First, the CCK model specified as equations (6.25) and (6.26) are estimated to examine herding asymmetries during rising (periods of positive market returns) and declining (periods of negative market returns) markets, respectively. The results are presented in Table 6.5 (for bullish markets) and 6.6 (for bearish markets). The results in Table 6.5 Panel A exhibit signs of asymmetric herding effects during a rising market as the asymmetric herding coefficient γ_2 is negative (except South Africa) and statistically significant for all markets. However, given that the coefficients of determination are low for all markets in Panel A, the results in Panel B represent better model fit as higher R^2 are observed.

In Table 6.5 Panel B, the asymmetric herding coefficients γ_2 are negative and statistically significant for all markets. In terms of herding asymmetry in declining markets, the results in Table 6.6 Panel A point to no asymmetric herding effects during bearish markets as positive and statistically insignificant γ_2 are perceived (except the Nigerian stock market). The alternative results in Panel B in Table 6.6 however depict negative and statistically significant asymmetric herding coefficients γ_2 for all markets. In consequence, the results in Panel B of both Tables 6.5 and 6.6 suggest evidence of asymmetric herding effects during rising and declining markets in Africa's emerging markets.

Table 6.5: Regression estimates in rising markets (increasing periods)

Panel A: Model containing intercept only						
Market	Obs.	γ_0	γ_1	γ_2	R^2	Adj. R^2
Egypt	610	2.058***	0.085	-0.011	0.0014	0.0011
		(0.000)	(0.367)	(0.509)		
Kenya	809	1.260***	0.304***	-0.001	0.0485	0.0462
		(0.000)	(0.001)	(0.946)		
Morocco	724	3.493***	-0.081	-0.082	0.0685	0.0659
		(0.000)	(0.373)	(0.059)*		
Nigeria	822	2.185***	0.489***	-0.021***	0.1009	0.0987
		(0.000)	(0.000)	(0.006)		
S. Africa	1135	1.094***	0.155***	0.014***	0.3070	0.3057
		(0.000)	(0.000)	(0.000)		
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	610	0.0035***	0.840***	-0.098***	0.5292	0.5268
		(0.000)	(0.000)	(0.000)		
Kenya	809	0.0017***	1.082***	-0.097***	0.6073	0.6059
		(0.000)	(0.000)	(0.000)		
Morocco	724	0.0042***	4.121***	-1.601***	0.8540	0.8534
		(0.000)	(0.000)	(0.000)		
Nigeria	822	0.0024***	1.879***	-0.278***	0.7426	0.7417
		(0.000)	(0.000)	(0.000)		
S. Africa	1135	0.0008***	0.612***	-0.030***	0.7875	0.7870
		(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.25): $CSAD_t^{UP} = \gamma_0 + \gamma_1^{UP}\left|R_{m,t}^{UP}\right| + \gamma_2^{UP}\left(R_{m,t}^{UP}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0 \; and \; \gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

These results imply that stock return dispersions and average market returns are nonlinearly related during conditions of increasing and decreasing market returns. Thus the linearity assumption implicit in the CAPM is conflicted since an increase in the average market return, under such circumstances, causes stock return dispersions to decrease or increase but at a declining rate. Further inspection of the asymmetric herding coefficients however reveals that herding is more prevalent during a rising market in Egypt, Morocco and Nigeria, but more prevalent during a declining market in Kenya and South Africa. Thus asymmetric effects on herd behaviour in relation to rising and declining market conditions are not homogenous in Africa as some markets show more prevalence in the up-markets and others in the down-markets. Market participants may herd during either of the market directions (a bull or a bear market) because such periods are associated with intense price movements and potentially high risks. Losing because all others have lost is perceived to be less harmful in many respects compared to gaining all alone in the stock markets.

Table 6.6: Regression estimates in declining markets

Panel A: Model containing intercept only						
Market	Obs.	$\boldsymbol{\gamma_0}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\gamma_2}$	R^2	Adj. R^2
Egypt	666	2.078***	-0.069	0.028*	0.0081	0.0052
		(0.000)	(0.481)	(0.091)		
Kenya	851	1.279***	0.121	0.029	0.0530	0.0508
		(0.000)	(0.103)	(0.144)		
Morocco	733	3.397***	0.284***	0.047	0.1472	0.1449
		(0.000)	(0.000)	(0.179)		
Nigeria	838	2.234***	0.269***	-0.023***	0.0232	0.0209
		(0.000)	(0.001)	(0.006)		
S. Africa	1210	0.984***	0.397***	0.001	0.6264	0.6257
		(0.000)	(0.000)	(0.594)		
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	666	0.0034***	0.621***	-0.045***	0.4594	0.4569
		(0.000)	(0.000)	(0.015)		
Kenya	851	0.0017***	1.055***	-0.139***	0.7104	0.7094
		(0.000)	(0.000)	(0.000)		
Morocco	733	0.0045***	3.566***	-0.949***	0.8690	0.8684
		(0.000)	(0.000)	(0.000)		
Nigeria	838	.0026***	1.312***	-0.156***	0.6863	0.6852
		(0.000)	(0.000)	(0.000)		
S. Africa	1210	.0008***	0.753***	-0.031***	0.8663	0.8660
		(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.26): $CSAD_t^{DOWN} = \gamma_0 + \gamma_1^{DOWN}\left|R_{m,t}^{DOWN}\right| + \gamma_2^{DOWN}\left(R_{m,t}^{DOWN}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0\ and\ \gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

In terms of cross-country comparison, the coefficients of the herding asymmetry in rising and falling markets for Morocco (-1.602 and -0.949, respectively) are the greatest in Africa followed by Nigeria with coefficients of -0.278 (for a rising market) and -0.156 (for a falling market). The South African market displays the least asymmetric herding coefficients (-0.030 and -0.031) for both rising and falling markets, respectively. This profound evidence of herding asymmetric regarding rising and falling markets is consistent with the findings in other studies. Chiang and Zheng (2010) provided evidence of herding asymmetry in both rising and falling markets, with a relatively more profound asymmetric herding in the Asian markets during rising markets. Similarly, Economou et al. (2011) found evidence of significant herding asymmetries during different markets conditions including rising and falling markets.

As a robustness check on the findings of the asymmetric herding under different market returns, the present study estimated a modified version of the CCK model (specified as equation 6.27) in the spirit of Chiang and Zheng (2010) and the results are presented in Table 6.7.

Table 6.7: Regression estimates of herd behaviour based on modified CCK Model

Panel A: Model containing intercept only

Market	Obs.	γ_0	γ_1	γ_2	γ_3	R^2	Adj. R^2
Egypt	1233	1.529***	-0.041**	-0.009	0.010	0.0073	0.0048
		(0.000)	(0.045)	(0.861)	(0.274)		
Kenya	1661	1.260***	0.046**	0.241***	0.004	0.0530	0.0508
		(0.000)	(0.038)	(0.000)	(0.747)		
Morocco	1458	3.448***	-0.296***	0.073	-0.001	0.2091	0.2074
		(0.000)	(0.000)	(0.195)	(0.957)		
Nigeria	1661	2.220***	0.185***	0.362***	-0.015	0.0958	0.0941
		(0.000)	(0.000)	(0.006)	(0.261)		
S. Africa	2346	1.038***	-0.088***	0.282***	0.007***	0.5292	0.5286
		(0.000)	(0.000)	(0.000)	(0.001)		

Panel B: Model without intercept but with time trend

Market	Obs	Trend	γ_1	γ_2	γ_3	R^2	Adj. R^2
Egypt	1233	0.0013***	-0.039	0.533***	-0.051***	0.5088	0.5073
		(0.000)	(0.117)	(0.000)	(0.000)		
Kenya	1661	0.0008***	0.068***	1.048***	-0.109***	0.7104	0.7094
		(0.000)	(0.008)	(0.000)	(0.000)		
Morocco	1458	0.0022***	-0.314***	3.739***	-1.204***	0.8618	0.8614
		(0.000)	(0.000)	(0.000)	(0.000)		
Nigeria	1661	0.0013***	0.139***	1.497***	-0.179***	0.7173	0.7166
		(0.000)	(0.000)	(0.000)	(0.000)		
S. Africa	2346	0.0004***	-0.082***	0.685***	-0.031***	0.8364	0.8361
		(0.000)	(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.27): $CSAD_t = \gamma_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0$ *and* $\gamma_2 = 0$, and herding is present if $\gamma_3 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

The results in Table 6.7 Panel A largely point to poor goodness of fit as the asymmetric herding coefficients γ_3 are wrongly signed with low R^2. On the other hand, the results in Panel B confirm the presence of asymmetry of herding behaviour in Africa's emerging markets under different conditions of market returns. Specifically, the asymmetric herding coefficients γ_3 are negative and statistically significant for all markets. Similar to the previous findings based on the CCK model, the coefficients for Morocco (-1.204) and Nigeria (-0.179) suggest that herding asymmetry is more prevalent in the two markets compared to others. The South African market exhibits the lowest prevalence of asymmetric herding effect in various conditions of market returns.

