# UNIVERSITY OF WITWATERSRAND

# JOHANNESBURG

# AFRICAN EQUITY MARKETS INTEGRATION: A CASE STUDY OF COMESA

Mundonde Justice

1149432

This thesis is submitted in fulfilment of the requirements for the degree of Master of Management in Finance and Investment.

Faculty of Commerce, Law and Management

Supervisor: Odongo Kodongo

## ABSTRACT

The vicious quest for higher risk-adjusted returns through diversification of portfolios has seen an enormous amount of foreign capital flows into new emerging markets. However, the success of any strategy profoundly depends on the degrees of comovements among markets - higher comovements limit the possible gains from diversification. It has been argued that the very act of chasing after these diversification benefits, which mainly includes financial globalisation, has actually resulted in the erosion of the benefits themselves. In addition, aspects such as international trade, the establishment of trade blocs and liberalisation of market controls has further reduced these diversification benefits. In this study, the long-run cointegration, short-run causality and volatility linkages were examined using six COMESA markets indices. The goal of the study was to ascertain whether the establishment of this bloc has resulted in increased association among the member markets.

The astonishing rate at which globalisation has been growing at has drawn with it both opportunities and risks for investors. The Engle-Granger, the Johansen cointegration technique and the ARDL test methods revealed that the markets integrated in the long run, a result indicative of low diversification benefits across COMESA markets. However, the weak short-run causality from the causality tests revealed that despite the strong long-run relationship, an active investment strategy that seeks to diversify portfolios in the short-run could still yield enormous diversification benefits. A subsequent examination of the volatility linkages using generalised autoregressive conditional heteroscedasticity models revealed that uniformity of volatility structures in terms volatility persistence, leverage effects and risk premium across the markets, indicative of the high likelihood of volatility spill-overs across the markets. This implies that, despite the weak short-run causality, the benefits from short-run diversification can still be quite low due to the high likelihood of volatility spillovers across these markets. In light of these results, investors within the COMESA markets should rather focus on other markets outside the COMESA as diversification destinations.

# CONTENTS

**CHAPTER 1: THE SCOPE AND PURPOSE OF THE STUDY ........................................ 1**

1.1 Introduction ........................................................................................................ 1

1.2 Problem statement and significance of the study ................................................ 3

1.2.1 Problem statement ............................................................................................ 3

1.2.2 Research objectives ........................................................................................... 4

1.2.3 Importance of the study ..................................................................................... 5

1.3 Significance of the study ..................................................................................... 5

1.4 Organization of the study .................................................................................... 6

**CHAPTER 2: EQUITY MARKET INTEGRATION ........................................................ 7**

2.1 Introduction ........................................................................................................ 7

2.2 Equity market integration. .................................................................................. 7

2.3 Determinants of equity market integration ......................................................... 9

2.3.1 Economic Integration ......................................................................................... 9

2.3.2 Foreign capital flows ......................................................................................... 17~~10~~

2.3.3 Stock market characteristics ............................................................................. 11

2.3.4 Technology ........................................................................................................ 12

2.3.5 Cross Listing of Companies ............................................................................... 13

2.4 Barriers to equity market integration in Africa .................................................... 13

2.4.1 Political Factors ................................................................................................. 13

2.4.2 Social Factors .................................................................................................... 14

2.4.3 Economic Factors .............................................................................................. 14

2.5 Benefits of equity market integration .................................................................. 15

2.5.1 Risk Transfer ..................................................................................................... 15

2.5.2 Capital Allocation .............................................................................................. 15

2.5.3 Investment and growth ...................................................................................... 16

2.5.4 Macroeconomic Discipline ................................................................................ 16

2.5.5Financial Development ...................................................................................... 17

2.5.6 Market liquidity ................................................................................................. 17

2.6 Costs of equity market integration. ..................................................................... 18

2.6.1 Volatility of Capital Flows ................................................................................. 18

2.6.2 Loss of macroeconomic stability ....................................................................... 18

2.6.3 Concentration of capital flows .......................................................................... 18

2.7. Empirical literature review .................................................................................. 19

2.7.1 Integration between developing markets .......................................................... 19

2.7.2 Integration between developed and developing markets .................................. 20

2.7.3 Integration between countries in economic blocs ............................................. 22

2.8 Chapter summary ........ 25

**3. DATA AND METHODOLOGY ........ 27**

3.1 Introduction ........ 27

3.2 The hypotheses ........ 27

3.3 Test variables ........ 28

3.3.1 The stock market indices ........ 28

3.3.2 Index returns calculation ........ 29

3.4 Stationarity tests ........ 30

3.4.1 Rationale for stationarity tests ........ 30

3.4.2 Augmented Dickey-Fuller (ADF) test ........ 31

3.4.3 Phillips-Perron (PP) test ........ 31

3.4.4 Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test ........ 32

3.5 Cointegration tests ........ 33

3.5.1 Engle-Granger method ........ 33

3.5.1.1 Why employ the Engle-Granger method ........ 33

3.5.1.2 The Engle-Granger procedure ........ 34

3.5.1.3 The error correction model (ECM) ........ 35

3.5.2 Johansen cointegration method ........ 36

3.5.2.1 The Johansen procedure ........ 36

3.5.2.2 The trace test and the maximum eigenvalue ........ 38

3.5.2.3 Vector Error Correction Model (VECM) ........ 39

*3.5.3* Autoregressive Distributed Lag Model (ARDL)…………………… … ………..39

3.5.4 Short-run dynamics ........ 40

3.5.4.1 Vector Autoregressions (VARs) ........ 41

3.5.4.2 Granger-Causality tests ........ 41

3.5.4.3 Impulse response functions and variance decompositions ........ 42

3.6 Volatility linkages ........ 43

3.6.1 Volatility models ........ 43

3.6.2 The ARCH model ........ 44

3.6.3 The GARCH model ........ 44

3.6.4 GJR GARCH ........ 45

3.6.5 Exponential GARCH ........ 46

3.6.6 Determining volatility linkages ........ 46

3.7 Chapter summary ........ 47

**CHAPTER 4: RESULTS AND ANALYSIS ........ 48**

4.1 Introduction ........ 48

4.2 Preliminary data tests ........ 48

4.2.1 Descriptive statistics ........ 49
4.2.2 Correlation between the variables ........ 49
4.2.3 Stationarity tests ........ 49
4.3 Engle-Granger cointegration tests ........ 49
4.3.1 Engle-Granger test ........ 5955
4.3.2 ARDL Test ........ 57
4.4.1 Johansen test ........ 6558
4.4.2 Vector error correction model ........ 61
4.5 Causality tests ........ 61
4.5.1 Vector Autoregressions (VAR) ........ 63
4.5.2 Granger-causality tests ........ 64
4.5.3 Impulse response functions ........ 67
4.5.4 Variance decompositions ........ 69
4.6 Volatility linkages ........ 71
4.6.1 Volatility patterns ........ 71
4.6.2 Residual diagnostics ........ 73
4.7 Chapter summary ........ 74

**CHAPTER 5: CONCLUSION AND RECOMMENDATIONS ........ 75**
5.1 A review of research objectives ........ 75
5.2 Summary of findings ........ 76
5.2.1 Are COMESA markets cointegrated? ........ 76
5.2.2 Are there significant short-run interactions among these markets? ........ 76
5.2.3 Are there any volatility linkages among the COMESA markets? ........ 76
5.3 Limitations of the study and recommendations for future study ........ 77
5.4 Conclusion ........ 78

## ACKNOWLEDGEMENTS

I highly acknowledge Dr Odongo Kodongo for his brilliance in seeing me through this piece of work. More so, I would like to give thanks to my wife Moreblessing and our daughter Taropafadzwa for their support and motivation during my working on this project. Finally, to the dear Lord is all the glory for his guidance as I journey through the academic world.

# CHAPTER 1: THE SCOPE AND PURPOSE OF THE STUDY

## 1.1 Introduction

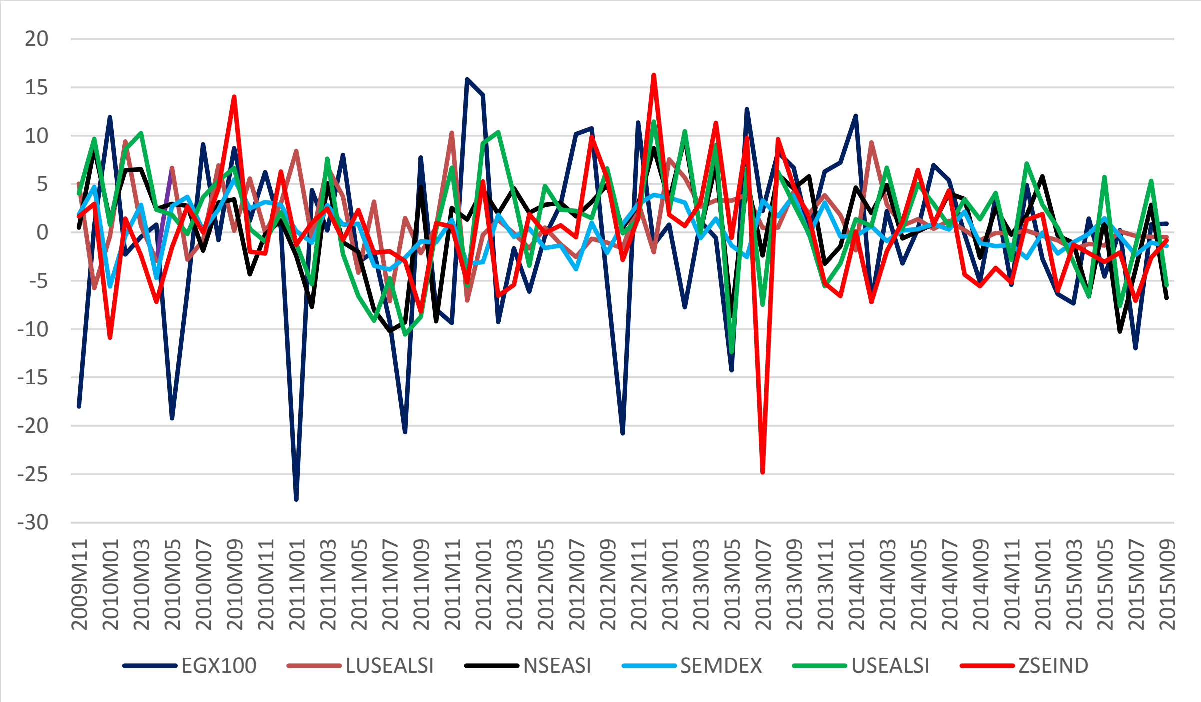
Conventional financial risk management has always dictated not putting all eggs in one basket. Applying this longstanding adage in the context of financial risk management points to the benefits that accrue from portfolio diversification and the imprudence of establishing positions in markets that have a higher propensity to deteriorate synchronously (Bodie, Kane and Marcus, 2009). The conception of diversification is largely contained in Markowitz's (1952) Modern Portfolio Theory (MPT) wherein diversification is quantified through an introduction of two statistical measures – covariance and correlation – that essentially measure the degree to which markets move together. Allocating funds to markets with lower association translates into reduced risk and higher returns – that is, higher risk-adjusted returns for a diversified portfolio (Glazakos, Merika and Karigosfiris, 2007). On the other hand, allocating funds across markets or asset with the high positive association will not aid in mitigating risks associated with the cash flows, thereby resulting in sub-optimal risk-adjusted returns.

Early studies predicted that international diversification would increasingly become relevant in investment theory and practice (Hui, 2005). Grubel (1968), Lessard (1973) and Solnik (1974) all concur on the importance of cross-country portfolio diversification based on the heterogeneity of markets. Their concurrence draws from the observation that securities in one market are less likely to be correlated with international securities, thus providing investors with an ability to enhance their risk-adjusted returns through diversification (Eun and Resnick 2009). However, the perceived heterogeneity of markets has waned considerably over time. Since the 1980s, markets have made notable strides towards adopting a liberalised approach to economic policy (Lampa and Otchere, 2001). Many emerging and developing markets implemented IMF and World Bank sponsored structural adjustment initiatives, the consequence of which has been the growth and expansion of African stock markets. Many countries underwent economic reforms centred on minimising the dominant role of state enterprises in favour of strengthening the leading role of the private sector (Jefferis and Smith, 2005). The stock market development received a major boost from privatisation drive, which, more often than not, entailed and not limited to listing of previously state entities thus facilitating the supply of newly tradable shares on the market (Jefferis and Smith 2005).

Financial sector reforms in developing markets ignited renewed attention on African markets from international investors. Deregulated markets saw fund flows, mainly taking the nature of foreign direct investments (FDI) and foreign portfolio investments (FPI), from industrialised markets into Africa trending upwards, a phenomenon contributing towards integration of African Equity Markets (Chinzara and Aziakpono, 2009a). However, critics of financial market liberalisation argue that capital market controls are a safeguard mechanism that policymakers cannot afford to lose control of; especially in light of the harmful spillovers that has plagued world markets in the past decades such as the 2007/2008 global economic crisis (Darrat and Benkato, 2003). In addition, activities of international investors pursuing optimal risk-return structure for their portfolio in an integrated world system reduce the benefits of international diversification (Kearney and Lucey, 2004). Cross-country diversification is recommended only on the assumption of minimal integration between national stock markets. Growth in multi-lateral trade, de-regulation of financial markets, rising cross-national capital flows among other factors, has induced a level of fusion between national markets.

COMESA was not an exception to these trends in global economics. COMESA has nine active stock exchanges. With a notable exception of Egyptian stock market, and relative to their European counter parts, these exchanges are characterised by small number of listed companies, very few trading participants, low trading volumes as well as low market capitilisation (African Development Bank 2010). Despite these attributes going against the grain of market co-movements, at the institutional level, co-operation is being encouraged between markets. East African Community member states, most of which are also COMESA members have established the East African Member States Securities Regulation Authority for the purpose of cordinanting and promoting capital market cooperation. Like wise SADC member countries most of which are COMESA member countries are working on ensuring that stock brokers in the region have real time screen based access to trading on linked exchanges in the region (AFD 2010). More-so, as way back as 2006, as part of capital market cooperation, Uganda and Kenya in 2006 signned a memorandum of understanding to cross list 35 blue-chip stocks over a two year period thus theorectically substantiating the homogeneity of markets across COMESA forntiers. A graphical plot of COMESA equity returns is provided under Figure 1. Though not showing a definitive co-moving trend over time, high volatility is evidently common across all markets.

**Figure 1. 0 Trending of African markets performance**




EGX 100 Price Index (EGX100) , Nairobi Securities Exchange All Share Index (NSEASI), Stock Exchange of Mauritius Index (SEMDEX), Ugandan Stock Exchange All share index (USEALSI), Lusaka Stock Exchange All share index (LuSEALSI), The Zimbabwe Stock Exchange Industrial index (ZSEInd.)

**Source:** Created by Author using data from www.Investing.com

## 1.2 Problem statement and significance of the study

### 1.2.1 Problem statement

The existence of COMESA presents a worthwhile case study to explore financial integration in the context of African markets. As a Regional Economic Community (REC), COMESA envisions establishing a currency union connecting multiple nations, covering 42.6% of African surface area, 44.6% of aggregate African population and 32% of total African GDP by 2025 through policy harmonisation (Carmgna, 2003). It is, therefore, quite interesting to measure the progress that the regional bloc has had towards this goal. This study attempts to do this through an analysis of long-horizon cointegration and short-term causal dynamics amid the COMESA financial markets. In addition, among the many consequences of regional integration has been the strengthening of comovements of world economies and financial markets, a development that might potentially neutralise the effectiveness of global assets diversification strategy. Whether this is so in the context of COMESA is difficult to answer without an investigative research into the question. Of the nineteen countries under

COMESA[1], only seven, namely, Egypt, Kenya, Mauritius, Swaziland, Uganda, Zambia and Zimbabwe, have functional equity exchanges. That is, equity markets that facilitate access to capital through allowing investors to buy shares in publicly traded counters as well as giving investors the potential of benefiting from company`s future performance as stock prices appreciate in the market. These with the exception of Swaziland constitutes the sample markets for this study. The chosen markets are members of the African Stock Exchange Association (ASEA) hence studying them allow the assessment of the effectiveness so far of this association in integrating African equity markets (Irving 2005).

The literature to date that purely explores either integration among African markets or integration between African markets and the developed economies can be subdivided into two (Kambaza and Chinzara, 2009). The first category looks at returns and volatility (Lampa and Otchere, 2001; Chinzara and Aziakpono, 2009; Ogum, 2002; Alagidede, 2008). A common discovery among these studies is that African markets are mostly segmented, especially in relation to more developed financial markets (Jefferis and Smith, 1999). The Second branch of literature mainly focuses on long-run comovements in international stock indices (Piesse and Hearn, 2002; Biekpe *et al*, 2003). Founded on the latter strand of the literature, this study investigates the integration of African stock markets by focusing on analyses of monthly returns and volatility.