Next, the asymmetric effects of herding behaviour under different market conditions of high and low trading volumes are also investigated by estimating the CCK model specified as equations (6.28) and (6.29) respectively. The results are displayed in Table 6.8 (for days when trading volumes are high) and Table 6.9 (for days when trading volumes are low).

Table 6.8: Regression estimates of herd behaviour on days of high trading volume

Panel A: Model containing intercept only						
Market	Obs.	γ_0	γ_1	γ_2	R^2	Adj. R^2
Egypt	290	1.770*** (0.000)	-0.009 (0.119)	0.0001 (0.118)	0.0089	0.0020
Kenya	310	1.433*** (0.000)	0.0002 (0.897)	-3.12e-06 (0.680)	0.0016	0.0014
Morocco	370	3.426*** (0.000)	0.002*** (0.122)	-4.50e-06 (0.300)	0.0096	0.0042
Nigeria	450	2.728*** (0.000)	0.001 (0.564)	-3.39e-06 (0.510)	0.0010	0.0005
S. Africa	588	1.446*** (0.000)	0.012*** (0.001)	-0.0001* (0.063)	0.0301	0.0268
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	290	0.005*** (0.000)	0.028*** (0.000)	-0.00014*** (0.002)	0.5169	0.5119
Kenya	310	0.0033*** (0.000)	0.016*** (0.000)	-0.00005*** (0.000)	0.6382	0.6346
Morocco	370	0.0071*** (0.000)	0.035*** (0.000)	-0.00012*** (0.000)	0.8628	0.8617
Nigeria	450	0.0053*** (0.000)	0.025*** (0.000)	-0.00004*** (0.000)	0.6094	0.6068
S. Africa	588	0.0015*** (0.000)	0.058*** (0.000)	-0.00042*** (0.000)	0.6781	0.6764

Notes: The results in this table are based on the estimation of equation (6.28): $CSAD_t^{V-HIGH} = \gamma_0 + \gamma_1^{V-HIGH}\left|R_{m,t}^{V-HIGH}\right| + \gamma_2^{V-HIGH}\left(R_{m,t}^{V-HIGH}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0$ and $\gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

Given that the results of Panel A of Tables 6.8 and 6.9 appeared to have suffered from poor model fitting as coefficients are statistically insignificant with very low R^2, equations (6.28) and (6.29) were re-estimated. The results in Panel B of Tables 6.8 and 6.9 from the re-estimated equations containing time trend depict remarkable improvement in model fitting. Besides, the asymmetric herding coefficients γ_2 are negative and statistically significant for all markets in both Tables. It can be realised that herding asymmetry is relatively more prevalent during low trading volume periods than in days of high trading volumes in all the markets (except Morocco).

Table 6.9: Regression estimates of herd behaviour on days of low trading volume

Panel A: Model containing intercept only						
Market	Obs.	$\boldsymbol{\gamma_0}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\gamma_2}$	R^2	Adj. R^2
Egypt	394	1.468***	0.005	-0.00004	0.0026	0.0025
		(0.000)	(0.318)	(0.338)		
Kenya	522	1.413***	-0.002	1.96e-06	0.0226	0.0189
		(0.000)	(0.138)	(0.791)		
Morocco	733	3.475***	0.0001	-2.21e-07	0.0044	0.0032
		(0.000)	(0.854)	(0.695)		
Nigeria	612	2.538***	-0.001	-8.89e-07	0.0023	0.0010
		(0.000)	(0.604)	(0.860)		
S. Africa	694	1.375***	0.001	-0.00002	0.0065	0.0036
		(0.000)	(0.597)	(0.153)		
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	394	0.0023***	0.045***	-0.00027***	0.5780	0.5747
		(0.000)	(0.000)	(0.000)		
Kenya	522	0.0020***	0.019***	-0.00009***	0.7232	0.7216
		(0.000)	(0.000)	(0.000)		
Morocco	733	0.0066***	0.0149***	-0.00001***	0.8113	0.8102
		(0.000)	(0.000)	(0.000)		
Nigeria	612	0.0036***	0.024***	-0.00005***	0.6529	0.6512
		(0.000)	(0.000)	(0.000)		
S. Africa	694	0.0013***	0.037***	-0.00026***	0.6675	0.6661
		(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.29): $CSAD_t^{V-LOW} = \gamma_0 + \gamma_1^{V-LOW}\left|R_{m,t}^{V-LOW}\right| + \gamma_2^{V-LOW}\left(R_{m,t}^{V-LOW}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0$ and $\gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

These results suggest that herding behaviour tends to be manifested more in periods of low trading volumes than in periods of high trading volumes in the African markets. The only exception is the results for the Moroccan stock market where the evidence rather supports the existence of relatively more pronounced asymmetric effect of high trading on herding behaviour. A striking observation from the results in Panel B of Tables 6.8 and 6.9, however, is that the asymmetric herding coefficients are generally very low for both high volume days and low volume days and for all markets. A possible inference is that trading volume may not be a major influential factor in herding behaviour although it does contribute to investor herding. This could be for the simple reason that trading volumes are generally low in Africa's stock markets (except for South Africa) and may be regarded by investors as being less informative.

Placing the results in this study within the context of previous studies, Tan et al. (2008) provided analogous evidence of asymmetric herding in the B-shares of the Shanghai and Shenzhen markets during low trading periods. Tan et al. (2008) however reported evidence of investor herding in the high volume conditions for both A-share and B-share markets in Shanghai and Shenzhen markets. While this evidence contradicts the findings in this study, it is nonetheless similar to the evidence observed in the Moroccan stock market. Also, Economou et al. (2011) found robust evidence of herding asymmetry in relation to trading volume in the Spanish and Portuguese markets. Moreover, the findings in this study support Mobarek et al. (2014) who recently found significant herding effect during periods of low trading volumes in Ireland and Norway.

In the final analysis, the present chapter has also examined the asymmetry of different market conditions relating to high and low periods of volatility. To this end, equations (6.30) and (6.31) are estimated and the results are reported in Tables 6.10 (for days when volatility is high) and Table 6.11 (for days when it is low). Similar to all previous analyses, the results reported as Panel A in both Tables are suspected to have suffered from poor model fitting as the coefficients for asymmetric effect of volatility are largely positive and statistically insignificant with very low R^2. The results in Panel B in both Tables (estimated with a suppressed intercept but with a time trend) exemplify better model fit. It can be perceived that the coefficients for asymmetric effect of volatility are negative and statistically significant with greatly improved R^2 (except Egypt which coefficients are insignificant statistically). The results in Panel B of Tables 6.10 and 6.11 thus suggest evidence of asymmetric effect of volatility on herding behaviour. In other words, differential herding behaviour is exhibited based on whether the market is in high volatility state or low volatility state. The Moroccan market seems to exhibit the greatest asymmetric effect of volatility herding in Africa with -1.054 and -3.696 asymmetric volatility coefficients for high and low volatility periods, respectively. The evidence of asymmetric volatility herding in African markets corroborates the findings of other previous studies such as Economou et al. (2011), Lao and Singh (2011), Klein (2013) and Mobarek et al. (2014).

Table 6.10: Regression estimates of herd behaviour on days of high volatility

Panel A: Model containing intercept only						
Market	Obs.	$\boldsymbol{\gamma_0}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\gamma_2}$	R^2	Adj. R^2
Egypt	587	1.545***	-0.213***	0.054***	0.0345	0.0312
		(0.000)	(0.004)	(0.000)		
Kenya	828	1.278***	0.213**	0.009	0.0479	0.0455
		(0.000)	(0.010)	(0.588)		
Morocco	715	3.502***	-0.043	0.051	0.0085	0.0057
		(0.000)	(0.670)	(0.198)		
Nigeria	450	2.729***	0.001	-3.39e-06	0.0035	0.0030
		(0.000)	(0.564)	(0.510)		
S. Africa	1180	0.913***	0.341***	0.003	0.5406	0.5398
		(0.000)	(0.000)	(0.307)		
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	587	0.0027***	0.321***	-0.006	0.4444	0.4416
		(0.000)	(0.000)	(0.709)		
Kenya	828	0.0014***	0.980***	-0.092***	0.6331	0.6317
		(0.000)	(0.000)	(0.000)		
Morocco	715	0.0036***	3.615***	-1.054***	0.8872	0.8867
		(0.000)	(0.000)	(0.000)		
Nigeria	450	0.0053***	0.025***	-0.0006***	0.6094	0.6068
		(0.000)	(0.000)	(0.000)		
S. Africa	1180	0.0005***	0.688***	-0.028***	0.8735	0.8732
		(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.30): $CSAD_t^{\sigma^2 HIGH} = \gamma_0 + \gamma_1^{\sigma^2 HIGH}\left|R_{m,t}^{\sigma^2 HIGH}\right| + \gamma_2^{\sigma^2 HIGH}\left(R_{m,t}^{\sigma^2 HIGH}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0 \; and \; \gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

Specifically, Lao and Singh (2011) found greater prevalence of herding asymmetry in the Chinese market relative to the Indian market. Mobarek et al. (2014) perceived significant asymmetric volatility herding coefficients in Denmark, Greece and Sweden during high and low volatility periods. There is however robust evidence of greater herding behaviour in Africa during low volatility days than in periods of high volatility. While this finding contradicts a number of studies (Tan et al., 2008; Klein, 2013; Mobarek et al., 2014) it may have implied a classic market sentiment. Conservative investing coupled with high risk aversion among investors in African markets may reverse herding tendencies during extremely high volatility periods. Thus the finding may be suggesting that investors become increasingly less confident about the investment decisions of others in periods of extremely high volatility in the market.

Since volatility is more or less a stylised fact about African markets, periods of high volatility may be associated with slowdown in investment activities, making the presence of minimum volatility a sufficient condition to trigger herd behaviour in these markets.

Table 6.11: Regression estimates of herd behaviour on days of low volatility

Panel A: Model containing intercept only						
Market	Obs.	$\boldsymbol{\gamma_0}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\gamma_2}$	R^2	Adj. R^2
Egypt	660	1.472***	0.020	0.001	0.0024	0.0020
		(0.000)	(0.785)	(0.952)		
Kenya	803	1.267***	0.199	0.039	0.0282	0.0258
		(0.000)	(0.046)	(0.247)		
Morocco	713	3.415***	0.279***	-0.173	0.0064	0.0036
		(0.000)	(0.042)	(0.111)		
Nigeria	818	2.538***	0.734***	-0.181	0.0190	0.0166
		(0.000)	(0.001)	(0.860)		
S. Africa	1136	1.106***	0.183***	0.040	0.2015	0.2001
		(0.000)	(0.000)	(0.002)		
Panel B: Model without intercept but with time trend						
Market	Obs	Trend	γ_1	γ_2	R^2	Adj. R^2
Egypt	660	0.0022***	0.579***	-0.059***	0.4490	0.4465
		(0.000)	(0.000)	(0.000)		
Kenya	803	0.0018***	1.414***	-0.175***	0.6859	0.6847
		(0.000)	(0.000)	(0.000)		
Morocco	713	0.0044***	6.453***	-3.696***	0.8549	0.8543
		(0.000)	(0.000)	(0.000)		
Nigeria	818	0.0026***	2.817***	-0.745***	0.6296	0.6282
		(0.000)	(0.000)	(0.000)		
S. Africa	1136	.0008***	1.077***	-0.155***	0.7805	0.7799
		(0.000)	(0.000)	(0.000)		

Notes: The results in this table are based on the estimation of equation (6.31): $CSAD_t^{\sigma^2 LOW} = \gamma_0 + \gamma_1^{\sigma^2 LOW}\left|R_{m,t}^{\sigma^2 LOW}\right| + \gamma_2^{\sigma^2 LOW}\left(R_{m,t}^{\sigma^2 LOW}\right)^2 + \varepsilon_t$. The decision rule is that no herding occurs if $\gamma_1 > 0$ *and* $\gamma_2 = 0$, and herding is present if $\gamma_2 < 0$ and is statistically significant. The p-values are in parentheses, with ***, ** and * denoting statistical significance at the 1%, 5% and 10% levels of significance, respectively.

6.9 Chapter Summary and Concluding Remarks

A general consensus of growing behavioural finance literature focusing on investor herding suggests the presence of herd behaviour in emerging equity markets owing to informational inefficiency and other factors unique to these markets. In this chapter, we explored investor behaviour by investigating their tendency to herd in Africa's emerging stock markets. The motives underlying investor herding, the theoretical underpinnings and the implications of such behaviour were highlighted in the opening sections of the chapter. We subsequently reviewed the extant literature on herding and specified our herding measure in line with the cross-sectional absolute deviation (CSAD) measure proposed by CCK. Finally, the empirical results of the presence of herd behaviour and asymmetric effects on herding were reported and analysed.

In general, compelling evidence of herding behaviour was detected in Africa's emerging stock markets (South Africa, Egypt, Morocco, Kenya and Nigeria). The findings in this chapter suggest rejection of the assumption of linearity and increasing relationship between stock return dispersions and aggregate market return. Instead, the prediction of non-linear relationship between the two in the presence of herd behaviour during unusual market movements is upheld. Market participants appeared to tend to ignore their private signals and followed the market consensus during such periods. The intensity of herding is however nonhomogeneous across these markets as cross-country comparisons showed evidence of significant variations in the herding values. The South African market, for instance, is observed to exhibit the lowest level of herding compared to the other markets, suggesting the presence of relatively greater informational efficiency in its market.

The findings in the present chapter further indicate convincing evidence of anti-herding behaviour during the 2007-2009 global financial crisis. In that case, the linear and increasing relationship existed as stock return dispersions appeared to widen following an increase in average market return. Again, this finding is also heterogeneous among markets as some markets (Morocco and Nigeria) experienced greater anti-herding behaviour than others (South Africa, Egypt and Kenya).

An analysis of herding asymmetry under different market conditions additionally indicated the presence of asymmetric herding effects in Africa's emerging stock markets. The findings implied that herding behaviour differed depending on whether the market is rising or falling, whether trading volumes are high or low, and whether market volatility is high or low. Thus while herd behaviour can be said to exist in the emerging stock markets in Africa, some periods in time experience more herding activities than other. In effect, herding asymmetry is not homogenous. Specifically, the findings perceived that herding is more pronounced under conditions of rising markets, low trading volume, and low volatility periods for stock markets in Egypt, Morocco and Nigeria. Nevertheless, the stock markets in South Africa and Kenya showed asymmetric herding effects during declining markets, high trading volume and high volatility periods. Thus stock return dispersions during extreme downside movements, high trading volume and high market volatility are much higher in the South African and Kenyan markets compared to those in the stock markets in Egypt, Morocco and Nigeria.

The present chapter thus concludes that herding behaviour exists in Africa's emerging stock markets and that asymmetric herding effects are present in these markets. However, the herding intensity and herding asymmetry are non-homogenous across markets, suggesting that herding is stronger in some markets than others and that it is more pronounced in some market conditions than other conditions. Interestingly, the findings relating to crisis periods showed evidence of significant anti-herding behaviour (exaggeration of differences) as increase in aggregate market return led to increase in stock return dispersions in these markets.

The evidence of convergence of investor decisions or trading strategies in this chapter has far-reaching implications for the efficiency and development of stock markets. Investor herding can systematically cause mispricing in financial asset prices, market instability and asset bubbles. Herding can also be a major source of shock and volatility spillover in financial markets and can limit portfolio diversification advantages by increasing the transaction costs of asset portfolios. Therefore, we suggest that policymaking and regulating of financial markets in Africa need to consider the impact of herding activities and formulate policies to discourage or halt their existence. The range of policies could involve stepping up efforts to improve informational efficiency and flows in African financial markets, improve market regulation and encourage effective reportage of firms' information, promote greater market integration with advanced financial markets for technology transfers and market efficiency among others, and educate market participants on the need for rational decision making and discourage same from herding behaviour. The next chapter presents summaries of the findings, conclusions and policy implications and recommendations of the study.

CHAPTER 7

Summary, Conclusions and Policy Recommendations

This chapter provides a synthesis of the preceding chapters, and summarises the entire study and the findings which addressed the research questions of the study. The chapter also makes a number of specific policy recommendations based on the findings in the study, and provides suggestions for future research directions. The summary of the study is presented in section one, the summary of the findings and conclusions are provided in section two, policy recommendations are outlined in section three, and the limitations of the study as well as suggestions for future research are provided in section four.

7.1 Summary of the Study

The crucial role of Stock markets in economic development and national prosperity has long been recognised. Economic agents such as investors, companies, and governments use the stock market to achieve their respective objectives. Basically, the health of the stock market is an indicator of the prevailing conditions and wellbeing of the economy. As a result, the progress of stock markets is a major policy issue worldwide. In particular, and of priority for policymakers, national governments, financial markets and international development partners are the issues of stock market development, market integration and efficiency, and investor behaviour in financial markets. These are the issues at centre stage for policy makers and academics alike. While research on international stock market development, integration and efficiency, and investor herding, especially, has been exhaustive in other parts of the world, research on these issues in stock markets in Africa is relatively scarce and non-existent in some cases.