### 1.2.2 Research objectives

The research aims to provide answers to the following questions:

a) Are equity markets within COMESA segmneted from each other?
b) Are there any volatility linkages within the COMESA markets?
c) Is intra-COMESA asset diversification of any value to investors in the long run?
d) Has the AESA initiative been effective in harmonising African equity markets?

Specifically, this study sets out to determine:

- the extent to which integration exists between COMESA markets
- whether there are short-run causal interactions among COMESA markets
- whether there are volatility spill-over effects among these COMESA markets
- the extent to which diversification across COMESA markets can be beneficial

[1] COMESA markets are Burundi, Comoros, D.R. Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia, and Zimbabwe.

### 1.2.3 Importance of the study

Poor equity market development, equity market inefficiencies, poor capital mobility and the limited availability of data are some of the reasons cited as having dampened research interest in developing African markets (Hearn *et al*, 2008). This study therefore contributes to this limited body of literature using most current data sets, which is important given the structural changes being undertaken in some of the economies in the sample. A notable example is a drive towards economic indigenisation and dollarization of the same in Zimbabwe. Undoubtedly, such domestic institutional changes have both long and short run economic implications that are of interest to investors. In addition, it has been shown in the literature that integration structure between international equity markets is time-variant (Bonfiglioli and Favero, 2005). This further justifies the importance of continuous assessments of the integration structure between national equity markets. For instance, in the absence of global economic shocks, country-specific factors become dominant in driving equity markets hence markets tend to move independently. In other periods, global shocks synchronise national business cycles hence markets tend to comove.

## 1.3 Significance of the study

Research work on the integration of stock market indices are crucial to a number of economic role players, mainly policy makers. From a policy standpoint, understanding financial integration is critical since equity markets have an influence on economic growth. Empirical studies substantiate the idea of wealthy countries having deep-networked financial markets (Torre and Schmkler, 2007). Interconnected capital markets are more efficient in the allocation of economic resources when compared to those that are segmented (Alagidede, 2009). Corporates can attract a wide spectrum of investors whose participation on stock markets ultimately decides companies that will live and those that go under. Diverse instruments traded on financial markets al`low the risk inherent in these assets to be borne by those most willing to take that risk in which case assets would trade at the best possible price.

Asset pricing literature predicts integrated financial systems to be more elastic to global factors compared to segmented markets in which case integration increases markets exposures to global crisis (Alagidede, 2008). More often, liberalised financial systems tend to fall victim to sudden downswings unrelated to the country`s sovereign risk when compared to segmented market systems protected through restrictive capital controls or limited international financing of domestic activities (Collins and Biekpe, 2003). Regulators ought to appreciate therefore the mechanics of channels through which volatility is transmitted from one market to another in an integrated system if domestic financial stability is to be guaranteed. Moreover, since financial markets are an essential channel in monetary policy transmission mechanism to the real economy (Tobin, 1969), the effectiveness of this policy tool largely depends on the nature of relationships between domestic and foreign markets (Kambaza and Chinzara 2014), hence the importance of research such as this that shades light on the subject.

### 1.4 Organization of the study

The remainder of this research project is structured sequentially as: Chapter two is a survey of theoretical and existing empirical literature on equity market integration. The third chapter is a detailed explanation of the econometric techniques applied in providing answers to the objectives spelt out in section 1.2. Included therein as well is the description of the data sets forming the core of this study. Results of the study are reported in chapter four whilst chapter five makes recommendations and concludes the study.

# CHAPTER 2: EQUITY MARKET INTEGRATION

## 2.1 Introduction

This chapter provides insights into a number of subjects as they related to the integration of equity markets. The chapter is subdivided into seven major sections. The first section is a technical description of the notion of equity market integration while the second section is a conceptual description of determinants of equity market integration. Barriers to capital markets fusion are examined in the third section. Benefits and costs of capital market integration are covered in the fourth and fifth sections respectively whilst an overview of equity markets with COMESA region is provided under the sixth section. Section seven reviews the empirical literature. The conclusion reviews all the concepts covered.

## 2.2 Equity market integration

An equity exchange is a virtual or physical place where buyers and sellers transact under a governing framework overseen by a regulatory body such as the Securities Exchange Commission in Zimbabwe and the Financial Services Board in the United States (Goodspeed 2013). Integration of equity markets is viewed from diverse angles. A direct approach to defining financial market fusion is founded on the notion that unhindered inter-country financial flows would, through searching for the optimal achievable return leads to the equalised rates of returns between countries (Bauera, Makiyema and Verschelde 2014).

In effect, when equity markets are integrated, assets with identical cash flows or risk characteristics must be priced identically irrespective of which markets they are from. The law of one price must, therefore, hold when financial markets are integrated (Jappelli and Pagano, 2008). Chen and Knez (1995) posit that two equity markets cannot be perfectly integrated if one can construct two portfolios from each market that have indistinguishable pay-offs but different prices. This would be a violation of the law of one price. Although this approach allows for a quantitative measure of the integration process, Kearny *et al.* (2004) argued that the challenge in operationalizing it is that of finding sufficiently homogeneous securities to allow for comprehensive comparison between markets. However, the advent and ever increasing constituent of depository receipts in investor portfolios permits application with reasonable degree of accuracy of this technique. Accquiring a DR instateneous converts an investor`s portfolio into an internationally diversed asset while circumventing the bottlenecks associated with investing in foregn markets directly. Depository receipts are negotiable instruments traded on local exchanges while foreign publicly traded stocks acts as the underlying asset (African stock markets hand book 2009). The continual buying and selling of the under lying in the foreign market and the ARD in the local market as prices evolves over time ensures parity between the two. COMESA exchanges, particularly those of Egypt and have tapped into this new development in financial engineering. More so, a growing trend within COMESA has been that of dual listing of assets across markets. Year 2006 for instance witnessed the signing of a memorandum of understanding (MoU) on cross listing between Kenya and Uganda (Joshua et al 2012). MoU of this nature are key to minimisising heterogeneity of assets trading on COMESA markets especially when this is associated with open register concept where stocks can move without restrictions from one country register to another. This will lead to common pricing of stocks in different exchanges with the forces of demand and supply determining prices in bothe exchanges. this implies therefore that detailed analysis using this technique can now be applied even in COMESA context.

Alternatively, equity market integration can also be explained in the context of which acquisition and ownership of domestic financial assets by foreign investors is regulated locally. Adopting this approach, Baele, Ferrando, Hordahrl, Krylova and Monnet (2004) described markets as integrated if investors in the respective markets encounter a homogeneous set of rules, have equal access to financial instruments and get equal treatment when they become active in foreign markets. In this view, markets are considered segmented when there exists systematic discrimination of foreign investors through burdening legal restrictions (Baele *et al* 2004). On the other hand, international capital market completeness[2] provides insight into integration structure of capital markets (Donno, 2004). Efficient markets under which the volume and availability of instruments eliminate constraints on investments with securities market values being determined by investment decision are considered complete (Marzia, 2005). This approach emphasises that perfect equity markets integration exist when there prevails a complete set of international markets that permits investors to insure against the full set of expected states of nature (Kearny, *et al* 2004).

Accordingly, an establishment of a regional bloc with specific rules, regulations and conditions for membership, such as COMESA, can result in completeness due to the increased number of investable assets, albeit across borders. However, COMESA, like most African capital markets are still far from achieving a state of completeness. Several factors have been cited as contributing to the narrow range of product offering of African capital markets. Honohan and Beck (2007) observed that institutional investors such as private pension funds as well as insurance companies haven`t build large enough capital stock to warrant introduction and effective demand for some financial products. A related factor contributing to narrow financial product offering is the low level of economic activity in most COMESA markets that makes it un-economic to pioneer new product development on these markets (AFD 2010).

International integration of equity markets can also be defined from the perspective of the correlation structure between stock market indices of respective countries over time. Low correlation levels between markets would point towards market segmentation while the high correlation between the same would point towards market integration (Bracker, Docking and Koch 2009). This is founded on the notion that synchronous markets are expected to fluctuate together over time. However, this approach is plausible on condition that the co-movement in markets can be rationalised on sound economic thinking and analysis (Chen *at al,* 1995). Parallel to this approach to defining international stock market integration has evolved out of time series econometric literature. A cointegration assessment, for instance, comes with an intuitive appeal in explaining capital market integration. A necessary condition for a series of international stock market indices to be considered integrated is the presence of cointegrating vectors (Bernard 1991).

## 2.3 Determinants of equity market integration

### 2.3.1 Economic Integration

Taking a macroeconomic perspective, the degree of interdependence between two or more economies is a determinant of stock market integration. Stocks markets between two countries with strong bilateral trade relationship are generally expected to be interrelated (Pretorius, 2002). Assuming that a major constituent of country A`s exports has unrestricted entry into country B, a downward swing in country B will trigger a downward pressure on country A`s capital market as a result of declining export performance. Consequantially, country B`s capital market owing to domestic economic pressure would take a downward trend as well. Country A and country B`s stock markets will, therefore, exhibit strong comovements, the strength of which is relative to the degree of trade ties between them. However, the trade ties do not necessary have to be between the two countries. It may happen that the two countries have strong ties with a third country in which case both country`s stock

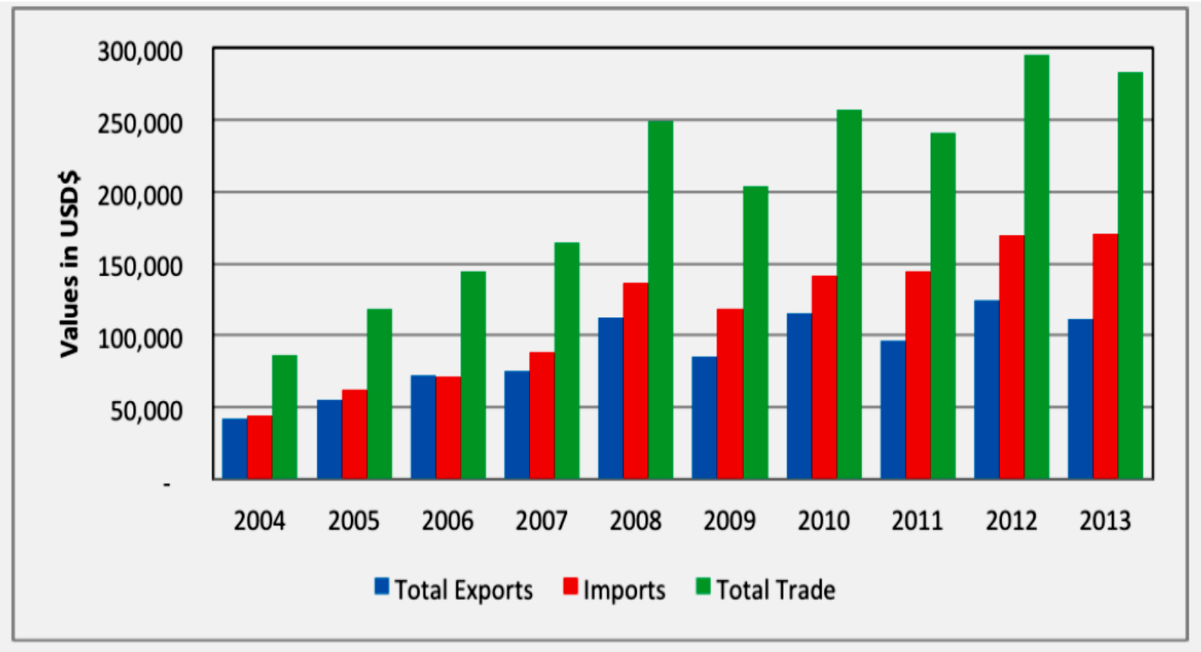
---

[2]An efficient market in which the volume and availability of financial securities eliminates constraints on

market would simultaneously respond to slow down from this common trading partner (Kambaza *et al* 2014).

Figure 2 below is a diagrammatic representation of trends in COMESA total global trade over the period 2004 to 2014. Even though COMESA trade with the rest of the world droped by 4% to US283 billion over a one year period ending 2014, the general trajectory has been upward between 2004 to 2014, a positive ingredient from the perspective of equity market integration. Over the period 2012 to 2014, total ecports contacted from US125 billion to US113 billion while imports remained steay at US170 billion. Causal agent to this recline being internal political conflict in Lybia which had a dampening effect of exports of crude oil to the European Union (EU) market (Annual report 2014).

**Figure: COMESA GLOBAL TRADE**




**Source: COMSTAT 2014**

### 2.3.2 Foreign capital flows

A conducive investment climate in destination countries is a precondition for free international capital mobility, a key ingredient to global capital market integration (Fratzscher, 2012). The stimulus to globalised financial markets in the 1980s and 1990s came from developed country governments through a policy shift towards deregulated foreign exchange and capital markets (Eun, 2004). For instance, aiming at attracting foreign capital,

investments outcomes and where pure investments decision determines market values (Donno, 2004).

the Tokyo Stock Exchange allowed participation of a limited number of international brokerage firms. Likewise, in 1986 the London Stock Exchange (LSE) allowed foreign firms as members to its bourse. Additionally, in the 1990s, emerging and developing economies structurally shifted their economies towards liberalisation as a means to attracting FDIs and FPIs (Chinzara *et al* 2014). Apart from enhanced financial market liquidity, depth and efficiency, capital account liberalisation increased the interconnectedness of domestic and foreign markets through the action of investors in search the best possible return on their funds (Aziakpono 2013).

As a result of financial liberalisation, in recent years, foreign direct investment has continued to flow in sizable volumes to Africa. Net FDI flows increased by 9% to US57 billion as of 2013 a reflection of the continued quest for higher returns by investors in developed countries where interest rates are relatively low. However, as a region, COMESA, over the two year period ending 2014 suffered a 16% decline in net FDI inflows, a development that goes against the grain of capital market integration. This decline is attributable to low inflows in conflict affected member states namely Egypt, Democratic Republic of Congo (DRC), Lybia and Uganda (COMESA report 2014). Figure 3, below is a dipction of total FDI flows following a thrust to adoption of pro-liberalisation policies in COMESA. The lion`s share of FDI flows went to Egypt (32%), then Sudan with (13%), DRC 12%, Zambia 10% and then Uganda with 7 %. Similary, between 2007 and 2013 intra-COMESA FDI inflows into Egypt where US38 million while Madagascar and Mauritius shared 94 million. Over the same period, Uganda attracted  US47 million with Zambia receiving US22 million (COMESA Annual report 2014).FDI as a source of capital influences capital market integration in principally two ways especially in regions like COMESA where countries share common investor groups. If for instance there is a pull back investors off these markets due to heightened risk pespectives, it implies therefore that markets within  COMESA will simultaneously deteriorate . Secondly, the action of investors swithching across markets seeking the best possible returns acts as a catalyst to stock market inter-connectedness.

### 2.3.3 Stock market characteristics

There are several stock market characteristics discussed as having capacity to determine the degree of financial market integration, the first of which is the size of the market. The size of a country`s stock exchange is an unbiased mirror image of its stage of development and may provide insights into expected transaction cost, liquidity and information costs (Pretorius 2002). A developed financial market is effective in attracting investors seeking to diversify their portfolios and hence acts as a stimulant to the process of international equity market integration (Farid 2013). Such factors as transaction costs, information costs and market size are key influences to cross-border capital flows (Portes and Ray 1999). Another market characteristic with a bearing of stock market integration is the nature of investor groups. Table 1 below is a summary of composition of local investors against foregn investors for COMESA markets under study. The statistics corroborates the notion within COMESA to develop and integrate equity exchange as means to facilitate foreign portfolio investemets (Hearn, Peisse and Strange, 2010). Nairobi Stock Exchange (NSE), the largest bourse in East Africa, over the four year period had the largest constituent of foreign participants in the sample. Percentage of total value traded by foreign nationals ranged between 20% and 50% for Egypt, Zambia, Zimbabwe and Mauritius. More-so when two markets share closer geographical proximity and share common investor groups whom more often than demand similar accounting and corporate governance standards, such markets are more likely to move towards convergence (Farid 2013).