Stock markets in Africa have been perceived historically as underdeveloped, isolated from the rest of the world and inefficient. Yet, these stock markets have been key participants in the global surge in stock market development and integration due to policy interventions. Indeed, during the last two decades, stock markets in Africa have witnessed an upsurge in stock exchanges and development as well as improved integration and informational efficiency. The inexplicably sparse research on Africa’s stock markets in relation to their development, integration and investor behaviour serves as the main motivation for the present study.

The overall aim of the study was to empirically analyse African stock markets in relation to their development, integration and investor herd behaviour over the period 1998-2014. Specifically, the study sought to accomplish the following objectives:

(i) To examine the domestic and global factors determining stock market development in Africa;

(ii) To investigate the evolving co-movement or integration among African stock markets and between them and the global stock market;

(iii) To analyse the association between market integration and informational efficiency of stock markets in Africa; and

(iv) To investigate the presence of herding behaviour and asymmetric effects of herding in Africa's emerging stock markets.

These specific objectives are addressed in four separate essays consisting of four independent empirical chapters in this study. Importantly, each of the specific objectives provides distinct research contributions. The first essay ($objective$ 1) examined domestic and global factors driving stock market development in Africa, and the second essay ($objective$ 2) investigated the evolving integration/co-movement of African stock markets with the world market. The third essay ($objective$ 3) analysed the association between the market integration and informational efficiency of stock markets in Africa, while the fourth essay ($objective$ 4) investigated the presence of investor herding behaviour in Africa's emerging stock markets.

Different methodologies were used to accomplish the various specific objectives of the study. Econometric estimation techniques were mainly employed in estimating the empirical results. The first objective, which examined the domestic and global factors driving stock market development in Africa, was accomplished using a dynamic panel modelling technique based on the difference GMM estimation methodology. The Continuous Morlet Wavelet transform, a time-frequency domain analysis was employed alongside DCC-GARCH analysis (a time-domain analysis) to achieve the second objective which investigated the evolving integration of African stock markets with the world market. The third objective, which tested the positive association between market integration and informational efficiency in stock markets in Africa, was attained using various panel modelling techniques such as pooled panel OLS regression, fixed effect and random, and GMM estimation techniques. The two policy variables of market integration and informational efficiency were measured using Stehle's (1977) single factor international capital asset pricing model (ICAPM) in the form specified by Hooy and Lim (2013). The fourth objective, which investigated the presence of herd behaviour in Africa's emerging equity markets, was accomplished using the cross-sectional absolute deviation (CSAD) herding measure proposed by Chang et al. (2000).

7.2 Findings and Conclusions of the Study

The findings of this study emanated from the four separate essays presented in the preceding four independent empirical chapters. These findings and conclusions are presented in the ensuing four subsections in this concluding chapter. The first subsection reports the findings and conclusions on the determinants of stock market development in Africa, while the second subsection outlines the findings and conclusions on evolving co-movements of African stock markets with the world market. The findings and conclusions on the hypothesis of positive association between market integration and informational efficiency of stock markets, and those on herding behaviour in Africa's emerging equity markets, respectively, are presented in subsections three and four.

7.2.1 Findings and Conclusions on Domestic and Global Determinants of Stock Market Development in Africa (Objective 1)

The importance of Stock market development as a source of economic growth and nations' prosperity has long been recognised. Indicators of stock market development such as market capitalisation as percentage of GDP, value traded as percentage of GDP, turnover ratio, and number of listed companies currently show that African stock markets have made some progress since the beginning of the 21st Century, although they still remain some of the least developed markets in the world. What factors influence these indicators of stock market development, especially in the presence of improved global market integration, represents an even more important policy question.

The study documented three key findings on the determinants of stock market development in Africa. First, both domestic and global factors influence stock market development in Africa. Additionally, the view that stock market development is a dynamic process is supported by the present study. Second, the domestic determinants of stock market development are categorised into macroeconomic and institutional factors. The main macroeconomic determinants are previous-period stock market development, income level, stock market liquidity, banking sector development, the supply of funds, and macroeconomic stability. Also, good quality institutions, particularly adherence to democratic accountability and improvement in bureaucratic quality are the principal institutional determinants of stock market development in Africa. Third, the performance of leading global stock markets, growth of trading partner economies, inflation in trading partner economies, and global financial crisis are the major global determinants of Africa's stock market development. Thus, while sound macroeconomic conditions and good quality institutions are needed for stock market development, current developments within the global financial scene imply that global factors are equally indispensable.

In particular, the finding in this study regarding global factors determining stock market development is both theoretical and empirical founded in the literature. The trade-growth literature suggests that economic and financial conditions abroad such as growth rates, income levels, inflation, against the backdrop of increased globalisation and financial integration, can significantly influence domestic growth (Arora and Vamvakidis, 2001). Specifically, a positive relationship between trade openness and economic growth has been documented (Greenaway et al., 1998; Arora and Vamvakidis, 2004). Additionally, studies have documented that globally integrated stock markets are more responsive to global events, and that global factors largely influence their performance (Bae et al., 2012; Hooy and Lim, 2013). Mensi (2014) documented that global factors, such as the returns of global stock index, commodity prices, global stock market uncertainty, and the United States economic policy uncertainty are influential global factors with significant effect on the emerging stock markets of the BRICS countries. Also, global factors determining stock market development in Africa include the performance of leading global stock markets, growth of trading partner economies, inflation of trading partner economies, and global financial crisis (Aawaar and Tewari (2016).

7.2.2 Findings and Conclusions on Evolving Integration of Stock Markets in Africa (Objective 2)

The commonly held view that stock markets in Africa are segmented from the global financial markets no longer represents an accurate assessment. The application of the continuous Morlet wavelet transform to investigate the evolving integration or co-movement among African stock markets and between them and the world market revealed noteworthy findings.

The overall suggestion of the findings in this study is that African market integration with the world has significantly evolved through time and in space. The dynamics of the interactive relationship between these markets and the world market appear to be changing quite rapidly over time and scale. Above all, the findings indicated that co-movements between stock markets are both time-varying and scale dependent, but with significant variations between market pairs. Another key finding in this study is that greater global co-movements at both short-and long-term frequency scales are perceived in Africa's emerging markets and the frontier markets in the Southern Africa region. The South African stock market is uniquely more integrated with the world market than any other African market.

An important implication of the findings in this study is that the magnitude and intensity of African stock market integration with the world market is growing and tends to be considerably affected by financial crisis periods. The findings further imply a gradually declining trend in both short-term, and even more so, in long-term international diversification gains in Africa's stock markets. From a financial standpoint, the findings also point to evidence of the likely occurrence of contagion in the emerging markets in Africa during the global financial crisis period.

At the regional level however, the study revealed lower intra-regional and inter-regional co-movements in both short- and long-term horizons among stock markets in Africa. Nevertheless, the relative strength of these dependencies differs between pairs of markets and pairs of regions. A major implication of the findings about intra-regional and inter-regional co-movements in Africa is that greater regional diversification benefits exist for investors, fund managers and hedge funds operating in African financial markets. For all interactive relationships however, no definite and stable lead-lag relationships could be observed either among stock markets in Africa or between them and the world stock market.

In comparison, the findings from the DCC-GARCH analysis suggest that co-movements are time-varying with persistent changes over time. However, the DCC-GARCH analysis is unable to capture simultaneously both the time and frequency aspects of the data, and has therefore only been used in this study as a secondary method.

7.2.3 Findings and Conclusions on the Link between Market Integration and Informational Efficiency of Stock Markets in Africa (Objective 3)

Market integration and informational efficiency of stock markets have been researched as separate concepts in the finance literature for a long time. In the present study we diverged from this common practice of testing whether markets are integrated with the world and whether markets are efficient based on the efficient market hypothesis. Instead, we tested the hypothesis of a positive association between market integration and the informational efficiency of stock markets applying African financial data. That is, we hypothesised that stock markets that are more integrated with the world market are also more informationally efficient markets.

The empirical findings of the study showed compelling evidence of a significant positive association between market integration and informational efficiency. Thus the suggestion is that a more integrated African stock market is also a more informationally efficient market, and the findings are robust across different estimation methods (pooled OLS regression, random effect model, dynamic GMM estimation). The findings additionally showed that market informational efficiency could be a dynamic process where previous-period level of efficiency plays an important part in determining the level of efficiency in the next period.

The positive link between market integration and informational efficiency may be associated with developing markets, suggesting that the liberalisation policies undertaken in these countries has led to increased foreign investment accessibility and improved market informational efficiency. A key implication of the findings is that market integration and informational efficiency are not independent policy variables, since a globally integrated stock market is likewise a globally informationally efficient market. The pricing process of an integrated market swiftly responds to and incorporates global common information. Another important implication is that once a stock market is slow in incorporating global common news into its prices, it requires exogenous interventions (such as financial liberalisation or other similar market-related policies) to improve its speed of price adjustment.

7.2.4 Findings and Conclusions on Herd Behaviour in Africa's Stock Markets (Objective 4)

Investor herding has become a topical issue in finance because of its dire consequences for the efficiency of financial markets in general and asset prices in particular. Herding behaviour is said to be common in emerging markets and may be persistent during crisis periods and stressful market conditions. The findings in the present study suggest that emerging stock markets in Africa are not exempt from this behaviour.

The findings in the study revealed compelling evidence of the presence of investor herd behaviour in Africa's emerging stock markets. The assumption of a linear and increasing relationship between stock return dispersions and aggregate market return predicted by CAPM was therefore rejected. Instead, the findings confirmed the prediction of non-linear relationship between return dispersions and market return during unusual market movements in the presence of herding behaviour. The implication of this is that market participants were more inclined to ignore their private signals and followed the market consensus during stressful market periods. Such situations are evidence against efficiency of the stock markets.

It is interesting to note that a comparative cross-country analysis found the intensity of herding to be non-homogenous among the markets, as evidenced by significant variations in the herding coefficients. An implication of this finding is that herding is more persistent in stock markets that are relatively less efficient.

The findings in the present study further showed convincing evidence of anti-herding behaviour during the 2007-2009 global financial crisis. The linear and increasing relationship was exaggerated as stock return dispersions increased greatly due to an increase in average market return. This represents exaggeration of investor differences, and is heterogeneous among markets as some African emerging markets (Morocco and Nigeria) experienced greater anti-herding behaviour than others (South Africa, Egypt and Kenya).

The finding further reported the presence of asymmetric herding effects in Africa's emerging stock markets. The findings implied that herding behaviour differed depending on whether the market is rising or declining, whether trading volumes are high or low, and whether market volatility is high or low. The herding asymmetry is however not homogenous as it was observed to be more pronounced in some markets (Kenya and South Africa) during declining markets, high trading volume, and high market volatility periods than other markets (Egypt, Morocco and Nigeria).

7.3 Policy Implications and Recommendations of the Study

The findings in this study contain a number of policy implications: the first three major policy implications in this section emanated from *Objective 1*; the fourth and fifth policy implications emanated from *Objective 2*; the sixth and seventh policy implications emanated from *Objective 3*; while the last two policy implications emanated from *Objective 4*. First, a major policy implication of the findings in this study is that African stock markets have become an active participant in world financial markets. Global factors such as the performance of leading global stock markets, growth of trading partner economies, inflation of trading partner economies, and global financial crises significantly influence the progress of their development alongside domestic macroeconomic and institutional factors. At the international level, we recommend that governments of leading global economies such as the G20 and international development partners should play a leading role in determining reform packages that ameliorate adverse effects of financial liberalisation and safeguard the opportunities associated with greater financial market linkages.

Second, sound macroeconomic environments such as economic growth, higher market capitalisation ratios, greater market liquidity, a strong banking sector, improved domestic savings and investment and good quality institutions play an indispensable role in stock market development. We therefore suggest that policy-making at national and regional levels should target promoting sound macroeconomic environments and good quality institutions that guarantee political stability and investor right protection across Africa. In particular, effective resolution of political strife and provision of effective bureaucracy in African countries are important for accelerated stock market development in Africa. The promotion of domestic investments and market liquidity is likewise a desirable approach to ensure stock market development in Africa.

A third policy implication of the findings *(based on objective 1)* is that stock market development is a dynamic process (as shown by the strong positive significance of the one period lag of stock market development in the GMM analyses). An important implication is that well-performing stock markets are likely to continue to perform well in the future.

The achievement of greater stock market development as measured by the market capitalisation ratio needs to be a major policy priority in African countries. Policies that boost savings and investments and promote financial deepening are needed to break the near vicious cycle of shallowness and illiquidity that characterises most African markets.

Fourth, another major policy implication of the findings *(emanating from objective 2)* in this study is that the dynamics of the interactive relationship between African stock markets (especially the emerging ones) and the world market is changing quite rapidly with evolving co-movements being both time-varying and frequency dependent. This represents greater risks of potential losses in international portfolio diversifications with their dire consequences for the stability of national financial markets and their respective economies. We perceive a gradually declining trend in both short-term and even much more in long-term international diversification gains in Africa's stock markets. It is highly recommended that policing of financial markets should entail policy guidelines for market participants on the changing patterns of portfolio diversification benefits and risks in the face of constantly evolving market interdependence, while enhancing greater portfolio investment in Africa. It is important for investors, fund managers, and hedge funds to take into account both the time-varying and scale-dependent nature of correlations in making final portfolio diversification and management decisions.

From a financial standpoint, a fifth policy implication of the findings *(emanating from objective 2)* is the possible occurrence of contagion in Africa's emerging and frontier stock markets during the global financial crisis periods. The wavelet analyses showed consistent evidence of increasing significant coherencies between most African stock markets and the world stock market (represented by the United States stock market) at both low and high frequencies especially during the 2008-2010 period. This implies that Africa may not be spared in any global financial turmoil and policies must consider crisis preventive measures and how the impact of such crises on African financial markets can be minimised should they occur.

Sixth, the positive link between market integration and informational efficiency may be closely associated with developing markets, signifying that market-based policies undertaken in these countries led to increased market accessibility and improved market informational efficiency. We conclude that market integration and informational efficiency are closely and positively related policy variables (but not independent). We accordingly recommend that the two policy goals should be pursued simultaneously and implemented as complementary policy objectives.

Seventh, although greater market integration has dire consequences for international diversification opportunities, the advantages of an efficiently integrated market (such as greater capital flows, international risk sharing, efficient prices, technology transfers, and growth) should serve as greater motivation for pursuing greater market integration in African countries. We suggest that Africa's emerging and frontier markets need to renovate their policy efforts to further integrate their capital markets with the rest of the world financial system. The integration-enhancing policies should however focus on operationalising *de facto* market integration to ensure the creation of accessible and enabling investing environments and destinations in the continent.

For African countries to fully realise the efficiency-enhancing advantages of market integration, the focus of policy efforts should be on the removal of both explicit and implicit investment barriers in their financial markets. This we suggest should be the policy stance of all African governments, policy makers, market regulators, and international development partners.

Finally, the conclusion in this study *(emanating from objective 4)* that investor herding and herding asymmetries are present in Africa's emerging stock markets has far-reaching policy implications. The presence of herd behaviour can systematically cause mispricing in financial assets, extreme market volatility and asset bubbles, and render financial markets inefficient informationally. Herding can impose huge additional transaction costs on asset portfolios and significantly reduce potential portfolio diversification benefits.

Therefore, we suggest that policing of financial markets in Africa should involve policy-making that considers the impact of herding activities and formulates appropriate policies to discourage or halt their existence. The range of policy targets could include, but not be limited to: (1) stepping up efforts to improve informational efficiency and flows in African financial markets, (2) improving market regulation and encouraging effective reportage of firms' information, (3) promoting greater market integration with advanced financial markets for technology transfers and market efficiency among others, and (4) educating market participants on the need for rational decision making and warning same against the practice of investor herd behaviour.

7.4 Limitations of the Study and Suggestions for Future Research

On the whole, the findings in the present study are consistent with economic theories and prior empirical studies, although a number of limitations were encountered. First, the study made a significant contribution to the policy debate on the determinants of stock market development. However, inaccessibility of up-to-date quality data on some African countries and variables limited the number of stock markets used to examine the domestic and global factors driving stock market development in Africa. Also, we were unable to tell whether the findings are homogenous or heterogeneous across different countries and regions in Africa. Therefore, it will make an important research contribution to widen the scope of the analysis with an extended dataset and large cross sections that provide more leverage to perform sub-sample analyses to verify whether or not the findings are homogenous across different countries and regions in Africa.

Second, another noteworthy contribution in this study is the analysis of evolving co-movements or integration among African stock markets and between them and the rest of the world. From an African perspective, the findings from the wavelet squared coherency analysis represent a novel contribution to the international financial integration literature (to the best of our knowledge). More importantly, we provided insight into portfolio diversification opportunities, taking into account investors with different interests in investment horizons such as short-term, medium-term and long-term investment horizons. However, the present study was unable to analyse the effects of foreign investors' presence on the integration or co-movement of African stock markets. This represents a gap in the literature deserving further research in the future. Another gap that warrants future research relates to the factors determining African equity market correlation with the rest of the world.