**Table 2.1: FOREIGNERS VS LOCAL INVESTORS**

| COUNTRY | TYPE OF INVESTOR | % OF TOTAL VALUE TRADED | | | |
|---|---|---|---|---|---|
| | | 2010 | 2011 | 2012 | 2013 |
| EGYPT | FOREIGN INVESTOR | 22 | 29 | 27 | 20 |
| | LOCAL INVESTOR | 78 | 71 | 73 | 80 |
| | TOTAL% | 100 | 100 | 100 | 100 |
| | | | | | |
| ZAMBIA | FOREIGN INVESTOR | 18 | 19 | 21 | 36 |
| | LOCAL INVESTOR | 82 | 81 | 79 | 64 |
| | TOTAL% | 100 | 100 | 100 | 100 |
| | | | | | |
| NAIROBI | FOREIGN INVESTOR | 51 | 52 | 49 | 47 |
| | LOCAL INVESTOR | 49 | 48 | 51 | 53 |
| | TOTAL% | 100 | 100 | 100 | 100 |
| | | | | | |
| ZIMBABWE | FOREIGN INVESTOR | 23 | 36 | 41 | 50 |
| | LOCAL INVESTOR | 77 | 64 | 59 | 50 |
| | TOTAL% | 100 | 100 | 100 | 100 |
| | | | | | |
| MAURITIUS | FOREIGN INVESTOR | 22 | 39 | 27 | 30 |
| | LOCAL INVESTOR | 78 | 61 | 73 | 70 |
| | TOTAL% | 100 | 100 | 100 | 100 |
| | | | | | |

**SOURCE:** CREATED by author using data from ASEA year book 2014

### 2.3.4 Technology

The advancement in communication technology has played no small role in creating integrated global equity markets. Before the invention of high-speed communication methods such as the internet, investors, at times, would be inadequately informed of available investment opportunities elsewhere due to lengthy time lags in information transmission between markets. Advancements in internet-based technology for instance has given investors around the world immediate access to the most recent information vital for price discovery purposes (Mlambo and Biekpe 2003). Establishing if a security has deviated from its intrinsic value is much faster in this digital age than it was before. International stock markets are becoming increasing interlinked as communication bottlenecks continue to dissipate due to increasing accessibility to market participants to high-speed technologies. Apart from the reduction in information cost, technology has contributed to equity market integration by facilitating computerised order processing and settlement thus reducing the cost of international transacting (Eun *et al* 2009). COMESA exchanges have made significant strides towards implementing morden technology in their operation. Egypt, Zambia, Malawi, Mauritus, Zimbabwe and Uganda are running automated trading platforms and there is strong momendum to improves theses technologies to meet global standards.

#### 2.3.5 Cross Listing of Companies

The process of equity market integration has benefited immensely from the actions of private corporations, especially multinational companies with operations spread in different geographical locations. It is expected that such companies, given the scale of their operations, can be listed on more than one securities exchange. A company through a process termed cross-listing can seek primary listing on one exchange and secondary listing on many other exchanges (Linde and Luiz, 2009). A key theoretical dimension motivating cross-listing of securities is lowering cost of capital. Cost of mobilising capital in segmented markets is generally high when compared to integrated markets. Integrated capital markets permit financial resources to flow in from resource-abundant countries where returns are generally low to resource-scarce countries hence reducing the cost of capital in the destination country as more funds becomes available (Henry, 2003). The opposite equally holds for segmented markets. More so, companies cross-list as a means to improving the liquidity of their securities as the shares will be trading on many exchanges thus attracting a large pool of potential investors. Cross listing of stocks provides a platform for international cooperation and harmonisation of trading standards between exchanges involved thus integrating markets in the process.

## 2.4 Barriers to equity market integration in Africa

#### 2.4.1 Political Factors

Nationalistic politics are a key impediment to equity market integration in Africa. Harmonisation of equity market governing standards often face stiff resistance, at country level, from public authorities who may not fully understand what a stock market is and the benefits it transmits to the economy (Okeahalam, 2001). Exercising their sovereign right to economic planning, central governments may oppose the notion of policy coordination arguing that it is synonymous to relinquishing an emblem of national sovereignty that an equity market represents (Irving 2005). As such, shedding off regulatory influence of domestic markets will not be a plausible economic decision especially if the stock exchange is state owned, as is the case with many African countries. Political turbulence in some COMESA countries namely Egypt (the Arab uprising), Zimbabwe (land question and impact on property rights) derails the efforts to integrate capital markets in the region through amplifying policy misalignments as well as impeding free flow of capital and goods.

### 2.4.2 Social Factors

Social factors, such as historical background, language, and culture can act against equity market integration within COMESA. Historically, Uganda stock exchange for instance is under-developed when compared to Kenya's stock market; so is Zimbabwean stock market when compared to Egyptian Stock market. Apart from the more developed markets dragging their feet in fostering speedy regional cooperation between markets, the financial means required, for instance, to technologically link markets may be beyond the means of the less developed markets (Irving, 2005). Language barriers between countries can have asymmetric impact on execution of trade transactions between investors and brokers especially when cross-country trades are involved. As an example, Tanzania has Swahili as its key commercial language and this can affect integration efforts (through high translation costs) with other markets where the language of business is Arabic or French (Onyuma, 2006). More so, the investment risk outlook is affected to a greater extent by the investor`s cultural orientation. For instance, because Zambian investors have better understanding of corporate culture in Zambia, they will be more comfortable with investing in stock issued by Zambian firms than those by firms from other countries thus affecting stock market integration in the process.

### 2.4.3 Economic Factors

As opposed to having one effective regional integration body in southern, eastern or western Africa, there is overlapping membership by exchanges in different regions of the continent. A case in point being countries such as Zimbabwe with membership to both SADC and COMESA, a scenario that often brood inconsistency and conflict on the policy front thus derailing integration initiatives (Okeahalam, 2001). In addition, investors transact in diverse currencies within COMESA, a feature that exposes investors to foreign currency risk given the high volatility that comes with currencies in less developed countries. Onyuma (2006) asserts that equity market integration in the European Union (EU) benefited a lot from the use of common currency in the Eurozone that eliminated currency risk. The lack of an effective capital markets dispute resolution body within COMESA coupled with the absence of executive institutions to enforce integration agreements, are other factors acting against financial market integration (Onyuma, 2006).

## 2.5 Benefits of equity market integration.

### 2.5.1 Risk Transfer

Virtually all financial assets have a risk constituent inherent in them. Capital market integration offers expanded possibility for international risk transfer as investors with the greatest skills to manage risk and high appetite for it shoulders the risks inherent in financial instruments (Jordan *et al*., 2009). This, an integral component of equity market integration, ensures effective and fair pricing of securities on exchanges. Firms mobilising resources for investment purposes thus benefits substantially from international risk sharing. The increase in the set of financial instruments coupled with cross-ownership of assets that follows equity market integration logically offers additional avenues for portfolio diversification and sharing of risk that is specific to an asset or a minute class of assets (Baele *at al*., 2004). Kalemli-Ozcan, Sorensen and Yosha (2001) assert that integrated capital markets through the risk sharing function, enhances specialisation in production thereby enriching the welfare of economic agents.

### 2.5.2 Capital Allocation

Wider equity market integration is a conduit for efficient capital allocation decisions (Bodie, Kane, and Marcus (2013). Economic units can choose the most efficient trading and settlement platforms if barriers to financial transactions are eliminated in foreign markets. More so, surplus units are at liberty and are permitted to invest funds in markets and projects deemed to have the maximum productive return (Baele *at al*., 2004). Consequently, through integration, productive opportunities with fair risk-return characteristics become available to investors. In Asia, for instance, deep capital market integration facilitated allocation of savings from economies characterised by ageing population towards those nations with strong infrastructure capitalisation needs (Ding, Lam, and Peiris 2014).

### 2.5.3 Investment and growth

In a number of African states, the capability to domestically mobilise savings is inhibited by marginal levels of income. Financial integration creates a large pool of international investable resources that countries can harness and dedicate towards economic development (Aizernman, Jinjarak and Park, 2013). Bekaert, Harvey and Lundblad (2001) documents evidence that over a five-year period, equity market liberalisation, on average resulted in 1 percent increase in economic growth for the sample countries they investigated. This is particularly so in view of the many channels through which asset prices affect the economy. Stock prices can, for instance, affect investment and growth through the credit channel. Rising asset prices following liberalisation induced capital flows improve firms balance sheets thus inducing banks to charge lower default risk premiums on loans as companies become more creditworthy (World Economic Outlook, 2000). Affordable access to capital is expected to transmit positively to investment and economic growth. Over and above the price channel effect, enhanced portfolio capital flows in an integrated system propel the development of domestic equity market in terms of both quality and quantity (Levine 2000). For instance, in terms of quantity, the volumes of stocks traded on the Korean Stock Exchange increased 12.2% to 265 billion between 1997 and 2005 following relaxation of capital market restrictions. (Ahn, 2008). From a quality perspective, the constituent of state-owned participants significantly decreased from 19.7% to 3.7% whereas that of institutional bodies and foreign players increased from 18% to 37.2% over the same period (Ahn, 2008).

### 2.5.4 Macroeconomic discipline

Capital market integration is argued to be an effective mechanism through which macroeconomic discipline is enhanced domestically (Allen, Carletti, Marquez, 2011). Free flow of capital between countries in an integrated system has a tendency to offer a reward for good policies and punishment for bad policies. Unsound policy directions, such as excessive public sector borrowing or ineffective financial sector regulation, depress investor confidence and induce speculative capital outflows to the detriment of the domestic equity market and the economy at large. Government’s dread of these consequences motivates them towards progressive policy directions (Agenor 2003). Also, equity market liberalisation is a signal to foreign investors that a country`s macroeconomic policy is on a positive trajectory as investors naturally demand sound policies prior to committing their funds (Allen *et al*, 2011). At micro-level, firms, stockbrokers and exchanges will be compelled to incorporate good corporate governance practices as a means to attracting business.

### 2.5.5 Financial development

Financial development can be understood as encompassing the twofold processes of innovation and institutional improvements of the financial system. The main channel through which movement towards integration contributes towards the development of domestic equity market is through harmonisation of accounting standards, securities laws and corporate governance (Stavarek, Repkova and Gadasova, 2011). To the extent that harmonisation of policy promotes convergence towards international best practices, integration is believed to have developed the domestic financial system (Ang, 2011).

Secondly, domestic markets can benefit from integration process through the competition channel. Removal of barriers to foreign participation triggers competition on the local bourses that drives transaction cost down and facilitates technological transfers between markets (Stavarek *et al*, 2011). Automation of exchange trading systems contributes positively towards price discovery (processes by which market participants attempt to establish equilibrium prices) on equity markets as information becomes readily available to traders. Brogaard, Hendershott and Riordan (2013) provided evidence to the effect that high-frequency trading plays a valuable role in price efficiency through trading in opposite direction to transitory pricing errors.

### 2.5.6 Market liquidity

Liquidity is defined as the speed and ease with which financial assets are converted into cash at market-set prices without significant loss of economic value (World Economic Outlook 2000). This definition implies that when compared to real estate, stocks and other securities trading in developed capital markets, due to their relatively larger size and depth, are more liquid when compared to those trading in many emerging markets. Liquidity constraint, therefore, emanates from uncertainties associated with converting assets into the medium of exchange (Economic Commission for Africa, 2008). Factors such as exorbitant transaction costs, restrictive policies to transacting and information asymmetries have a negative bearing on capital market liquidity. Integration of capital market through policy harmonisation and creating a large pool of potential investors facilitates the ease with which assets can trade on financial markets. Liquidity in the financial markets minimises uncertainties about the timing and settlement of trades in financial instruments (Levine 1999).

## 2.6 Costs of equity market integration.

### 2.6.1 Volatility of Capital Flows

Financial integration can create conducive conditions to a higher likelihood of instability in funds flows, generally evidenced by large unanticipated short and medium term capital reversals stemming from speculative pressures on the local currency (Stavarek, Repkova and Gadasova 2011). A borrower for instance, due to large reversals of foreign portfolio flows runs the risk of encountering liquidity runs. This is generally high the larger the constituent of short-term capital inflows relative to a nation`s stock of international reserves. Systemic financial crises associated with capital reversals are related to both real and supposed movements in local economic fundamentals along with external environmental conditions such as changes in global interest rates (Stavarek *et al*., 2011). Whether justified or not, herding often transforms into large movement into or out of certain asset classes thereby exacerbating asset price and capital volatility (Reinhart, Kaminsky and Vegh, 2003).

### 2.6.2 Loss of macroeconomic stability

Financial integration influences multiple facets of economic performance more specifically investments rates, trade openness, the growth rate of gross domestic product and consumption patterns (Moungani, 2012). Viewed in this context, financial integration can be a source of macroeconomic instability. The volatility of national consumption growth pattern relative to income for most financially networked economies (MFIEs) has on average increased since the 1990s (Kose *et al* 2003). Precisely, this is the decade when capital market integration as measured through financial inflows and outflows into these economies was at its peak (Kose et al 2003). This instability in consumption was pronounced in the case of portfolio investment when compared to direct investments because of the long-term relationship established by the latter (Moungani 2012). Agenor (2003) further documents the negative macroeconomic consequences of capital market integration ranging from rapid monetary expansion and the associated inflationary pressure, real exchange rate appreciation and the loss of export competitiveness.

### 2.6.3 Concentration of capital flows

Determining factor of inward investment flows into emerging and developing economies are many. Capital flows are elastic to country-specific influences reflecting domestic opportunities and risks (Taylor and Sarno 1997). For instance, equity-oriented capital movements (FDI and FPI) can increase in the event of creditworthiness being restored some

COMESA markets such as Zimbabwe. Likewise, FDI and FPI may be attracted by the prospect to use domestic raw materials especially in resource abundant African countries (Taylor et al 1997).

However, these factors are heterogeneous across countries. As noted by Jefferis (2005), in an integrated regional financial system, it is rare for all countries involved to accrue equal benefits. Some countries may lose out as capital flows are concentrated in a few countries with the most attractive investible funds pull factors. Agenor (2010) provides sufficient historical confirmation that phases of surges in cross-border funds flows tend to be highly concentrated in a limited number of beneficiary countries. In the 1990s, the dramatic increase in foreign capital inflows was directed towards the large and medium sized Asian and Latin America economies with the level of flows into low-income countries falling over the same period. Little capital flows are directed towards the Sub-Saharan Africa.

## 2.7. Empirical literature review

Empirical studies on the subject of international equity market integration gained momentum since the 1987 global equity market crash and the crisis that plagued Asia in 1992 (Chinzara 2009). The central theme in the literature on discussions on the subjected of capital market integration has its roots on long-run linkages between international equity markets and its implications for potential diversification benefits a central tenant in portfolio theory. Researchers have extensively examined linkages between markets in North America, Europe and Asia but markets in Africa have received minimal attention (Lamba and Otchere 2001). Overall, conclusions reached in literature seem to suggest that differences in sample time periods, sample markets, and methodology applied have a strong influence on conclusions drawn from market integration studies with researchers reporting diverging results for the same markets in some cases. This section examines the various studies that have been carried out on sundry markets with the aim of further understanding the concept of equity market integration.

### 2.7.1 Integration between developing markets

The shift from a bank-based system to one that is dependent on capital markets as sources of long-term investment financing has resulted in the establishment and restructuring of a number of African stock exchanges (Piesse and Hearn 2005). Measuring integration through transmission of return volatility across markets, Piesse and Hearn (2005b), provided evidence in favour of integration between markets within Sub-Saharan Africa. Applying GARCH family of models on a sample size of 10 African countries over a period spanning 1997 and 2000, unidirectional and bidirectional volatility transmissions were established. Highly capitalised markets of Nigeria and South Africa transmitted their volatility to the less developed markets.

Return and volatility linkages beween Indian equity market and that of twelve other Asian developing markets for the period from November 1997 to 2008 was investigated by Mukhjere and Mishra (2010). To explore the possibility of capital market integration, GARCH (1,1) model was applied on daily opening and closing prices data for the indices under study. The four markets of Hong Kong, Korea, Thailand and Singapore were concluded to exhibit strong degrees of correlation with the Indian market. On the other hand, Pakistan and Sri Lankan equity market where concluded to be weakly integrated with that of India.

Using monthly returns on a sample stretching from 1997 to 2009 a period under which most African countries allowed foreign investor participation of local bourse, Odongo and Ojah (2012) investigated concurrently the occurance of unconditional currency risk pricing and market segementation in Africa`s major stock markets. Using a multi-factor model compounded with exchange rate risk, the reseachers found strong evidence suggesting that African stock markets are largely segmented. This finding diverges from Lamba and Otchere's (2001) conclusion that SA financial markets are increasing integrating with the world markets. As stated earlier, time period and method of study have a great bearing on results on integration studies. Additionally, foreign exchange risk was found to be un conditionally priced in African stock markets sampled. In which case international investors can divesfy into these markets without worrying about unconditional risk stemming from foreign currency fluctuations.

### 2.7.3 Integration between developed and developing markets

Partly due to low number indigenous listed companies and few counters dominating trading activity, African capital markets received minimal attention until the early 2000s through the pioneering work by Lamba and Otchere (2001). Using multivariate cointegration and vector error correction, the authors investigated the dynamic relationship between South Africa and major developed markets over the period May 1988 to May 2000. US, Canada and Australia were concluded to have the most influence on South African financial markets whereas Japan`s impact was minimal over the post-apartheid error. A long-run relationship did not exist between South Africa and these advanced markets during the apartheid error. Generally, their findings confirmed South Africa as more economically and financially integrated with the world markets and the dismantling of apartheid was a key ingredient in this process.

Collins and Biekpe, (2003), tested the extent of market integration in African by analysing the extent of contagion between African equity markets and d`eveloped capital markets through applying adjusted Pearson`s correlation coefficient as in Forbes and Rigobon (2002). Granger Causality test was also used to assess the direction of causality between markets in the six-country sample research. Only in the highly capitalised markets of South Africa and Egypt did the study provided evidence of contagion implying therefore that African markets are largely segmented over the long horizon.

Aziakpono and Chinzara (2009), investigated benefits from international diversification accruing to long horizon South African investors using seven world stock market daily data between 1995 to 2008. Pairwise equity portfolios were tested for long run co-movement using cointegration techniques and the Johansen and Juselius (1992) multivariate cointegration approach was applied for wider portfolios in the sample. The pairwise analysis suggested that diversification is worthwhile in China, Australia, and Japan with limited benefits likely to be realised from UK, Germany and the US.

Zhang (2010), tested the hypothesis that capital markets co-movement is subject to geographical and cultural distance between countries. The study emphasised the role of geographical distance as proxy for information asymmetry andf unfamiliarity between countries. A large daily data set constituting 782 pairs draw from 22 emerging markets and 22 developed markets spanning the years between 1995 and 2007 feed into the research. Using fitted conditional correlation technique found in GARCH, the reseachers concluded that stock markets from countries that share common religion as well as common historical identity tend to significantly co-move as convegency of investor behavior leads to convegency of markets. However, cultural effects on equity market co-movement is strong for countries that have strong bi-lateral trade in goods and services.

Ampomah (2011), investigated linkages between African capital markets and the linkages between these markets and global equith market indices. With a sample of ten African countries, monthly returns of S&P indices were analyses covering the period from 1998 to 2000. Volatility of index return was decomposed into three after which the effect of regional and global factors to index volatility were estimated. The paper concluded that African markets are very much segmented from global markets despite most of these countries embarking on structural adjustment programs. As in Biekepe (2003), an eception only applies to South Africa which was concluded to be integrated into the global financial system.

Graham, Kiviaho, and Nikkinen (2012) analysed stock market co-movement between twenty-two emerging stock market indices and the US. Using the three-dimensional wavelet coherencies, a higher degree of co-movement was established between emerging markets and the developed US market though the strength thereof is country depended on. For instance, when compared to African Markets of Morocco and Egypt, emerging markets of Brazil, Mexico and Korea showed strong linkages with the US signifying therefore that investing selectively in emerging markets is a prudent investment strategy. Integration of emerging markets in South America and the rest of the world were examined by Arouri, Bellalah, and Khoung (2010). Blending GARCH and structural break analysis as in Bai and Perron (2003), the study concluded that cross-market co-movement has changed over time and has increased substantially since 1994. The structure of the linkages notably changed after 2006.

Majdoub and Mansour (2014), using an assortment of techniques namely multivariate GARCH BEKK, CCC and DCC assessed equity market integration between the United States and five emerging Islamic states of Malaysia, Turkey, Indonesia, Parkistan And Qatar.Emperical results from the models pointed out that US equity market index are weakly correlated correlated over time. More so no evidence was established in favour of volatility spill overs from US market into the Islamic markets. These finding apart from corroborating the finding by Zhang (2010) that cultural and religious differences plays an essential role in integrating markes also gives insight into perculiarities of Islamic finance. For instance Islamic finance does not accommodate interest bearing investments as well as insistence on asset backing that has effect of volatility transmission. Caution should thus be excersed when divesfying into these markets.

### 2.7.4 Integration between countries in economic blocs

Asserting that much of the empirical tests on the theories of financial market integration primarily concentrated on OECD markets and Asian Emerging economies, Piesse *et al*, (2002), linkages between the three dominant equity markets (South Africa, Botswana, and Namibia) within the Southern African Customs Union (SACU). The key supposition in this branch of literature is that economic cooperation plays a major role in explaining stock market co-movements. Cointegration along with Granger causality and Error Correction tests were used to provide more insight into market dynamics under SACU. Using stock indices data spread from January 1990 to January 2000, an unexpected finding from this study was that of Namibia Granger Causing price developments in South Africa. This, according to the authors, was explained in terms of South Africa being influenced by a common emerging market factor that would affect Namibia more intensively. Largely, the findings of this study lent evidence in support of the positive impact that macroeconomic and developmental linkages have on financial integration in a trading block arrangement.

Positing that, if capital markets are integrated, convergence on financial assets must be observed, Nelsen, Uanguta and Ikhide (2005) investigated the level of integration between countries that are members of the Common Monetary Area (Lesotho, Namibia and Swaziland). Applying uncovered interest rate approach to sample data between January 1994 and December 2004, the author concluded that Lesotho, Namibia, and Swaziland have well integrated financial markets in which case portfolio diversification across these markets will not be beneficial. In a related study, Aziakpono (2006) tested the law of one price on financial markets within SACU. With the application of cointegration and error correction methods as well as impulse response examination, the research identified a hierarchical integration structure that starts with South Africa, then Namibia, followed by Lesotho and lastly Botswana.

Using daily market indices data from January 1, 1999, to December 31, 2005, Yu and Hassan (2010) investigated integration of equity markets within the Middle East and North Africa (MENA). Applying cointegration analysis, they concluded that long run relationship is strengthening between the Egypt, Jordan, Morocco, Turkey (non-GCC countries) and the US. Furthermore, the study provided evidence in support of long run equilibrium between GCC and non-GCC countries. As would be expected, the US market was observed to Granger cause most of the non-GCC countries. Using daily stock market indices data from January 2000 to December 2007 and applying GARCH family of models, Boujir and Lahech (2007), using, investigated equity market linkage between Morocco and US equity market after the two countries signed a free trade arrangement.

Empirically, the study showed that contrary to what would be expected despite an increase in cross-country trade, the two markets hard no significant linkages. A similar study was carried out by Maghyereh and Al-zoubi (2005) who sought out to evaluate the influence of FTA between Jordan and the US on stock markets of the respective countries. Using Dynamic

Conditional Correlation (DCC) as developed by Engle (2002) on weekly data spanning January 1987 to May 2004, the study concluded free trade agreement significantly contributed towards increased capital market co-movement between Jordan and the US.

To pin-point factors that may expeiate capital markets integration within MENA region, Guesimi, Moisseron and Teuron (2014), applied a conditional International Capital Assert Pricing Model (ICAPM) in the presence of exchange rate risk on data from seven major MENA markets. Through allowing the price of risk to vary with time, factors such as inflation rate, interest rates, dividend yields and exchangerate volatility where found to be key determinats of capital market integration. Degree of integration however was found to be sensitive to country specific factors, as country in the same Bloc may exibit very different level of integration. A case in point being that of Syria which due to current political instability is list integrated. To the contrary, Egypt, Turkey and Tunisia experienced significant increase integration wise.

Agyapong (2014) used cointegration to investigate stock market integration in West African Monetary Union. Focusing only on the most active markets of this trading area namely Nigeria and Ghana, the study showed that the two equity markets are not integrated. This, a rather surprising result given that Ghana and Nigeria have significant economic ties suggesting therefore that economic ties alone may not explain equity market linkages between countries. Instead, the level of development of the equity markets in question is an important determinant of capital market integration. Earlier studies concluded some markets in the West African Community, specifically Ghana not to be integrated with other international markets. Alhassan (2006) investigated using cointegration and error correction the linkage between Ghana equity market and the world major markets of Canada, France, Germany, Hong Kong, UK and the USA. No evidence of linkages was found between Ghanaian equity market and these markets.

Kambaza and Chinzara (2014), set out to investigate whether equity market comovements on the African continent are concentrated along regional blocks. Drawing a sample of eight countries from the continent`s major trading blocs; notably SADC, COMESA, ECOWAS, MENA, EAC, and ECOWAS, the study used Johansen cointegration approach to investigate co-movements in equity markets. Daily data for the period 01 January 2000 to 28 July 2010 were used in the research. The empirical tests showed that long-run equilibrium between markets is limited to few countries characterised by liquid exchange, strong trading ties and similar industrial structure. Equity market co-movement along regional bloc lines could not be confirmed. However, this finding contradicts the same researcher's earlier conclusions that financial market integration in Africa exists along regional blocs (Kambaza and Chinzara 2012).

## 2.8 Chapter summary

A review of relevant theoretical concepts of equity market integration was provided in this chapter. Firstly, the description was given of the diverse views through which international equity market integration can be defined. Building on the definition, determinants and barriers to the fusion of equity markets were discussed. Economic ties, foreign capital flows, cross-listing of companies, stock market characteristics were explained as some of the theoretical drivers explaining internationalisation of stock markets. On the other hand, in an African context, socio-politic factors were forwarded as hindrances to market integration efforts. Benefits and costs of capital markets becoming increasing homogeneous formed part of the theoretical discussion in this chapter with international risk sharing, efficient capital allocation among others being identified as key benefits derived from integration. Policy concerns on the integration of markets are identified to be emanating from factors such as the loss of macroeconomic stability, volatility of international capital flows, as well as the concentration of capital, flows to a few countries in an integrated system.

Review of empirical literature was carried out through sub-dividing the chronology of analysis into the integration of markets in developing world, developed world, developed markets versus developing markets as well as analysis of the integration of markets constituting a trading bloc. To a larger extent, developed markets were found to be integrated, with word`s largest financial centres such as USA and UK steering the internationalisation process. Studies that solely focused on developing equity markets on the African continent largely concluded these markets to be segmented. When integration process is assessed between developed and developing countries, only the economically and financially advanced emerging markets were found to be integrated with developed markets. Studies on the impact of economic blocs on the integration of markets provided mixed evidence with regard to the influence of macroeconomic synchronisation on equity market fusion. Studies that sampled only the dominant markets from trading blocs across Africa largely concluded markets to be segmented while those that sampled countries from the same region reported fusion of markets to be on the rise. However many of the studies are for the MENA region with studies soley focusing on COMESA lagging behind, a gap this research sets out to fill using more recent data sets. The next chapter details the econometric techniques to be applied.

# 3. DATA AND METHODOLOGY

## 3.1 Introduction

As indicated in the preceding chapter, the subject of stock market cointegration has increasingly become more important and relevant against a backdrop of intensifying globalisation characterised by increased association between once geographically distinct economies. Much of studies in literature examined comovements in terms of returns and volatility among economies in their investigations (Ogum, 2002; Alagidede, 2008; Chinzara and Aziakpono, 2009) whereas a few other studies examined long-run comovements existing among international stock indices (Piesse and Hearn, 2002). Drawing from the latter strand of literature, this study investigates the levels of cointegration among African stock markets, with a focus on daily returns and volatility. The data sets and the methods employed to address the research questions are described herein this chapter.

## 3.2 The hypotheses

The study followed closely the works of Ogum (2002), Alagidede (2008) and Chinzara and Aziakpono (2009) in examining the level of cointegration among some of the COMESA economies. In order to address the objectives laid down in chapter 1, the study tested the following hypotheses:

**1.** **$H_0$:** The level of cointegration has remained the same for the COMESA countries, despite belonging to one economic bloc

**$H_1$:** The markets of the countries in the COMESA economic bloc have increasingly become more cointegrated

**2.** **$H_0$:** Integration among the COMESA countries still remains low and investors can diversify their portfolios among these countries' markets

**$H_1$:** The level of integration among COMESA members has become prohibitively high so much that investors may not realise any diversification benefits

**3.** **$H_0$:** Despite belonging to the same trade bloc, volatility spill-overs from one market to another are not evident

**$H_1$:** There are volatility spillovers and contagion among the COMESA member economies' equity markets.

## 3.3 Test variables

Based on the hypotheses specified above, the study subsequently examined the level of integration among stock market of COMESA members focusing on the first as well as second moment. The first moments analysis involved the examination of the returns on the broad market indices and how they move with each other. This enabled the analysis to determine whether there are any diversification benefits among these economies to such an extent that investors and portfolio managers can improve the risk-adjusted returns on their portfolios. The second moments analysis involved the determination of whether the markets are integrated in terms of volatility spill-overs and contagion. This allowed the analysis to make recommendations in terms of regulations and preventative measures that may need to be put into place. Due to increased level of globalisation and speedy improvement in technology and flow of information, financial market ills are now easily transferred from one economy to another. In this section, a description of which indices were employed and how returns were calculated is provided.

### 3.3.1 The stock market indices

Broad market indices were employed for the six markets examined over a seven-year period from October 2009 to September 2015. These are Egypt's EGX 100, the Kenyan NSEALSI, Mauritius' SEMDEX, Uganda's USEALSI, the Zambian LuSEALSI and Zimbabwe's ZSEInd (African Securities Exchange, 2015). The choice of frequency of data to employ has been subjected to enormous debate in the literature relating to market linkages, with three levels of frequency – daily, weekly and monthly – dominating the discussion (Heilmann, 2010). Due to improvement in technology, intra-day modelling has become possible. While employing such high frequencies may result in enormously large sample sizes, it does not bring about the merit of an enhanced ability to determine the relationships between markets. Rather, it may complicate analyses given the differences in trading times across markets. Conversely, while lower frequencies such as annual and semi-annual facilitate the examination of the long-run relationships among variables, their offsetting disadvantages include lower sample sizes and their failure to recognise short-run adjustment patterns (Heilmann, 2010). Therefore, monthly data were employed due to their benefits that include the ability to reduce the effect of different trading times between markets while at the same time eliminating any intra-day trading patterns such as the lunch effect and yielding enough observations. Table 3.1 provides some information on the indices employed in the study.

**Table 3. 1 Broad market indices**

| Country | Index and Index composition |
|---|---|
| **Egypt** | The EGX 100 Price Index, introduced on 2 August 2009, tracks the performance of the 100 most active companies on the Egyptian stock exchange, including the 30 companies in the EGX 30 Index and the 70 companies in the EGX 70 Index (Bloomberg, 2015). |
| **Kenya** | The Nairobi Securities Exchange All Share Index (NSEASI) is a market cap weighted index consisting of all the securities on the NSE. It has a base value of 100 as of January 2008 (Bloomberg, 2015). |
| **Mauritius** | The Stock Exchange of Mauritius Index (SEMDEX) is a market cap weighted index including all shares traded on the Stock Exchange of Mauritius. The base value is adjusted to reflect new listing and rights issues (Bloomberg, 2015). |
| **Uganda** | The Ugandan Stock Exchange All share index (USEALSI), introduced on the 23rd of October 2003, is a market cap weighted index including all shares traded on the USE with a base value of 100 (African Securities Exchange association, 2015). |
| **Zambia** | The Lusaka Stock Exchange All share index (LuSEALSI) is based on the weighted market capitalisation of all the stocks trading on the LuSE. The index has a base date of 2 January 1997 with a base value of 100 (African Securities Exchange association, 2015). |
| **Zimbabwe** | The Zimbabwe Stock Exchange Industrial index (ZSEInd.) is based on market cap of all companies with the exception of mining companies on the ZSE. The index is adjusted to cater for new issues and restructurings (Zimbabwe Stock Exchange, 2015) |

### 3.3.2 Index returns calculation

Stock returns are largely made up of two components – capital gains and dividend yields. However, there has been a debate about the inclusion of dividends in the determination of the returns. For instance, Sharpe and Cooper (1972) argue that dividends have no effect on beta estimates in asset pricing tests. However, recent studies show that investors have become more reliant on dividends, more so in down markets characterised by acute loss of the capital gains (Mortimer and Page, 2012). Soe and Dash’s (2008) U.S study revealed that dividends now account for 30 percent more of the total returns relative to the prior decade. A much more recent study by the Heartland Funds (2014) revealed that for U.S stocks over a 200-year period from 1802 to 2002, dividends have accounted for 5.8% of the 7.9% yearly return. Dimson *et al.* (2009), in an international study over the period 1900 to 2005 across 17 countries found that the yearly return averaged approximately 5%, and the constituent of dividends was 4.5%. Thus, considering this importance in the calculation of returns, this study included the dividend yield in the determination of the indices’ returns.

In calculating returns, the study employed data on closing prices and dividend yields on each index from the respective exchanges for each month. Following Strugnell, Gilbert, Kruger (2011), an estimation that assumes that dividends are paid equally throughout the year was employed. The dividends are then calculated as the product of dividend yield and the closing price of the index in each month. As specified under Equation 3.1, the total return, $R_t$, is calculated using $P_t$, the monthly closing price in month t, $P_{t-1}$, the closing monthly price in a preceeding month and $D_t$, the dividend yield in month t:

$$R_t = \ln [((P_t + (1/12) * P_t * \frac{D_t}{100})) / P_{t-1}] * 100 \qquad (3.1)$$

Of note, the equation employs the natural logs approach because this formula calculates the continuously compounded returns, which are more desirable than the simple returns in that an postulation of any specific holding period is not required and the appropriate form of compounding to apply during this time period (Brooks, 2008). Furthermore, continuously compounded returns posseses a positive time-additive characteristic so much that a multi-period return is simply a summation of the continuously compounded one period returns (Tsay, 2005).