Third, the current study further contributed to the international financial integration literature by testing the positive association between market integration and informational efficiency of stock markets in Africa. We answered in the affirmative the straightforward question of whether an integrated stock market is also an informationally efficient one using data from 11 African markets. The market efficiency effects of market integration contain more policy relevance. We had wanted to analyse this all important policy question using data from all African countries, but were heavily constrained by data. We equally desired to have included a lot more controlled variables such as those proposed in the Fama-French Three Factor model as well as variables surrogating the ability of investors to short sell, and country-level degree of investibility. Such analysis would have provided further insight on how global information gets transmitted in African markets. Further research is desirable to fill this gap.

Fourth, we contributed to the literature on behavioural finance, on herding behaviour to be precise, but the subject remains heavily under-researched in African financial markets. But for want of time and data limitation, the present study would have taken into account the influence of the fluctuations in world commodity prices and the United States economy on herding behaviour in African stock markets. We therefore suggest that future research directions in herding behaviour in African financial markets should include many more markets and also analyse the effect of global factors such as oil prices, and the influence of the US and Chinese economies on herding in Africa. Country analyses that utilise both primary and secondary data will do well in that regard.

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APPENDICES

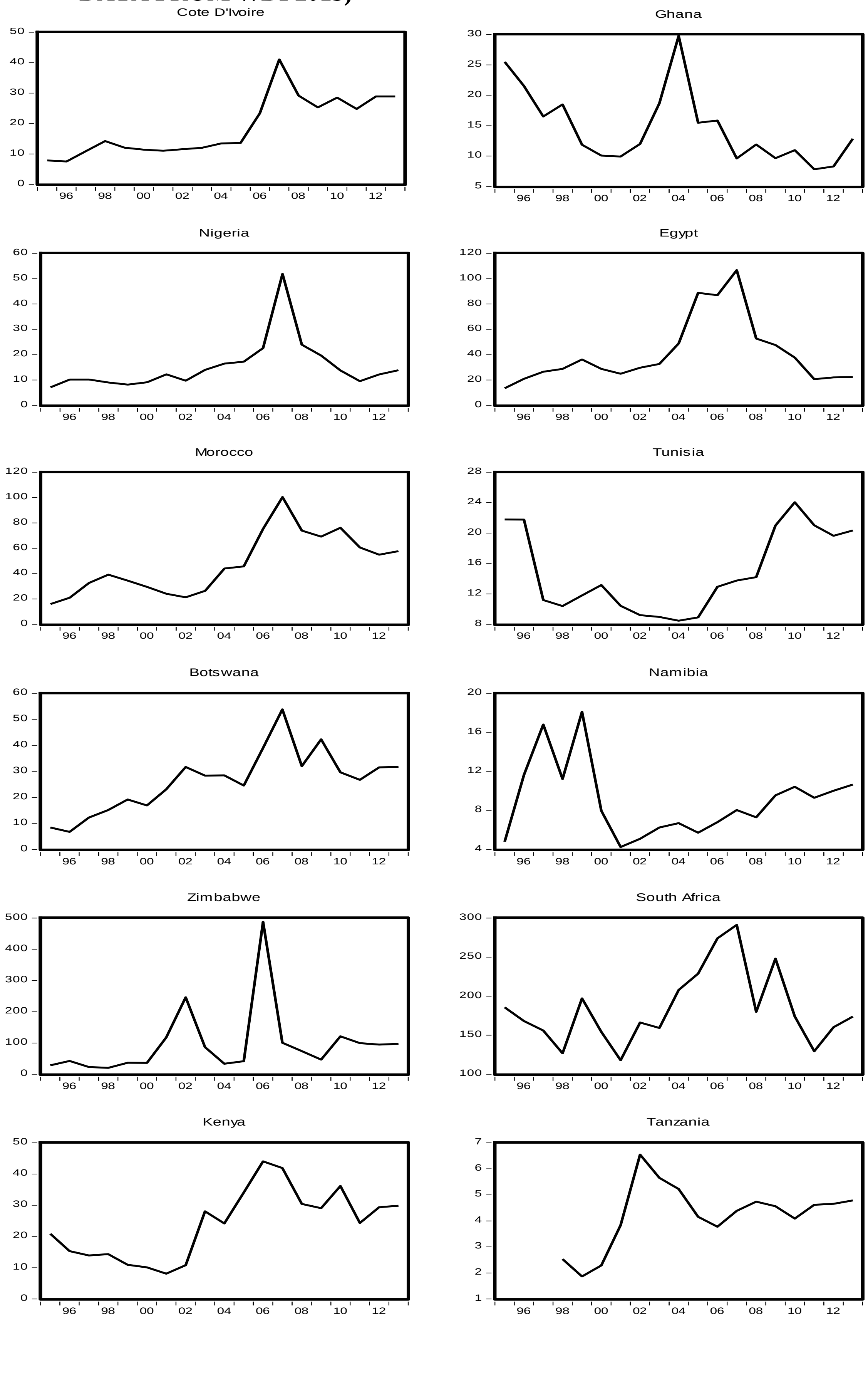
APPENDIX A: THE LEVEL OF STOCK MARKET DEVELOPMENT IN AFRICA AVERAGED OVER 17 YEAR-PERIOD

Stock Market Development in Africa (Average 1995-2012, % of GDP)

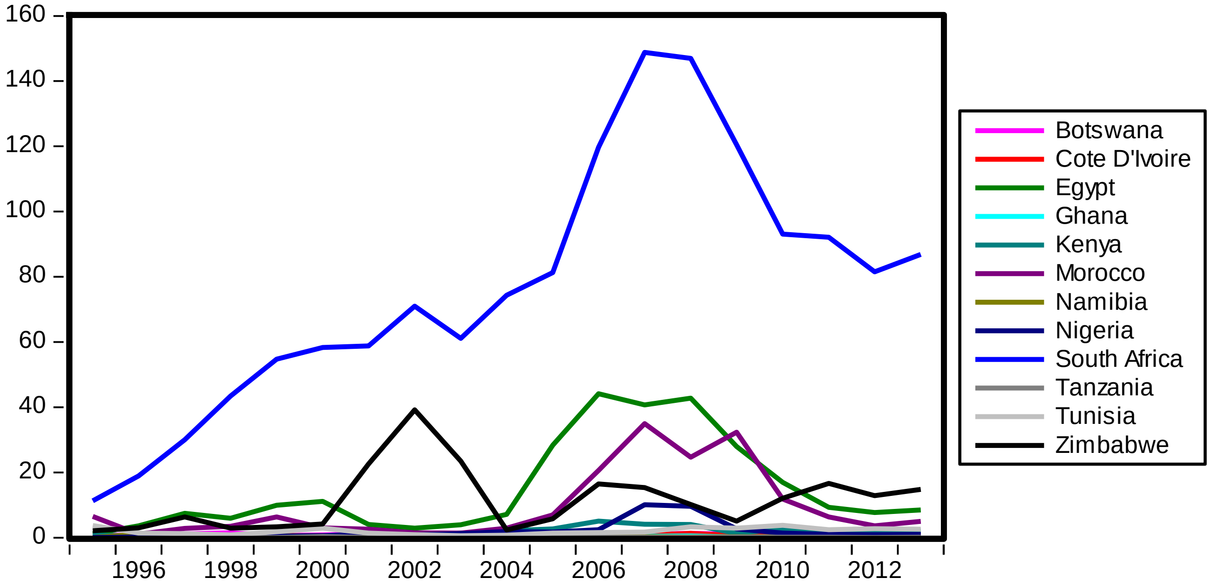
Country	Market Capitalisation (US$ Million)	Market Capitalisation (% of GDP)	Value Traded (% of GDP)	Turnover Ratio (%)
East Africa				
Uganda	2188	11.91 (13)	0.081	1.33
Tanzania	777	4.18 (16)	0.123	4.26
Kenya	6282	25.06 (7)	1.762	6.75
West Africa				
Cote D'Ivoire	3503	20.03 (8)	0.432	2.35
Ghana	1982	13.36 (12)	0.403	2.87
Nigeria	23477	16.64 (10)	2.059	10.67
North Africa				
Morocco	32533	51.66 (3)	9.606	18.49
Tunisia	4736	13.86 (11)	1.974	13.81
Egypt	51251	46.21 (5)	15.28	32.80
Southern Africa				
Botswana	2479	29.49 (6)	0.929	4.88
Malawi	857	19.26 (9)	0.582	2.96
Mauritius	3249	46.59 (4)	2.638	6.12
Namibia	588	8.44 (15)	0.291	3.24
Zambia	1210	11.61 (14)	0.366	3.94
Zimbabwe	6866	109.64 (2)	11.32	13.12
S. Africa	417789	187.66 (1)	75.89	41.24
Total	559767	1231.20	123.74	168.83
Excluding SA	141978	1043.54	47.85	127.59
SA as % of Total	74.64	15.24	61.33	24.43
Africa Average	25.36	84.76	38.67	75.57
Brazil	579293	45.63	23.72	54.05
China	1827619	51.35	69.10	148.69
India	590822	55.23	53.64	117.51
Malaysia	225219	153.12	59.34	37.12
United Kingdom	2595711	130.33	129.85	105.67
United States	14555055	122.43	206.05	174.87

Source: Authors' calculations based on World Bank, World Development Indicators (WDI 2015). Rankings of African stock markets over 1995-2015 based on market capitalisation are provided in parentheses.