## 3.4 Stationarity tests

### 3.4.1 Rationale for stationarity tests

When conducting long run time series tests that seek to explore the long-run relationships among variables, it is pertinent to check for stationarity in the variables (Brooks, 2008). This is because while some of the dynamic model standard estimation and testing procedures such as the Johansen do not require that the variables be stationary, other methods such as Engle-Granger and OLS methods will yield non-standard distributions which, in turn, lead to spurious regression results (Hjalmarsson and Österholm, 2007). Mahadeva and Robinson (2004) and Gujarati (2005) define a stationary series as one defined by independent of time mean. Effectively, a such series possesses a constant mean, constant variance and constant auto-covariances for any of its given lag (Brooks, 2008). Spurious regressions entail finding a significant relationship between unrelated series, resulting in grimly erroneous inferences. According to Granger and Newbold (1973), spurious regressions are typified by apparently high degree of fit ($R^2$) but with low values of the Durbin-Watson statistic[3]. In addition to the stationarity concerns, variables being modelled together have to be integrated of the same order (Brooks, 2008). This is true for the dynamic model standard estimation and testing procedures, including the Johansen method. The order of integration refers to the number of differencing that has to be applied on a non-stationary time series before it turns out

[3]A statistic employed to measure the degree of autocorrelation, a relationship between values separated from each other by a given time lag, in the residuals or prediction errors from a regression analysis (Savin and White, 1977)

stationary (Brooks, 2008). For instance, if z times differencing is required on a non-stationary series, $y_t$, until it becomes stationary, it is described as being integrated of order z, specified as:

$$\mathbf{y_t \sim I(z) \;\; or \; \Delta^z y_t \sim I(0)} \qquad \textbf{3.2}$$

Determining the order of integration in a series is important if reliable sample statistics as as means, variances, and correlations with other variables are to be obtained. At times a non-stationary variable ought to be transformed into a stationary variable for this to be realised. Such statistics are only useful in description of future behaviour to the extent that the series is stationary (Brockwell and Davis, 2013). It is thus vital to check the stationarity characteristic and order of integration in series prior to running tests. For this purpose, while one test would have sufficed, two tests – the Augmented Dickey-Fuller together with the Kwiatkowski–Phillips–Schmidt–Shin tests - were employed to ensure robustness in the results.

### 3.4.2 Augmented Dickey-Fuller (ADF) test

The ADF, tests for unit roots in a time series sample, especially in a more intricate set of time series models. The model is founded on the reasoning that a series, say $y_t$, is integrated, then the lagged level of the series, $y_{t-1}$, will not provide any relevant information that can be used to predict the changes in $y_t$ except for the information already obtained from the lagged changes in the series, $\Delta y_{t-k}$ (Hall, 1994). The model is based on the hypotheses that:

$$\mathbf{H_0 : y_t \sim I(1) \; and \; H_1 : y_t \sim I(0)} \qquad \textbf{3.3}$$

These hypotheses, according to Brooks (2008), can be tested based on the following equation:

$$\mathbf{\Delta y_t = \psi y_{t\text{-}1} + \textstyle\sum_{i=1}^{p} a_i \Delta y_{t\text{-}1} + u_t} \qquad \textbf{3.4}$$

with $\psi y_{t-1}$ being the intercept term and $\sum_{i=1}^{p} a_i \Delta y_{t-1}$ being the lags of the dependent variable that permit for the mopping up of autocorrelation. Negative is the ADF statistic and the rejection of the hypothesis of the presence of a unit root at a certain level of confidence is storng if the statistic is more negative (Elliott, Rothenberg and Stock, 1996). However, failing to reject the null due to the test statistic being less negative than the critical values implies that $y_t$ is integrated of a higher order than being tested. Accordingly, the test is repeated up to a point when the null hypothesis of a unit roots in the series is discarded (Fuller, 1976). Despite this apparent ease in executing the test, the ADF has certain limitations to it, an observation which warrants its use in conjunction with other tests. For instance, it fails to differentiate between stationary processes that persist frequently from non-stationary processes and also fails to ascertain the optimal lag length to be employed in the tests (Brooks, 2008).

### 3.4.3 Phillips-Perron (PP) test

The PP test is usually employed as a substitute of the ADF (Mahadeva and Robinson, 2004). The PP test statistic is modified in such a way that in the event of serially correlated errors, there is no necessity of extra lags of the dependent (Brook, 2008). Unlike the ADF test, the PP being a non-parametric it makes no supposition concerning the error process of the variable and this characteristic makes it applicable to a wider set of problems. Therefore, it is considered largely superior to the ADF. In addition, the method integrates an automatic correction to the ADF process to allow for auto-correlated residuals and heteroscedasticity. However, similar to the ADF test, the hypotheses in the PP test are set up as:

$$\mathbf{H_0 : y_t \sim I(1) \text{ and } H_1 : y_t \sim I(0)} \qquad \mathbf{3.5}$$

The PP test, despite its apparent superiority over the ADF, also suffers from certain shortfalls. For instance, it is an asymptotic theory that is mostly applicable in large sample examinations (Mahadeva and Robinson, 2004). This might be problematic when examining economic data for which only annual frequency is available. In addition, the model is not immune to some of the problems plundering the ADF test such as the sensitivity to structural breaks (Brooks, 2008). Therefore, it is prudent to employ this test in conjunction with other tests.

### 3.4.4 Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test

While most economic time series are stationary, empirically its  observed that unit root tests implemented using the ADF usually fail to discard the null hypothesis of a unit root for majority of economic time series (Nelson and Plosser, 1982). Moreover, allowing for error autocorrelation when executing the ADF test fails to change these results. In order to circumvent this, an alternative test – the KPSS – was developed to circumvent the issue low explanatory power in the ADF and its inclination towards finding series to be non-stationary (Kwiatkowski *et al*., 1992). While the ADF tests for unit roots in a series, the KPSS tests for stationarity around a deterministic trend in series (Brooks, 2008). For a series $y_t$, the KPSS is based on the hypotheses that:

$$\mathbf{H_0 : y_t \sim I\ (0)\ \ and\ H_1 : y_t \sim I\ (1)} \qquad \mathbf{3.6}$$

The decision rule is that of rejecting the null hypothesis that $y_t$ is stationary for the alternative that $y_t$ has a unit root when the KPSS test statistic is greater than the KPSS critical value. Ideally, with confirmatory data analysis, for a stationary series the ADF test ought to reject the null hypothesis of non-stationarity while the KPSS fails to reject the null hypothesis of stationarity. Nevertheless, as a result the intricate and recurring structural breaks, non-uniform variances, long-range dependence and thick-tailed distributions caused by heteroskedasticity or asymmetric effects of shocks in the series (Hamed and Riyami, 2008). In the case that that happens, the decision arrived at based on the KPSS would be considered over the ADF determination, as the former is generally superior relative to the former.

## 3.5 Cointegration tests

Based on the first two hypotheses, the study examined the long-run relationships among the indices using the Johansen and the Engle-Granger tests. These are described below.

### 3.5.1 Engle-Granger method

*3.5.1.1 Why employ the Engle-Granger method*

As mentioned above, regressing one non-stationary series against another might produce spurious outputs, which in turn leads to flawed conclusions. However, it is quite conceivable that the very same regressions may yield meaningful inferences rather than spurious, provided the variables are cointegrated (Lee, 1993). That is to say, the series employed in the regressions may possess unit root processes [I(1)] but their linear combination might be stationary [I(0)]. To determine whether that is the situation between variables, an ordinary least squares regression is estimated. Subsequently, the residuals – the error terms – from the regressions are extracted and put through a unit root test. Rejecting the null hypothesis of $u_t \sim$ I(1) for the ut ~ I(1) arrives at the decision that variables are cointegrated and have relationship relationship stretching into the long run. That is, their linear combination possesses the characteristics of a stationary variable, namely, a constant mean, constant variance and constant auto-covariances for each of its given lag (Brooks, 2008). The Engle-Granger method, in which variables need not be stationary, essentially achieves this.

*3.5.1.2 The Engle-Granger procedure*

Subsequent to the stationarity tests conducted as described above, the Engle-Granger test could then be run. This involves the estimation of OLS models between each of the indices employed in this study. The regressions were run based on equation 3.4 below specified as:

$$\mathbf{y_t = \beta_0 + \beta_1 x_t + \epsilon_t} \qquad \mathbf{3.7}$$

With: $\beta_0$ being the y-intercept, $\beta_1$ denoting the slope coefficient, and $\epsilon_t$ is the error term. According to Enders (2004), as long as the variables are cointegrated, equation 3.5 yields a super-consistent estimator irrespective of the integration order in the variables. Based on the OLS output, a residual series of $\epsilon_t$ – the estimated values of the deviation from the long-run equilibrium – is generated as:

$$\mathbf{\epsilon_t = y_t - \hat{y}_t} \qquad \mathbf{3.8}$$

The residual series is subsequently tested for unit roots in order to ascertain if the variables have a long-run association. The test for unit roots, for which the ADF test is employed, is meant to establish whether these deviations from the long-run equilibrium possess a constant mean, constant variance and constant autocovariance. The ADF is thus estimated on the model, specified as:

$$\mathbf{\Delta\hat{\epsilon}_t = a_1\hat{\epsilon}_{t-1} + \varepsilon_t} \qquad \mathbf{3.9}$$

where: $\mathbf{\Delta\hat{\epsilon}_t}$ are the estimated first-differenced residuals, $\mathbf{\hat{\epsilon}_{t-1}}$ are the estimated lagged residuals, $a_1$ is the coefficient of the slope of the line on which the unit root tests are conducted and $\varepsilon_t$ are errors obtained in fitting both differenced residuals. The hypotheses tested are specified as:

$$\mathbf{H_0: a_1 = 0 \text{ and } H_1: a_1 < 0} \qquad \mathbf{3.10}$$

The test statistic is determined as:

$$\mathbf{F_{\hat{\varepsilon}t} = \hat{a}_1 / SE(\hat{a}_1)} \qquad \mathbf{3.11}$$

where: $SE(\hat{a}_1)$ represents the standard error of $\hat{a}_1$. Based on the comparison of the test statistic and the critical value from the Dickey-Fuller table, failure to reject the null hypothesis implies that the residuals are stationary. This, in turn, means that the variables used to estimate the OLS equation from which the residuals were extracted are cointegrated. Of note, while the determination of cointegration is quite important, there are various aspects of that cointegrating relationship that are not observable from the approach above. Accordingly, an error correction model is estimated.

There is, however, a substitute way of estimating the Engle-Granger test. Contrary to the above procedure that involves using one series as a dependent variable and another as the independent variable, this procedure runs two equations where the dependent variable in one equation is employed as the independent variable in the other. This procedure uses two test statistics to determine whether there is cointegration between two series – the tau-statistic and the z-statistic – and as such, it gives results that are more robust. Examining the p-values associated with each of these statistics will determine whether the hypothesis of no cointegration is rejected or not. Based on the apparent advantages, the latter method was employed.

*3.5.1.3 The error correction model (ECM)*

An ECM is a dynamic model that looks at the adjustment of a series back to equilibrium subsequent to the series' departure from long-run equilibrium in the preceding periods (Brooks, 2008). While most economic and financial series are cointegrated in the long run, various factors such as structural changes in the economy might result in temporary departures of various series from their long-run equilibrium relationships. Explicitly, the ECM can be employed to determine the speed at which one variable, the dependent variable, adjusts back to equilibrium following a movement or a change in the independent variable. The ECM, therefore, augments the cointegration-determination approach described above as it provides some information about the relationship between variables both in the short run and in the long run. The model in its simple form is specified as:

$$\mathbf{y_t = a_0 + \gamma_0 x_t + \gamma_1 x_{t-1} + a_1 y_{t-1} + \varepsilon_t} \qquad \mathbf{3.12}$$

Where: $y_t$ is the dependent variable, $x_t$ is the independent variable, $y_{t-1}$ and $x_{t-1}$ are lagged values of $y_t$ and $x_t$, respectively. Although the model allows for the determination of the speed of adjustment of the variables back to equilibrium, it is subject to multicollinearity[4] and spurious correlation[5]. Estimating equation 3.8 but employing the first differences of the variables help in solving these two problems. This, however, not only results in the loss of information concerning the long-run equilibrium but also distorts the economic theory implied by the variables in their level form. To remedy this, an error-correction mechanism formulation of the dynamic structure is derived. It is specified as:

$$\Delta y_t = \gamma_0 \Delta x_t - (1 - \alpha_1)\left[y_{t-1} - \beta_0 - \beta_1 x_{t-1}\right] + \varepsilon_t \qquad \mathbf{3.13}$$

Where: $-(1-\alpha_1)$ is the speed of adjustment of a variable back to equilibrium, and $\epsilon_{t-1} = y_{t-1} - \beta_0 - \beta_1 x_{t-1}$ is the error-correction mechanism that measures the degree of departure of the system from equilibrium. The coefficient of $\epsilon_{t-1}$ is expected to be negative if the system converges to equilibrium.

### 3.5.2 Johansen cointegration method

The employment of the Johansen method, in addition to the Engle-Granger two-step method, was warranted by two main shortfalls of the latter method. First, while the Engle-Granger method is relatively easy to execute, it can only be run on two variables at a time and requires larger sample sizes in order for the inferences to not be marred by estimation errors (Brooks, 2008). Given that the sample employed is made up of eight series, it is perhaps more apt to examine the relationships among these variables by treating all test variables as endogenous in a multivariate framework offered by the Johansen cointegration method (Maggiora and Skerman, 2009). Secondly, and perhaps most importantly, relative to the Johansen method, the Engle-Granger method does not allow for hypothesis testing on the cointegrating relationships in the series themselves (Ssekuma, 2011).

#### *3.5.2.1 The Johansen procedure*

When executing the Johansen method, the starting point is a vector autoregression[6] (VAR) of a certain order, say p, given by:

---

[4] Multicollinearity refers to high correlation among multivariate explanatory variables such that one variable can be linearly predicted from the others with a high degree of accuracy (Farrar and Glauber, 1967).

[5] Spurious correlation is the false presumption that two variables are correlated when they are not as a result of a third factor that is not apparent at the time of examination (Lev and Sunder, 1979)

[6] A VAR is a model employed in multivariate estimations to capture the linear interdependencies among multiple time series. The model generalizes the univariate autoregressive model by allowing for more than one evolving variable (Hamilton, 1994).

$$\mathbf{X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots\ldots + \Pi_p X_{t-p} + u_t} \qquad \mathbf{3.14}$$

Where: $X_t$ is an $n \times 1$ vector of order one [I(1)] integrated variables, $u_t$ is a $n \times 1$ vector of innovations while $\Pi_1$ through $\Pi_p$ are $m \times m$ coefficient matrices. Subtracting $X_{t-1}$ on both sides reparameterizes equation 3.5 to:

$$\mathbf{\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots\ldots + \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + u_t} \qquad \mathbf{3.15}$$

Where: $\Gamma_1 = \Pi_1 - I$, $\Gamma_2 = \Pi_2 - \Gamma_1$, $\Gamma_3 = \Pi_3 - \Gamma_2$ and $\Pi = I - \Pi_1 - \Pi_2 - \ldots - \Pi_p$. The $\Pi$ matrix, the impact matrix, determines the extent to which the system is cointegrated. Therefore, it is possible to revert back to the reparameterized equation 3.6 if the first equation of the system is specified as:

$$\mathbf{\Delta X_{1t} = \gamma'_{11} \Delta X_{t-1} + \gamma'_{12} \Delta X_{t-2} + \ldots\ldots + \gamma'_{1p-1} \Delta X_{t-p+1} - \Pi'_1 X_{t-p} + u_t} \qquad \mathbf{3.16}$$

Where: $\gamma'_{ij}$ is the first row of $\Gamma_j$, $j = 1,2,\ldots.p - 1$. Here $\Delta X_{1t}$, $j = 1,2,..p-1$ and $u_t$ are considered to be stationary [I(0)] and so for a meaningful equation, $\Pi'_1 X_{t-p}$ must be stationary as well (Ssekuma, 2011). If elements of $X_t$ are not cointegrated, it follows therefore that they will be equal to zero. Nevertheless, all the rows of $\Pi$ must be cointegrated if the components of $X_t$ are cointegrated. Of note, the rows of $\Pi$ do not necessarily have to be distinct as, according to Harris (1995), the number of distinct cointegrating vectors depends on the row rank of $\Pi$.