APPENDIX B: TREND ANALYSIS OF MARKET CAPITALISATION (AS % OF GDP) OF AFRICAN STOCK MARKETS (EXEMPLIFIED BASED ON DATA FROM WDI 2015)



APPENDIX C: CHARACTERISTIC OF STOCK MARKETS IN AFRICA – COMPARING VALUE TRADED (AS % OF GDP) OVER TIME (1995-2013)



APPENDICES D - F: RESULTS OF OLS REGRESSION, FIXED EFFECT AND RANDOM EFFECT ESTIMATIONS

Prior to the implementation of the substantive estimation methodology, the study reported estimation results from pooled OLS regression, fixed effect and random effect models intended to provide partial justification of the appropriateness and robustness of the chosen GMM estimation. The results from the auxiliary estimation methods were largely in appropriate as most of the regressors are insignificant statistically, but with large R-square (95%). Besides, the pooled OLS regression results failed to meet the requirements of the classical OLS assumptions.

APPENDIX D: AUXILIARY ESTIMATION RESULTS ON DOMESTIC DETERMINANTS OF STOCK MARKET DEVELOPMENT; DEPENDENT VARIABLE: STOCK MARKET CAPITALIZATION RELATIVE TO GDP

Variable	Pooled OLS Estimation	Fixed Effect Estimation	Fixed Effect Robust Estimate.	Random Effect Estimation
Lagged dependent	0.738	0.358	N/A	0.738
	(17.98)***	(6.37)***	(N/A)	(17.98)***
GDPPC Growth	0.009	0.027	0.024	0.009
	(0.84)	(3.05)***	(2.08)*	(0.84)
Private Credit	-0.068	0.029	0.493	-0.068
	(-1.50)	(3.73)***	(5.78)***	(2.42)**
Value Traded	0.152	0.296	0.362	0.151
	(6.80)***	(10.93)***	(8.83)***	(6.80)***
Domestic Savings	0.003	0.013	-0.003	0.003
	(0.39)	(1.79)*	(-0.27)	(0.39)
FDI	-0.016	-0.004	-0.005	-0.016
	(-0.87)	(-0.22)	(-0.41)	(-0.87)
Inflation CPI	0.008	0.036	0.053	0.008
	(0.48)	(2.27)**	(2.22)**	(0.48)
Real Interest Rate	0.010	0.004	0.002	0.010
	(2.12)**	(0.93)	(1.46)	(2.12)**
Political Risk	0.003	-0.040	-0.130	0.003
	(0.14)	(-0.88)	(-2.14)*	(0.14)
Constant	0.952	1.059	2.035	0.952
	(5.52)***	(2.85)***	(4.03)***	(5.52)***
Observations	180	180	192	180
R-square	0.9470	0.8919	0.6899	0.9570
F-Statistic / Wald Chi2	337.29	65.35	595.32	3035.63
Prob > F	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Hausman Test		242.19		
Prob > Chi2		[0.000]***		

Notes: Fixed Effect Robust estimation is the fixed effect regression tested for autocorrelation and heteroscedasticity using Driscoll-Kraay standard errors testing method. The problem of endogeneity may still be persistent despite the preference for the fixed effect estimation based on the Hausman specification test.

For the fixed effect and random effect models, the Hausman specification test statistic[36] suggests the appropriateness of the fixed effect estimation. However, the likelihood of endogeneity among regressors and the dynamic process involved due to the presence of lagged dependent variable render the fixed effect estimation a limited estimation technique.

[36] Hausman Test specifies the null hypothesis as H0: Random Effect Model is appropriate and the alternative hypothesis as H1: Fixed Effect Model is appropriate.

APPENDIX E: AUXILIARY ESTIMATION RESULTS ON GLOBAL DETERMINANTS OF STOCK MARKET DEVELOPMENT; DEPENDENT VARIABLE: STOCK MARKET CAPITALIZATION RELATIVE TO GDP

Variable	Pooled OLS Estimation	Fixed Effect Estimation	Fixed Effect Robust Estimate.	Random Effect Estimation
Lagged dependent	0.680	0.382	N/A	0.680
	(16.85)***	(6.82)***	(N/A)	(16.85)***
GDPPC Growth	0.013	0.024	0.024	0.013
	(1.31)	(2.65)***	(2.10)*	(1.31)
Private Credit	-0.083	0.297	0.501	-0.083
	(-1.87)*	(3.73)***	(6.44)***	(-1.87)**
Value Traded	0.193	0.306	0.365	0.193
	(8.69)***	(11.53)***	(8.12)***	(8.69)***
Domestic Savings	0.003	0.012	-0.005	0.003
	(0.41)	(1.56)	(-0.39)	(0.39)
FDI	-0.021	0.002	-0.005	-0.021
	(-1.12)	(0.12)	(-0.40)	(-1.12)
Inflation CPI	0.022	0.036	0.056	0.022
	(1.43)	(2.23)**	(2.17)*	(1.43)
Real Interest Rate	0.009	0.005	0.003	0.009
	(1.97)*	(1.24)	(1.82)*	(1.97)*
Political Risk	0.034	-0.039	-0.128	0.034
	(1.56)	(-0.82)	(-2.45)**	(1.56)
GEINDEX	0.004	0.003	0.003	0.004
	(2.84)***	(2.43)**	(2.31)**	(2.84)***
Commodity Prices	0.020	-0.013	-0.001	0.020
	(1.95)*	(-0.35)	(-0.02)	(1.95)*
MTP Growth	-0.006	0.018	0.024	-0.006
	(-0.32)	(0.84)	(1.93)*	(-0.32)
MTP Inflation	0.094	0.017	-0.002	0.094
	(4.71)***	(0.70)	(-0.06)	(4.71)***
Financial Crisis	-0.100	-0.060	0.026	-0.100
dummy	(-1.62)	(-1.06)	(0.69)	(-1.62)
Constant	0.790	1.001	1.980	0.790
	(4.48)***	(2.33)**	(4.89)***	(4.48)***
Observations	180	180	192	180
R-square/(within)	0.9567	0.8991	0.7004	0.9567
F-Statistic / Wald Chi2	260.38	45.50	636.13	260.38
Prob > F	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Hausman Test		95.45		
Prob > Chi2		[0.000]***		

Notes: The Pooled OLS regression results do not pass normality tests (based on standardised normal probability (P-P) plot; homoscedasticity tests (Breusch-Pagan / Cook-Weisberg test for heteroscedasticity – chi2 = 10.78; prob > chi2 = 0.001); and multicollinearity tests (variance inflation factor, mean VIF = 26.97). Fixed Effect Robust estimation is the fixed effect regression tested for autocorrelation and heteroscedasticity using Driscoll-Kraay standard errors testing method. The problem of endogeneity may still be persistent despite the preference for the fixed effect estimation based on the Hausman specification test.

APPENDIX F: TIME-VARYING RELATIONSHIPS AMONG AFRICAN STOCK MARKETS

Panel A: South Africa versus African stock markets

Market	α	$\theta 1$	$\theta 2$	Log Likelihood
South Africa				
Kenya	0.067(1.409)	0.006(0.539)	0.937(42.00)***	-3402.163
Egypt	0.083(2.144)**	0.00(0.009)	0.862(1.661)*	-3673.986
Morocco	0.163(4.317)***	0.002(0.00)	0.969(32.95)***	-3280.405
Tunisia	0.172(4.612)***	0.00(0.003)	0.864(0.218)	-3094.281
Botswana	0.321(2.510)***	0.053(2.564)***	0.935(36.36)***	-3105.827
Mauritius	0.130(1.247)	0.010(1.701)*	0.982(83.52)***	-3121.906
Namibia	0.326(3.243)***	0.011(2.564)***	0.979(35.45)***	-3241.218
Cote D'Ivoire	0.178(2.160)**	0.034(2.048)**	0.946(30.99)***	-3371.026
Ghana	-0.005(-0.156)	0.00(0.219)	0.999(199.9)***	-3247.083
Nigeria	-0.020 (-0.533)	0.00 (0.001)	0.759(3.778)***	-3481.106

Panel B: Egypt versus African stock markets

Market	α	$\theta 1$	$\theta 2$	Log Likelihood
Egypt				
Kenya	0.203(4.824)***	0.083(1.261)	0.616(1.849)*	-3440.556
Morocco	0.157(4.189)***	0.011(0.377)	0.638(2.160)**	-3331.612
Tunisia	0.061(1.042)	0.012(1.812)*	0.971(95.91)***	-3147.595
Botswana	-0.003(-0.096)	0.00(0.001)	0.883(4.454)***	-3222.250
Mauritius	0.108(1.811)*	0.016(2.058)**	0.958(52.61)***	-3174.225
Namibia	-0.024(-0.434)	0.009(1.457)	0.979(80.25)***	-3364.243
South Africa	0.083(2.144)**	0.00(0.022)	0.862(1.661)*	-3673.986
Cote D'Ivoire	0.046(1.605)	0.00(0.000)	0.245(0.107)	-3455.286
Ghana	0.012(0.304)	0.021(0.995)	0.925(11.43)***	-3292.442
Nigeria	0.082(2.002)**	0.111(1.898)*	0.00(0.000)	-3520.890

Panel C: Kenya versus African stock markets

Market	α	$\theta 1$	$\theta 2$	Log Likelihood
Kenya				
Egypt	0.203(4.824)***	0.083(1.261)	0.616(1.849)*	-3440.556
Morocco	0.171(4.370)***	0.00(0.00)	0.069(0.132)	-3054.617
Tunisia	0.171(3.472)***	0.027(1.226)	0.856(10.49)***	-2860.761
Botswana	0.0747(2.304)**	0.00(0.00)	0.040(0.012)	-2932.075
Mauritius	0.144(3.520)***	0.042(0.631)	0.432(0.730)	-2907.533
Namibia	0.083(2.342)**	0.00(0.00)	0.005(0.002)	-3069.191
South Africa	0.067(1.409)	0.006(0.539)	0.937(42.00)***	-3402.163
Cote D'Ivoire	0.099(2.052)**	0.008(1.083)	0.974(45.10)***	-3151.635
Ghana	0.098(2.958)***	0.005(0.767)	0.025(0.019)	-2983.601
Nigeria	-0.015()	0.00()	0.441()	-3393.645

Panel D: Nigeria versus African stock markets

Market	α	$\theta 1$	$\theta 2$	Log Likelihood
Nigeria				
Kenya	0.123(2.052)**	0.007(0.888)	0.980(47.42)***	-3242.525
Egypt	0.082(2.002)**	0.111(1.898)*	0.000(0.00)	-3520.890
Morocco	0.024(0.618)	0.00(0.000)	0.861(0.971)	-3137.867
Tunisia	-0.013(-0.336)	0.077(1.911)*	0.00(0.000)	-2952.270
Botswana	0.021(0.647)	0.00(0.065)	0.215(0.116)	-3027.855
Mauritius	0.094(2.566)***	0.00(0.000)	0.855(0.421)	-2981.817
Namibia	-0.009(-0.283)	0.001(0.110)	0.00(0.000)	-3165.093
South Africa	-0.020(-0.533)	0.000(0.000)	0.760(3.778)***	-3481.106
Cote D'Ivoire	0.062(1.943)*	0.007(0.224)	0.008(0.002)	-3244.207
Ghana	0.080(1.765)*	0.030(1.876)*	0.909(35.99)***	-3083.076

Notes: The *sample covers the periods 18/01/2002 – 26/12/2014 containing 676 weekly observations for each market. The α, $\theta 1$, and $\theta 2$ are parameters of the GARCH (1, 1) process.* T-statistics are in parentheses. *The* * **, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively. T-statistics are in parentheses.

APPENDIX G: CONDITIONAL VARIANCE: DYNAMIC CORRELATION MODEL (ENGLE 2002) - OUTPUT FROM OXMETRICS7

Conditional Correlations from Multivariate DCC-GARCH

	Coefficient	Std. Error	t-value	t-prob
rho_21	-0.037458	0.045704	-0.8196	0.4128
rho_31	0.103749	0.050149	2.069	0.0390
rho_41	0.026469	0.054788	0.4831	0.6292
rho_51	0.033124	0.047086	0.7035	0.4820
rho_61	0.057229	0.049392	1.159	0.2470
rho_71	0.101822	0.048574	2.096	0.0365
rho_81	0.543807	0.033401	16.28	0.0000
rho_91	0.189915	0.057905	3.280	0.0011
rho_101	0.118170	0.049910	2.368	0.0182
rho_111	0.279145	0.047505	5.876	0.0000
rho_121	0.061875	0.055915	1.107	0.2689
rho_32	0.015966	0.040875	0.3906	0.6962
rho_42	0.022071	0.043256	0.5102	0.6101
rho_52	0.015023	0.041860	0.3589	0.7198
rho_62	-0.036194	0.041776	-0.8664	0.3866
rho_72	-0.031830	0.045378	-0.7015	0.4833
rho_82	-0.045901	0.048530	-0.9458	0.3446
rho_92	0.025588	0.047740	0.5360	0.5922
rho_102	0.007704	0.046284	0.1665	0.8679
rho_112	-0.069740	0.046746	-1.492	0.1362
rho_122	0.034921	0.043727	0.7986	0.4248
rho_43	0.154852	0.079308	1.953	0.0513
rho_53	-0.028055	0.043061	-0.6515	0.5150
rho_63	0.140810	0.065634	2.145	0.0323
rho_73	0.120639	0.047867	2.520	0.0120
rho_83	0.198333	0.056428	3.515	0.0005
rho_93	0.247752	0.083465	2.968	0.0031
rho_103	0.165965	0.040843	4.064	0.0001
rho_113	0.182169	0.071771	2.538	0.0114
rho_123	0.042440	0.044080	0.9628	0.3360
rho_54	0.067489	0.041411	1.630	0.1037
rho_64	-0.097803	0.067597	-1.447	0.1485
rho_74	-0.018219	0.045749	-0.3982	0.6906
rho_84	-0.043496	0.040659	-1.070	0.2851
rho_94	-0.031371	0.067570	-0.4643	0.6426
rho_104	-0.029193	0.035211	-0.8291	0.4074
rho_114	0.000962	0.074448	0.01292	0.9897
rho_124	0.058831	0.054300	1.083	0.2790
rho_65	0.079121	0.043252	1.829	0.0678
rho_75	0.044471	0.041796	1.064	0.2877
rho_85	-0.037535	0.053365	-0.7034	0.4821
rho_95	-0.037226	0.042244	-0.8812	0.3785
rho_105	0.009468	0.046317	0.2044	0.8381
rho_115	-0.005454	0.043864	-0.1243	0.9011
rho_125	0.157970	0.040158	3.934	0.0001
rho_76	0.345929	0.054681	6.326	0.0000
rho_86	0.079177	0.052023	1.522	0.1285

rho_96	0.125935	0.047960	2.626	0.0089
rho_106	0.190262	0.046491	4.092	0.0000

APPENDIX H: CONDITIONAL VARIANCE: DYNAMIC CORRELATION MODEL (ENGLE 2002) - OUTPUT FROM OXMETRICS7 CONT'D.

Conditional Correlations from Multivariate DCC-GARCH

	Coefficient	Std. Error	t-value	t-prob
rho_116	0.109994	0.049053	2.242	0.0253
rho_126	0.085376	0.044862	1.903	0.0575
rho_87	0.169321	0.045065	3.757	0.0002
rho_97	0.126390	0.048003	2.633	0.0087
rho_107	0.176000	0.043929	4.006	0.0001
rho_117	0.180594	0.045769	3.946	0.0001
rho_127	0.070464	0.045013	1.565	0.1180
rho_98	0.360423	0.073349	4.914	0.0000
rho_108	0.142197	0.048505	2.932	0.0035
rho_118	0.316654	0.053091	5.964	0.0000
rho_128	0.036088	0.046681	0.7731	0.4398
rho_109	0.126343	0.050473	2.503	0.0126
rho_119	0.580699	0.054391	10.68	0.0000
rho_129	0.079767	0.057823	1.379	0.1682
rho_1110	0.138922	0.044900	3.094	0.0021
rho_1210	0.082154	0.043183	1.902	0.0576
rho_1211	0.092217	0.056963	1.619	0.1060
alpha	0.209897	0.015796	13.29	0.0000
beta	0.358778	0.036145	9.926	0.0000

No. Observations: 676 No. Parameters: 116
No. Series: 12 Log Likelihood: -0.20307.372