Of order $m \times m$ is the matrix $\Pi$. When its rank is m, implying, m number of linearly independent rows or columns, then it creates grounds for m-dimensional vector space. This points to the fact that all $m \times 1$ vectors can be generated as linear combinations of its row. Any of this linear combination of the rows would result in stationarity, meaning that $X_{t-p}$ has stationary components if the rank of $\Pi$ is $r < m$. Therefore, the $\Pi$ matrix is essentially a product of two matrices – $\alpha$, an $n \times r$ matrix showing the speed of adjustment of the system to the previous periods' deviation from the equilibrium, and $\beta$, an r x n matrix showing the long run coefficients of the co-integrating relationships (Kambadza and Chinzara, 2012). This can be expressed as $\Pi = \alpha\beta'$. Johansen's procedure estimates the VAR subject to $\mathbf{\Pi} = \beta\alpha'$ for various values of $r$ number of cointegrating vectors, using the maximum likelihood estimator assuming $u_t \sim iidN(0,\Sigma)$. Therefore, equation 3.7 can be rewritten as:

$$\mathbf{\Delta X_{1t} = \gamma'_{11} \Delta X_{t-1} + \gamma'_{12} \Delta X_{t-2} + \ldots\ldots + \gamma'_{1p-1} \Delta X_{t-p+1} - \beta\alpha'_1 X_{t-p} + u_t} \qquad \mathbf{3.17}$$

Determining the number of cointegrating vectors entails conducting two likelihood ratio tests, namely, the trace test and the maximum eigenvalue (Johansen, 1991).

### 3.5.2.2 The trace test and the maximum eigenvalue

The trace test employs the trace of the matrix – the total of the eigenvalues – in its execution (Brooks, 2008). The tests for potential cointegrating relationships are conducted sequentially until one fails to reject the null hypothesis of r co-integrating vectors against the alternative of r>n co-integrating vectors (Hjalmarsson and Österholm, 2007). The hypotheses are set up as:

$$\mathbf{H_0: r = 0 \text{ (no cointegrating relationship)}}$$

$$\mathbf{H_1: r > 0 \text{ (at least r cointegrating relationships exist)}} \qquad \mathbf{3.18}$$

The test statistic is given by the equation:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1-\hat{\lambda}_i) \qquad \mathbf{3.19}$$

Where: r is the number of cointegrating vectors being tested for under the null hypothesis, T is the sample size and $\hat{\lambda}$i+1 is the estimated value for the *i*th ordered eigenvalue from the Π matrix (Brooks, 2008). A higher test statistic relative to the critical values provided by Johansen and Julius (1990) would result in the rejection of the null hypothesis for the alternative that at least r-cointegrating relationships exist among the variables. Successive tests would then show the maximum number of cointegrating relationships among the variables.

Unlike the trace test, the maximum eigenvalue executes separate tests on each eigenvalue (Brooks, 2008). Herein this test, the null hypothesis of r cointegrating vectors against the respective alternative of r+1 cointegrating vectors is tested.

The hypotheses are specified as:

$$\mathbf{H_0: r = 0 \text{ (no cointegrating relationship)}}$$

$$\mathbf{H_1: r > 0 \text{ (at least r cointegrating relationships exist)}} \qquad \mathbf{3.20}$$

The test statistic is determined as:

$$\lambda_{max}(r,r+1) = -T\ \text{In}\left(1-\hat{\lambda}_{r+1}\right) \qquad \mathbf{3.21}$$

A test statistic higher than the critical value means that the eigenvalue tested is non-zero and that there are at least r+1 cointegrating vectors in the system. The null hypothesis of r = 0 would then be rejected for the alternative r = 1. Sequential testing of the hypotheses is then executed until one fails to reject the null hypothesis of r = n for the alternative r = n+1.

*3.5.2.3 Vector Error Correction Model (VECM)*

Subsequent to the Johansen test, if there is cointegration amongst the variables based on the trace and maximum eigenvalue tests, the Vector Error Correction Model (VECM) is then estimated. The reason for estimating the VECM is to connect the short run and long run causal link between the variables while an effort is also made to recover lost information due to differencing the data (Ang and McKibbin, 2007). The VECM seeks to indicate the speed of adjustment back to long run equilibrium after a short run shock without the loss of the long run information (Jalil and Ma, 2008). If the coefficient on one of the series, say EGX100, is found to be positive and significant, this implies that EGX100 changes positively to maintain equilibrium. The same applies to all the six variables in the system.

*3.5.3 Autoregressive Distributed Lag Model (ARDL)*

In addition to the above mentioned test of cointegration, for robustness reasons, the autoregressive distributed lag model will be used. ARDL is prefereed for this purpose for a number of reasons. Firstly because of its applicability irrespective of whether the regressor variables are either *I(0), I(1)* or mutually/fractionally integrated (Marashdeh 2005). Secondly, while other cointegration techniques such as Engle Granger specified above are sensitive to the size of the sample, ARDL works perfectly well even in small samples (Odhiambo 2010). Thirdly, this approach to cointegration is documented to provide unbiased estimates of the long run model even with some of the regressors being endogeneous (Harris and Sollis 2003). The ARDL model takes the form (Pasaran and Shin 2001):

$$\boldsymbol{\alpha(L,p)y_t = a_0 + \sum_{i=1}^{k} \beta_i\,(L,q_i)x_{it} + \lambda' w_t + \epsilon_t} \qquad (\mathbf{1})$$

$$\forall_t = \mathbf{1}, \dots, \boldsymbol{n}$$

Where $\boldsymbol{\alpha(L,p) = 1 - \alpha_1 L - \alpha_2 L^2 - \cdots - \alpha_p L^p}$

$$\boldsymbol{\beta_t\,(L,q_t) = \beta_{t0} + \beta_{t1}L + \beta_{t2}L^2 + \cdots\ \beta_{tqi} + L^{qt}} \quad \forall_t = \mathbf{1,2,\dots,k}$$

Where $y_t$ is the dependent variable and $\alpha_0$ is a constant term, and $L$ is a lag operator such that $Ly_t = y_t - 1$, $w_t$ is $S \times 1$ vector of deterministic variables such as intercept terms, exogenous variables with fixed lags. Below is how the longrun elasticities are computed

$$\boldsymbol{\Phi_t} = \frac{\widehat{\boldsymbol{\beta_t}}(\mathbf{1}, \widehat{\boldsymbol{q}}_t)}{\boldsymbol{\alpha}(\mathbf{1}, \widehat{\boldsymbol{p}})} = \frac{\widehat{\boldsymbol{\beta}}_{t0} + \widehat{\boldsymbol{\beta}}_{t1} + \cdots + \widehat{\boldsymbol{\beta}}_{tq}}{\mathbf{1} - \widehat{\boldsymbol{\alpha}}_1 - \widehat{\boldsymbol{\alpha}}_2 - \cdots - \widehat{\boldsymbol{\alpha}}_p} \quad \forall_i = \mathbf{1}, \mathbf{2}, \ldots\ldots, \boldsymbol{k} \qquad (\mathbf{2})$$

With $\hat{p}$ and $\widehat{q_\iota}$; $i$ = 1,2…..$k$ are the estimated values of $\hat{p}$ and $\widehat{q_\iota}$; $I$ = 1,2…..$k$

On the other hand, the long run coefficients are estimated from:

$$\boldsymbol{\pi} = \frac{\widehat{\boldsymbol{\lambda}}(\widehat{\boldsymbol{p}}, \widehat{\boldsymbol{q}}_2, \ldots \ldots \widehat{\boldsymbol{q}}_k)}{\mathbf{1} - \widehat{\boldsymbol{\alpha}}_1 - \widehat{\boldsymbol{\alpha}}_2 - \cdots - \widehat{\boldsymbol{\alpha}}_p} \qquad (\mathbf{3})$$

Where $\hat{\lambda}(\hat{p}, \hat{q}_2, \ldots \ldots \hat{q}_k)$ denotes $\hat{\lambda}$ estimated in one for the respective ARDL model.

The Error Correction model will be defined as:

$$\boldsymbol{ECM_t} = \boldsymbol{y_t} - \widehat{\boldsymbol{\alpha}} - \sum \widehat{\boldsymbol{\beta}}\, \boldsymbol{x_{it}} - \boldsymbol{\lambda' w_t} \quad (\mathbf{4})$$

Were $x_t$ is a $k$ - dimensional forcing variables which are not cointegrated among themselves

$\epsilon_t$ is a vector of stochastic error terms with zero mean and contant variance covariance.

Decision criterion under the ARDL technique is based on two sets of asymptotic critical values provided for in Pesaran *et al* (2001). The fist set considers variables to be I(0) while the second considers the same to be I(1). The decision rule is such that if the computed ***F***-statistic is greater than the upper bound critical value, a pair of series is concluded to be cointegrated. Conversly, if the calculated ***F***- statistic is lower than the lower bound critical value, series exibits absence of long run equilibrium state. The test becomes inconclusive if the calculated ***F***- statistic falls within the region defined by the lower and upper bounds of the Pesaran critical values.

### 3.5.4 Short-run dynamics

The three cointegration tests above, the Engle-Granger, ARDL and the Johansen procedures, allowed for the determination of whether there exist a long-run cointegrating relationship between the series. In addition, the respective error correction models allowed the study to infer on the short-run dynamics of the long-run relationship in terms of whether there is disequilibrium correction and the speed thereof. However, there are tests described below that were conducted in the short-run to determine more explicitly the short-run dynamics among these variables.

*3.5.4.1 Vector Autoregressions (VARs)*

Propagated by Sims (1980), vector autoregressive models (VARs), are a natural generalisations of univariate autoregressive class of models. With VAR modelling, systems of regressions comprised of blends of univariate time series models as well as simultaneous equations models can be estimated (Brooks, 2008). For instance, a variable such as EGX100, can depend not only on its own lags or combinations of white noise terms but also on past values of other variables in the system, such as LUSEALSI and the LUSEALSI, to like wise depend on its past values as well as on past values of the EGX100 under VAR modelling. The estimated VAR models facilitates the investigation of the short-term dynamics of the variables and the model is set up as follows:

$$\mathbf{Y_t = \beta_{1,0} + \sum_{i=1}^{P} \beta_{1,i}\, Y_{t-1} + \sum_{j=1}^{P} \beta_{1,p+j} X_{t-j} + \varepsilon_{1,t}} \qquad \textbf{(3.22)}$$

$$\mathbf{X_t = \beta_{2,0} + \sum_{i=1}^{P} \beta_{2,i}\, Y_{t-1} + \sum_{j=1}^{P} \beta_{2,p+j} X_{t-j} + \varepsilon_{1,t}} \qquad \textbf{(3.23)}$$

Where: $Y_t$ and $X_t$ represent any of the series in the system, p depicts the order of the model with $\varepsilon_{1,t}$ being white noise residuals. Comprising the β matrix are the model coefficients, that is, the contributions of each lagged observation on current observations of any one of the series. The AIC and the SBIC information criterion are examined in order to choose an appropriate lag length. Of importance under the VAR models are the significance, signs and relative sizes of the coefficients on the lagged variables and the $R^2$ statistics of model significance.

*3.5.4.2 Granger-Causality tests*

As a tool to provide deeper in sight into the causal linkages between indices, Granger-causality tests are conducted based on the VAR models. These tests facilitates the scrutiny of intertemporal connections among variables since they measure the correlation structure between the current value of one measurable and past values of other variables (Brooks, 2008). This method permits for the sequential ordering of movements in series. Compared to the VAR, this makes it simpler to detect the influence that variables have on each dependent variable under a short run time horizon (Quinn, Cole and Kiyavash, 2011). For this purpose, Block Exogeneity Wald test based on the Chi-squared distribution is used and the hypotheses is set as:

1. $H_0$: Lags of EGX100 do not Granger-cause LUSEALSI
   $H_1$: Lags of EGX100 Granger-cause the LUSEALSI

2. $H_0$: Lags of LUSEALSI do not Granger-cause EGX100
   $H_1$: Lags of the LUSEALSI Granger-cause EGX100

Lags of EGX100 (Xt) are said to Granger-cause LUSEALSI (Yt) when collectively, the coefficients in $\beta_{1,p}$ uner the VAR equation specified above are significantly different from zero. This assetion is tested using, a Chi-squared test of the null hypothesis that $\beta_{1,p}$ is equal to 0 against the alternative that $\beta_{1,p}$ is significantly different from 0. Likewise, if the p parameters in $\beta_{2,i}$ from the second VAR equation specified above are collectively significant, it implies then that the null hypothesis that the lags of $Y_t$ do not Granger-cause Xt can be rejected. The rejection of both null hypotheses, in turn, mean that the null in the hypothesis of no dual causality would be rejected for the alternative that there is dual causality stock market indices.

*3.5.4.3 Impulse response functions and variance decompositions*

The VAR and Granger causality tests are useful in establishing whether a set of series have a statistically significant casusal structure. However the approach fall shot when it comes to establishing the lenth of time the effect would take to pass through the system. (Brooks, 2008). Impulse response functions (IRF) and variance decompositions based on VARs can be estimated to extract such valuable information (Ling, Naranjo and Scheick, 2010). IRFs trace out the degree of elasticity of the dependent variables in the VAR to one standard deviation shocks to each of the variables (Seymen, 2008).

While, on the other hand, decomposition of variance determine what part of the forecast error variance of any variable in the system is accounted for by innovations or exogenous shocks to each dependent variable in the system (Lux, 2008). Under scenarios where the system is stable, shocks will ultimately dissipate through. Materially, the ordering of variables impacts the estimation of these fuctions (Brooks, 2008). Under their estimation, held costant are the error terms of all other equations in the VAR system; though, the error terms are have potential to be correlated between equations. More so, assuming errors to be independent leads to misrepresentation of the system dynamics.

Sims (1980) suggested as a remedy the application of orthogonalized IRFs and variance decompositions. This requires, before running the function, orthogonalizing the shocks to the VAR using the Cholesky decomposition (Pesaran and Shin, 1998). This approach uses the decomposition of a positive-definite matrix into the product of a lower triangular matrix and its conjugate transpose, useful for efficient numerical solutions and for solving systems of linear equations (Martin and Wilkinson, 1995). This approach was therefore adopted in the estimation of the forecast error variance decompositions and IRFs.

## 3.6 Volatility linkages

### 3.6.1 Volatility models

While various time series models go a long way in analysing various relationships among variables, Chinzara and Aziakpono (2009) argue that for financial and high-frequency macroeconomic datasets, the employment of these models may not be appropriate. This is because these datasets are often characterised by excess volatility, volatility clustering and leverage effects, all of which the traditional time series models fail to capture. With macroeconomic and financial data, time-varying volatility has been documented as a common phenomenon more than constant volatility hence accurate modelling of time-varying volatility is critical (Brooks, 2008). To meet this need when examining stock market volatility linkages and spillovers, various studies employ volatility models such as Engle's (1982) Autoregressive Conditional Heteroskedasticity (ARCH) and Bollerslev's (1986) Generalized Autoregressive Conditional Heteroskedasticity (GARCH). Various extensions to these models were also introduced to deal with particular shortfalls of the ARCH and GARCH models.

### 3.6.2 The ARCH model

In ARCH models conditional variance is modelled as a linear function of the past squared innovations (Bollerslev, 1994) as shown below:

$$\mathbf{y_t = u_t, \qquad [u_t \sim N(0,h_t)]} \quad \mathbf{3.24}$$

$$\mathbf{h_t = a_0 + \sum_{i=1}^{q} a_j u_{t-1}^2} \quad \mathbf{3.25}$$

Where: $h_t$ is the conditional variance. For the model to be considered admissible, the conditional variance must always be positive. This will only be the case if all of the conditional variance coefficients are positive such that $\alpha_0 > 0$ and $\alpha_0 \geq 0$ (Brooks, 2008). Therefore, ARCH process explicitly models time-varying conditional variance. Nevertheless, the model has been criticised, as it requires the selection of high ARCH orders in order to capture the dynamics of the conditional variance, which in turn translate into many parameters being used (Karlsson, 2002). In addition, the ARCH models assume symmetric effects of shocks, an assumption which is not only restrictive but also false in financial time series data. Negative innovations affect future variance more than positive shocks. The third criticism of the ARCH model relates to its assumption of a slow reversion back to the mean. Financial time series data tends to be characterised by volatility clustering. In addition, the observation of non-negativity restrictions being easily violated in the ARCH models have been cited as another limitation of the model (Toggins, 2008).

### 3.6.3 The GARCH model

The GARCH model, developed by Bollerslev (1986) and Taylor (1986), is an extension of the ARCH model for variance heteroskedasticity and it was designed to counter most of the ARCH model limitations. The GARCH model allows volatility to vary over time and has a much more flexible lag structure (Zhang, 2009). This enables it to capture volatility clustering and to encompass the leptokurtic distribution of the financial time series data. As such, GARCH models tend to have heavier tails than those of normal distribution. The model also assigns weights that decline exponentially to past observations in the data, which imply that shocks that are more recent will have more impact on the model resulting in better data inferences over long horizons (Karlsson, 2002). In addition, since recent events, are weighted more in this model, black swan events-a sudden large, unexpected movement in the data are also encompassed. The GARCH (1, 1) can be modelled as:

$$\mathbf{h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-1}^2 + \sum_{i=1}^{p} \beta_i h_{t-1}} \qquad \mathbf{3.26}$$

$$\mathbf{h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1}} \qquad \mathbf{3.27}$$

The unconditional variance $h_t$ can be derived by taking the unconditional expectation of equation 3.4 under the hypothesis of covariance stationarity, which allows for the following inference:

$$\mathbf{h} = \alpha_0 + \alpha_1 \mathbf{h} + \beta_1 \mathbf{h} = \frac{\alpha_0}{1 - \alpha_1 - \beta_1} \qquad \mathbf{3.28}$$

This unconditional variance exists when the following conditions are satisfied: $\alpha_1 + \beta_1 < 1$ and for non-negativity conditions to be satisfied $\alpha_0 > 0$. However, the normal GARCH (1.1) model fails to model volatility asymmetries with respect to the sign of past shocks. With the GARCH(1.1) both bad news and good news are assumed to have the same impact on volatility which is not the case with financial time series data where bad news have larger effects on volatility than good news-leverage effect (Engle and Patton, 2000).

The ARCH and GARCH models have been largely successful in the estimation of in-sample parameters and reliable out-of-sample volatility forecasts can be obtained (Hurditt, 2004). However, these models fail to guarantee non-negativity of conditional variance and fail to capture asymmetry in volatility (Chinzara and Aziakpono, 2009). In addition, these models fail to allow for any direct feedback between the mean and conditional variance (Brooks, 2002). As such, various non-linear extensions to these models have been developed to address these shortfalls. These include the GARCH-in-mean (GARCH-M) which deals with the lack of direct feedback between the conditional variance and the mean, the Exponential GARCH (EGARCH), and Glosten, Jagannathan and Runkle (1993) GARCH (GJR-GARCH) developed to deal with the volatility asymmetry. Much of empirical analysis on the volatility of financial markets used the latter two models to capture the asymmetry in volatility (Alberg, Shalit and Yosef, 2008; Chinzara and Aziakpono, 2009, Ou and Wang, 2011 and Thalassinos, Muratoglu and Ugurlu, 2012). As such, this study employed the GJR-GARCH and the EGARCH.

### 3.6.4 GJR GARCH

The GJR model is a simple extension of GARCH with an additional term added to account for possible asymmetries (Brooks, 2008). Glosten, Jagananthan and Runkle (1993) develop the GARCH model that allows the conditional variance a different response to past negative and positive innovations. It is modelled as:

$$\mathbf{h_t} = \alpha_0 + \sum_{i=1}^{q} \alpha_i \mathbf{u}_{t-1}^2 + \gamma_i u_{t-1}^2 d_{t-1} + \sum_{i=1}^{p} \beta_i \mathbf{h}_{t-1} \qquad \mathbf{3.29}$$

Where $d_{t-1}$ is a dummy variable with the specification that $d_{t-1} = 1$ if $u_{t-1} < 0$, indicative of a negative shock; and $d_{t-1} = 1$ if $u_{t-1} \geq 0$, indicative of a positive shock. The impact of positive and negative shocks is given as $\alpha_1$ and $\alpha_1 + \gamma$, respectively. In this model, the leverage effect is present if $\gamma > 0$ and there is an asymmetric impact on volatility if $\gamma \neq 0$. The non-negativity conditions are satisfied if $\alpha_0 > 0$, $\alpha_1 > 0$, $\beta \geq 0$ and $\alpha_1 + \gamma_i \geq 0$. The model is still admissible if $\gamma_i < 0$ given that $\alpha_1 + \gamma_i \geq 0$ (Brooks, 2008).

### 3.6.5 Exponential GARCH

The Exponential GARCH (EGARCH) was proposed by Nelson (1991) and also exhibits the attractive property of capturing leverage effects. For the EGARCH model, the conditional variance is modelled as:

$$\log(h_t) = \alpha_0 + \sum_{j=1}^{q} \beta_j \log(h_{t-j}) + \sum_{i=1}^{p} \alpha_1 \left| \frac{u_{t-i}}{\sqrt{h_{t-i}}} \right| + \sum_{k=1}^{r} \gamma_k \frac{u_{t-k}}{\sqrt{h_{t-k}}} \qquad 3.30$$

Where: $\gamma_k$ captures the leverage effects, as such, leverage effects exists if $\gamma_k < 0$ and if $\gamma_k \neq 0$ then the impact on volatility is asymmetric. The EGARCH employs the term $\log(h_t)$ which forces negative parameters to be positive. Therefore, there is no need to artificially impose non-negativity constraints on the model parameters (Brooks, 2008). As such, it is apparent that the EGARCH model allows for the unrestricted estimation of the variance unlike the normal GARCH specification (Thomas and Mitchell, 2005). Both the GJR-GARCH and the E-GARCH employed the following mean equation:

$$\gamma = \mu + \theta h_{t-1} + \mu_t \qquad 3.31$$

where $\theta$ is the risk premium which should be positive and statistically significant under the GJR-GARCH and negative and statistically significant under the E-GARCH model if increased risk as a result of an increase in the conditional variance leads to a rise in the mean return (Brooks, 2008).Cognizant of the discussion above of all the GARCH specifications, it has been noted that GARCH residuals still tend to be leptokurtic when GARCH models are used in modeling volatility in return series. Therefore, the standard z-tests tend to be unreliable (Belhoula and Naoni, 2011). As a result, the student-t distribution and the Generalised Error Distribution (GED) have been proposed as opposed to using the normal distribution (Brooks, 2008). As such, this study employed the student-t distribution for the distribution assumption.

### 3.6.6 Determining volatility linkages

To examine the extent of volatility linkages across these markets, the structure and behaviour of volatility in each of the respective markets was modelled. Three volatility attributes were then examined and compared to determine the level of similarity across the market. These are volatility persistence - which looks at clustering of volatility caused persistence of shocks, leverage effects - which looks at whether bad news affects volatility more than the good news of the same magnitude, and risk premium - which looks at whether investors are compensated for greater risk (Brooks, 2008).

## 3.7 Chapter summary

In this chapter, and based on the three hypotheses and research objectives, presentation of the description of the dataset, the test variables and pre-test approaches employed was made. In addition, a description of the three main methods – the Engle-Ganger and Johansen cointegration techniques and the GARCH models – was provided together with the justifications for the use thereof. The following chapter reports the results of all the analyses employed in the determination of the level of cointegration among the COMESA countries and volatility spillovers and linkages tests.

# CHAPTER 4: RESULTS AND ANALYSIS

## 4.1 Introduction

Based on the data and the methods of analysis outlined in the immediately preceding chapter, this chapter reports the results of the tests conducted, relates the findings to the previous studies and provides rationalisations for the observed patterns and results. At the outset, the chapter looks at preliminary data tests comprising descriptive statistics, correlation determination and stationarity tests on the indices employed. Subsequently, the chapter reports the results of the Engle-Granger cointegration examinations, ARDL test then followed by the out comes from the Johansen cointegration technique. Thereafter, the chapter reports the results of the vector autoregressions, Granger-causality tests, and impulse response and variance decomposition functions. Last, the chapter reports on the outcomes of the tests on volatility linkages from the volatility models estimated.

## 4.2 Preliminary data tests

### 4.2.1 Summary of descriptive statistics

Table 4.1 below presents the descriptive statistics for the six indices employed. Egypt and Zimbabwe both records negative returns over the sample period. This could be reflective of the political crisis in the former and economic crises defining the later since year 2000. The highest average return was realised in Uganda, a market exhibiting higher volatility relative to other markets such as Mauritius and Nairobi. This compounds Fari (2010) observation that African markets are characterised by substantial returns though volatile. The EGX100 shows greater volatility relative to all the other indices as shown by the greater standard deviation and the greater departure of the median from the mean. This is followed by the ZSEIND and the USEALSI, which have just about the same level of volatility. Such high volatility as is largely common in African stock market, could be attributed to the same reasons stated earlier. All the other indices are negatively skewed, except for the LUSEALSI and all the indices have relatively low positive kurtosis, with the exception of ZSEIND. As in Kodongo and Ojah (2013), the normality assumption appears to be violated in the distribution of national equity market returns. The presence of non-normal return behavior implies that investor are more likely to demand more compensation for risk assummed far beyond the dictates of volatility as measured by the standard deviation. In particular, negative skewness in most COMESA markets is indicative of the fact that investments should attract a skewness premium. In addition, presence of heavy tails than those under normal distribution impacts the way volatility is modelled in African markets as standard distribution models are rejected by the data (Bekaert and Heavy 2002). Deviation from normality can however be modelled using ARCH techniques.

**Table 4. 1 Descriptive statistics**

| Statistic | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| **Mean** | -0.550 | 1.092 | 0.923 | 0.202 | 1.340 | -0.188 |
| **Median** | 0.251 | 0.221 | 1.924 | 0.135 | 1.449 | -0.053 |
| **Std. Dev.** | 8.719 | 3.583 | 4.691 | 2.364 | 5.503 | 5.937 |
| **Skewness** | -0.696 | 0.474 | -0.730 | -0.059 | -0.340 | -0.419 |
| **Kurtosis** | 3.673 | 3.425 | 3.072 | 2.531 | 2.589 | 6.658 |

### 4.2.2 Correlation between the variables

Although correlation coefficients cannot be used to measure causality and long-term cointegration between variables, they can still be used to infer on the relationship. That is, they can be used to identify whether variables move together or not, how strong that association is and in which direction one variable move in relation to the other. From Table 4.2 below, the correlation coefficients range from -0.254 between the EGX100 and the LUSEALSI, indicating a weak negative association, to 0.763 between the NSEASI and the USEALSI, indicative of a strong positive association between the two. Regional co-oprtation between Uganda and Kenya along with permited cross listing across the the two markets to a large extent explains the strong positive correlation between these markets (Ojah *et al* 2011). The coefficients between the EGX100 and the SEMDEX (-0.057) and between the LUSEALSI and ZSEIND (0.083) are close to zero, indicative of a very weak association between these series. Thus, it is conceivable that from the cointegration and causality tests, the association may also be weak and insignificant. Nevertheless, because correlation and causality are quite different statistical measures of association, it is also possible to still find significant cointegration and causality between variables with low correlation. On the other hand, correlation structure conveys very useful information when it comes to construction of investment portfolios (Alagidede 2008). Correlation is negative between the following pairs, Egypt and Zambia, Zambia and Mauritius as well as Mauritius and Egypt. This is indicative of the fact that portfolio diversification across these markets could yield superior returns.

**Table 4. 2 Correlation between the variables**

| Index | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| **EGX100** | 1.000 | -0.254 | 0.268 | -0.057 | 0.127 | 0.144 |
| **LUSEALSI** | -0.254 | 1.000 | 0.119 | 0.313 | 0.198 | 0.083 |
| **NSEASI** | 0.268 | 0.119 | 1.000 | 0.343 | 0.763 | 0.348 |
| **SEMDEX** | -0.057 | 0.313 | 0.343 | 1.000 | 0.301 | 0.279 |
| **USEALSI** | 0.127 | 0.198 | 0.763 | 0.301 | 1.000 | 0.449 |
| **ZSEIND** | 0.144 | 0.083 | 0.348 | 0.279 | 0.449 | 1.000 |

### 4.2.3 Stationarity tests

As mentioned in chapter 3 above, it is paramount that before cointegration tests are run, variables should be checked for their order of integration. This is because, for the results to be accurate, the variables should be integrated of the same order. In addition, other methods such as Engle-Granger and OLS methods will yield non-standard distributions, which, in turn, lead to spurious regression results if non-stationary data is employed in these tests (Hjalmarsson and Österholm, 2007). Three tests – ADF, PP and KPSS – were run on each variable for the sake of robustness in the results. In levels, all the variables were found to contain unit roots, therefore rejecting the null hypothesis of no unit roots for the alternative. However, all the six indices were found to be stationary in first differences, leading to the conclusion that they are integrated of order one [I(1)]. Subsequent tests of cointegration could then be carried out after ascertaining the order of integration of these six indices.

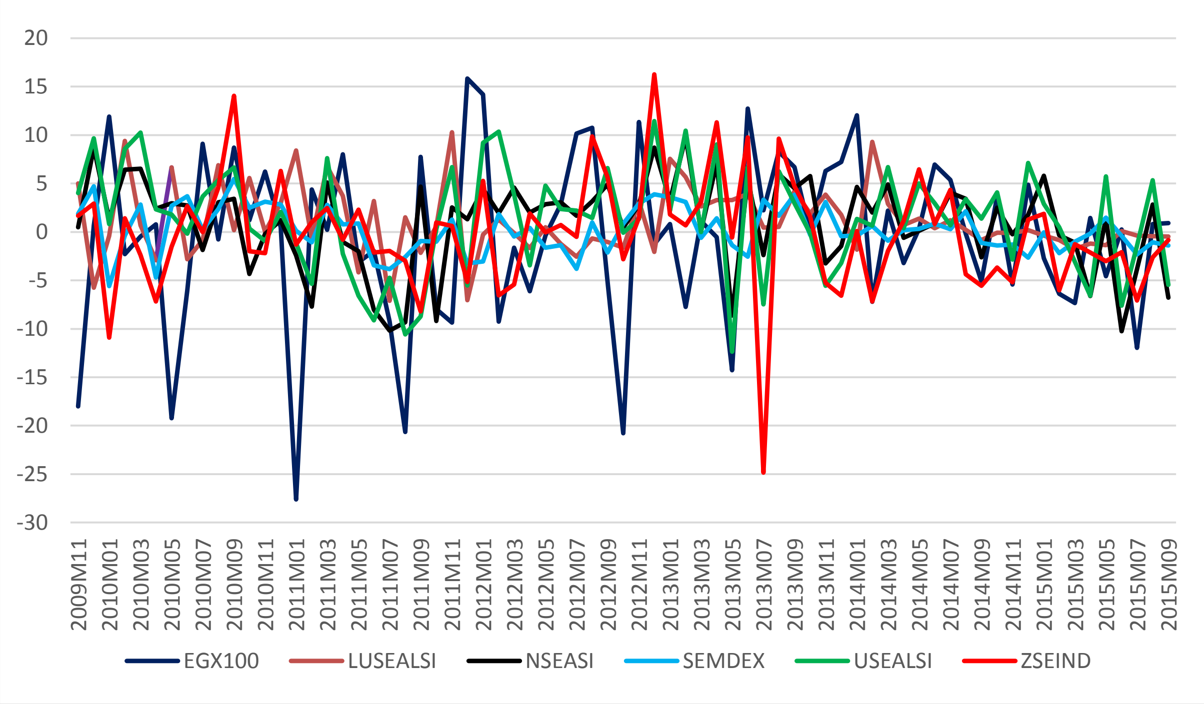
**Table 4. 3 Stationarity tests**

| Index | ADF | | PP | | KPSS | | Decision |
|---|---|---|---|---|---|---|---|
| | In levels | First differences | In levels | First differences | In levels | First differences | |
| **EGX100** | -2.345 | -8.817*** | -2.339 | -9.097*** | 0.289 | 0.108*** | [I(1)] |
| **NSEASI** | -2.089 | -3.325** | -2.102 | -9.518*** | 0.302 | 0.090*** | [I(1)] |
| **SEMDEX** | -3.242 | -3.679** | -3.009 | -7.701*** | 0.293 | 0.127** | [I(1)] |
| **ZSEIND** | -3.123 | -6.808*** | -3.172 | -6.969*** | 0.331 | 0.079*** | [I(1)] |
| **USEALSI** | -2.456 | -4.274*** | -2.452 | -8.078*** | 0.325 | 0.083*** | [I(1)] |
| **LUSEALSI** | -2.673 | -9.013*** | -2.222 | -9.005*** | 0.278 | 0.114*** | [I(1)] |

***, ** and *** indicate significance at 10%, 5% and 1%, respectively.**

In Figure 4.1 below, the six indices, based on their log returns, are graphed over the study period. The series where re-indexed to ensure that the scale would be consistent. Consistent with the stationarity tests reported above in Table 4.3, the movement in the series indicates that they possess unit roots, that is, they are not stationary. In addition, some of the series show greater volatility than the others. From the figure, however, it is not clear whether these series are trending in the same direction, an observation which warrants further investigation with respect to possible cointegration among these series.

**Figure 4. 1 Stock market indices**




## 4.3 Engle-Granger cointegration tests

The Engle-Granger two-step procedure, as described in the preceding chapter, was used to establish if there exist long-term cointegrating relationships between the six variables employed. The results from the cointegration tests, as well as the error correction model, are presented below.

### 4.3.1 Engle-Granger test

Table 4.4 below reports the results from the Engle-Granger procedure. The procedure conducts pairwise cointegration tests and uses both variables as dependent variables in the respective tests. The automated output indicates that all the variables are cointegrated as reflected by the p-values associated with the tau-statistics. That is, the null hypothesis of absence of long run association can be rejected in all the tests, some at 1%, others at 5% and others at 10% depending on the p-values. The z-statistic as reported in the column that follows and its associated p-values, representing an alternative approach of calculating a test statistic under the Engle-Granger technique, indicates that the same conclusion can be drawn as from the tau-statistic. All the p-values are less than 5%, meaning that the series share a relationship in the over the long term. The finding is contrary to Kambaza *et al* (2014) who could not confirm integration of equity markets along regional bloc lines. The divergence in findings could be explained by the difference in sampling techniques for the markets constituting the studies. While this study concentarated on markets soley within COMESA Kambaza *et al* (2014) sampled only the dominant markets from the many economic blocs dotted across Africa. These results are consistent with the a priori expectation that, because these markets belong to one trading bloc – COMESA with increased intra-bloc trade, the markets should increasingly become integrated in the long run (Annual report 2014).

**Table 4. 4 Engle-Granger cointegration test**

| Dependent | tau-statistic | Prob.* | z-statistic | Prob.* |
|---|---|---|---|---|
| **EGX100** | -8.1877 | 0.0000 | -67.3670 | 0.0000 |
| **LUSEALSI** | -8.8119 | 0.0000 | -74.0278 | 0.0000 |
| **EGX100** | -9.3237 | 0.0000 | -76.0826 | 0.0000 |
| **NSEASI** | -7.6561 | 0.0000 | -65.7660 | 0.0000 |
| **EGX100** | -8.7837 | 0.0000 | -71.9295 | 0.0000 |
| **SEMDEX** | -6.6385 | 0.0000 | -54.6116 | 0.0000 |
| **EGX100** | -9.1495 | 0.0000 | -74.5676 | 0.0000 |
| **USEALSI** | -4.5156 | 0.0027 | -39.8864 | 0.0001 |
| **EGX100** | -8.9034 | 0.0000 | -72.6618 | 0.0000 |
| **ZSEIND** | -8.9830 | 0.0000 | -75.2924 | 0.0000 |
| **LUSEALSI** | -9.9300 | 0.0000 | -81.7672 | 0.0000 |
| **NSEASI** | -7.5722 | 0.0000 | -64.8197 | 0.0000 |
| **LUSEALSI** | -10.8032 | 0.0000 | -87.5846 | 0.0000 |
| **SEMDEX** | -5.3331 | 0.0002 | -52.3130 | 0.0000 |
| **LUSEALSI** | -3.1606 | 0.0897 | -23.0004 | 0.0178 |
| **USEALSI** | -4.3192 | 0.0048 | -35.9959 | 0.0004 |
| **LUSEALSI** | -3.2201 | 0.0792 | -25.0696 | 0.0103 |
| **ZSEIND** | -9.2206 | 0.0000 | -77.2586 | 0.0000 |
| **NSEASI** | -3.6660 | 0.0281 | -27.9228 | 0.0048 |
| **SEMDEX** | -4.6705 | 0.0017 | -42.8440 | 0.0000 |
| **NSEASI** | -3.6372 | 0.0304 | -37.3271 | 0.0003 |
| **USEALSI** | -4.3689 | 0.0042 | -56.7835 | 0.0000 |
| **NSEASI** | -6.8949 | 0.0000 | -58.5785 | 0.0000 |
| **ZSEIND** | -8.5152 | 0.0000 | -71.7902 | 0.0000 |
| **SEMDEX** | -4.6139 | 0.0020 | -42.0294 | 0.0001 |
| **USEALSI** | -4.2184 | 0.0064 | -36.0162 | 0.0004 |
| **SEMDEX** | -7.4512 | 0.0000 | -62.4393 | 0.0000 |
| **ZSEIND** | -9.9270 | 0.0000 | -82.3398 | 0.0000 |
| **USEALSI** | -6.9225 | 0.0000 | -58.1910 | 0.0000 |
| **ZSEIND** | -7.9743 | 0.0000 | -67.2620 | 0.0000 |

**Table 4.4a AIC Lag Selection Criteria**

| Value of AIC lag Selection Criteria | | | | MODEL |
|---|---|---|---|---|
| LAG-1 | LAG-2 | LAG-3 | LAG-4 | |
| 12,78 | 12,66498 | 12,999 | | LUSEALSI vs EGX_100 |
| 11,73 | 11,57 | 11,67 | | EGX_100 vs LUSEALSI |
| | | | | |
| 6,41 | 6,21 | 6,27 | | NSEASI vs EGX_100 |
| 11,69 | 11,66 | 11,68 | | EGX_100 does vs NSEASI |
| | | | | |
| 10,21 | 10,29 | 10,59 | | SEMDEX vs EGX_100 |
| 11,58 | 11,63 | 11,66 | | EGX_100 vs SEMDEX |
| | | | | |
| 11,41 | 11,46 | 11,53 | | USEALSI vs EGX_100 |
| 11,63 | 11,67 | 11,71 | | EGX_100 vs USEALSI |
| | | | | |
| 7,68 | 7,7 | 7,75 | | ZSEIND vs EGX_100 |
| 11,62 | 11,65 | 11,678 | | EGX_100 vs ZSEIND |
| | | | | |
| 6,315 | 6,23 | 6,283 | | NSEASI vs LUSEALSI |
| 12,79 | 12,69 | 12,73 | | LUSEALSI vs NSEASI |
| | | | | |
| 10,38 | 10,31 | 10,36 | | SEMDEX vs LUSEALSI |
| 12,76 | 12,61 | 12,62 | | LUSEALSI vs SEMDEX |
| | | | | |
| 11,46 | 11,52 | 11,59 | | USEALSI vs LUSEALSI |
| 12,83 | 12,72 | 12,73 | | LUSEALSI vs USEALSI |
| | | | | |
| 7,67 | 7,71 | 7,76 | | ZSEIND vsLUSEALSI |
| 12,79 | 12,71 | 12,72 | | LUSEALSI vs ZSEIND |
| | | | | |
| 10,406 | 10,29 | 10,34 | | SEMDEX dvs NSEASI |
| 6,39 | 13,57 | 6,19 | 10,24 | NSEASI vs SEMDEX |
| | | | | |
| 11,42 | 11,49 | 11,56 | | USEALSI vs NSEASI |
| 6,18 | 6,24 | 6,301 | | NSEASI vs USEALSI |
| | | | | |
| 7,57 | 7,618 | 7,67 | | ZSEIND vs NSEASI |
| 6,18 | 6,23 | 6,28 | | NSEASI vs ZSEIND |
| | | | | |
| 11,47 | 11,53 | 11,6 | | USEALSI vs SEMDEX |
| 10,38 | 10,26 | 10,35 | | SEMDEX vs USEALSI |
| | | | | |
| 7,62 | 7,64 | 7,714 | | ZSEIND vs SEMDEX |
| 10,37 | 10,16 | 10,19 | | SEMDEX vs ZSEIND |
| | | | | |
| 7,51 | 7,54 | 7,89 | | ZSEIND vs USEALSI |
| 11,44 | 11,49 | 11,6 | | USEALSI vs ZSEIND |

**Table 4.4b LM tests reuslts**

| MODEL | F - STATISTIC LM TEST | Prob | CONCLUSION |
|---|---|---|---|
| | | | |
| LUSEALSI vs EGX_100 | 2,3300 | 0,1000 | No Serial correlation |
| EGX_100 vs LUSEALSI | 0,2460 | 0,7800 | |
| | | | |
| NSEASI vs EGX_100 | 0,2810 | 0,7500 | No Serial correlation |
| EGX_100 does vs NSEASI | 0,2280 | 0,7967 | |
| | | | |
| SEMDEX vs EGX_100 | 2,3560 | 0,1320 | No Serial correlation |
| EGX_100 vs SEMDEX | 0,3166 | 0,7200 | |
| | | | |
| USEALSI vs EGX_100 | 0,3900 | 0,6700 | No Serial correlation |
| EGX_100 vs USEALSI | 0,3386 | 0,7141 | |
| | | | |
| ZSEIND vs EGX_100 | 2,3700 | 0,1338 | No Serial correlation |
| EGX_100 vs ZSEIND | 0,8140 | 0,4533 | |
| | | | |
| NSEASI vs LUSEALSI | 0,6730 | 0,5137 | No Serial correlation |
| LUSEALSI vs NSEASI | 0,0909 | 0,9140 | |
| | | | |
| SEMDEX vs LUSEALSI | 2,2197 | 0,1176 | No Serial correlation |
| LUSEALSI vs SEMDEX | 2,2550 | 0,1137 | |
| | | | |
| USEALSI vs LUSEALSI | 0,1515 | 0,8597 | No Serial correlation |
| LUSEALSI vs USEALSI | 0,4740 | 0,6248 | |
| | | | |
| ZSEIND vsLUSEALSI | 0,2935 | 0,5899 | No Serial correlation |
| LUSEALSI vs ZSEIND | 0,9779 | 0,3821 | |
| | | | |
| SEMDEX dvs NSEASI | 0,7875 | 0,4570 | No Serial correlation |
| NSEASI vs SEMDEX | 1,6139 | 0,1900 | |
| | | | |
| USEALSI vs NSEASI | 0,0181 | 0,8340 | No Serial correlation |
| NSEASI vs USEALSI | 0,3017 | 0,5847 | |
| | | | |
| ZSEIND vs NSEASI | 0,5269 | 0,4706 | No Serial correlation |
| NSEASI vs ZSEIND | 0,6056 | 0,4394 | |
| | | | |
| USEALSI vs SEMDEX | 0,2714 | 0,6042 | No Serial correlation |
| SEMDEX vs USEALSI | 0,9059 | 0,3631 | |
| | | | |
| ZSEIND vs SEMDEX | 0,4625 | 0,4849 | No Serial correlation |
| SEMDEX vs ZSEIND | 1,0880 | 0,2984 | |
| | | | |
| ZSEIND vs USEALSI | 0,1517 | 0,6984 | No Serial correlation |
| USEALSI vs ZSEIND | 0,9720 | 0,3291 | |

### 4.4c Autoregressive Distributed Lag test result

| | PERSARAN CRITICAL VALUES | | | |
|---|---|---|---|---|
| | F-STATISTIC | LOWER BOUND | UPPER BOUND | CONCLUSION |
| | **A** | **B** | **C** | |
| LUSEALSI vs EGX_100 | 5,895** | 4,0400 | 4,7800 | long run relation A › C |
| EGX_100 vs LUSEALSI | 17,32*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| NSEASI vs EGX_100 | 5,21* | 4,0400 | 4,7800 | long run relation A › C |
| EGX_100 does vs NSEA | 12,68*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| SEMDEX vs EGX_100 | 23,66*** | 4,0400 | 4,7800 | long run relation A › C |
| EGX_100 vs SEMDEX | 25,073*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| USEALSI vs EGX_100 | 11,52*** | 4,0400 | 4,7800 | long run relation A › C |
| EGX_100 vs USEALSI | 22,5*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| ZSEIND vs EGX_100 | 17,083*** | 4,0400 | 4,7800 | long run relation A › C |
| EGX_100 vs ZSEIND | 22,95*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| NSEASI vs LUSEALSI | 5,26* | 4,0400 | 4,7800 | long run relation A › C |
| LUSEALSI vs NSEASI | 4,3800 | 4,0400 | 4,7800 | Inconclusive |
| | | | | |
| SEMDEX vs LUSEALSI | 4,4000 | 4,0400 | 4,7800 | Inconclusive |
| LUSEALSI vs SEMDEX | 16,39*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| USEALSI vs LUSEALSI | 6,31** | 4,0400 | 4,7800 | long run relation A › C |
| LUSEALSI vs USEALSI | 4,4100 | 4,0400 | 4,7800 | Inconclusive |
| | | | | |
| ZSEIND vsLUSEALSI | 17,02*** | 4,0400 | 4,7800 | long run relation A › C |
| LUSEALSI vs ZSEIND | 4,6020 | 4,0400 | 4,7800 | Inconclusive |
| | | | | |
| SEMDEX dvs NSEASI | 4,95* | 4,0400 | 4,7800 | long run relation A › C |
| NSEASI vs SEMDEX | 5,516* | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| USEALSI vs NSEASI | 10,229*** | 4,0400 | 4,7800 | long run relation A › C |
| NSEASI vs USEALSI | 7,885** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| ZSEIND vs NSEASI | 19,7675*** | 4,0400 | 4,7800 | long run relation A › C |
| NSEASI vs ZSEIND | 7,95*** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| USEALSI vs SEMDEX | 10,03*** | 4,0400 | 4,7800 | long run relation A › C |
| SEMDEX vs USEALSI | 4,89* | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| ZSEIND vs SEMDEX | 19,75*** | 4,0400 | 4,7800 | long run relation A › C |
| SEMDEX vs ZSEIND | 5,97** | 4,0400 | 4,7800 | long run relation A › C |
| | | | | |
| ZSEIND vs USEALSI | 22,018*** | 4,0400 | 4,7800 | long run relation A › C |
| USEALSI vs ZSEIND | 11,3*** | 4,0400 | 4,7800 | long run relation A › C |

### 4.3.2 ARDL test

Selecting an appropriate lad structure is imperative when applying ARDL method. Information criterion was used for this purpose in this study. The objective is to choose a model that minimises the information criteria. Broadly, the three mostly applied critearia are Akaike (1974) criterion (AIC), Schawarz (1978) Beyesian criterion (SBIC) and Hannan-Quin criterion (HQIC). Of the three, SBIC is consistent and not efficient while the opposite holds for AIC. This then implies that no criterion can be deemed superior to the other (Brooks, 2008) and for that reason, AIC is used in this study. Results of the same are reported under Table 4.4a. The light blue shade is indicative of the modelled selected. Further-more the selected model was subjected to Lagrange Multiplier (LM) to ascertain the absence or presence of serial correlation. The LM test the null of absence of serial correlation agaimst an altenative of autocorrelated residuals. The F-version of the test is reported under Table 4.4b with no autocorrelation detetective in the residuals.

Subsequent to choosing the lag order, pairwise ADRL model tests where perfomed. Whollistically, 30 pairs where investigated and Table 4.4c reports the results of the bound tests of cointegration. Based on the discussion in section 3.4, the existence of long run equilibrium between equity market series is confirmed if the calculated F-statistic is greater than the peasaran upper bound critical value. Indications are that the null hypothesis of no longrun relationship between the markets under study can not be accepted for 26 of the stock market pairs since the F-statistics exceeds the upper bound critical value at varying levels of siginificance. However, subject to the dependent variable for a set of series, the results of the test couldn`t be conclusive in four of the highlighted pairs under Table 4.4c. The reults, to a larger extend, compounds the earlier results under the Engle Granger cointegration tests. More so, the finding along with other previous studies provides evidence in favour of the assesion that stock markets in the same region tend to exhibit long run relationship. Testing a similar hypothesis, Marashdeh (2010), using ARDL approach to integration concluded that stock markets of Egypt, Turkey, Morrocco and Jordan are cointegrated. These markets are all in the MENA region.

### 4.4 Johansen cointegration tests

Further to the Engle-Granger cointegration test employed above, the Johansen procedure was also run. As mentioned in chapter 3, the Engle-Granger method requires larger sample sizes and can only be run on two series at a time. In addition, it is only the Johansen framework that allows for hypothesis testing on the cointegrating relationships in the series themselves (Ssekuma, 2011). The results from the Johansen tests are reported below. Prior to conducting the actual cointegration tests, information criterion was employed to choose the correct number of lags. Four of the six reference information criterion in Table 4.6 below pointed to two lags as the optimum leg length. Therefore, the subsequent tests were run based on two legs in their specification

**Table 4. 5 Lag length criteria**

VAR Lag Order Selection Criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -1203.601 | NA | 1.05e+09 | 37.80004 | 38.00244 | 37.87978 |
| 1 | -1112.179 | 162.8456 | 1.87e+08 | 36.06810 | 37.48487* | 36.62624 |
| 2 | -1060.642 | 58.18376* | 97111512* | 34.88692* | 38.21371 | 36.61911* |
| 3 | -1024.524 | 50.79183 | 1.27e+08 | 35.57887 | 39.42438 | 37.09381 |
| 4 | -986.8020 | 45.97339 | 1.41e+08 | 35.52506 | 40.58494 | 37.51840 |
| 5 | -930.3813 | 82.13702 | 1.18e+08 | 35.58257 | 41.16117 | 37.35866 |
| 6 | -894.9196 | 29.92088 | 1.54e+08 | 34.90374 | 42.39236 | 37.85388 |

* indicates lag order selected by the criterion

#### 4.4.1 Johansen test

For the Johansen cointegration test, the output in Table 4.7a was extracted. The first test based on the trace matrix revealed that there are six cointegrating equations from the variable employed. All the p-values are equal to zero meaning that at 5% significance level, the null hypothesis that $r = 0$ can be rejected in favour of the alternative that $r > 0$. The same is true for the subsequent null hypotheses that $r = 1$, $r = 2$, $r = 3$, $r = 4$ and $r = 5$ as confirmed by the subsequent p-values. The same was also true when the maximum eigenvalue statistics and p-values were examined; this test also confirmed the presence of six cointegrating equations at 5% significance level. These results are consistent with what was observed in the Engle-

Granger cointegration tests were significant long-run relationships were found to be existent among all of the six markets examined. However, the results of the Johansen cointegration test run for the period, prior to the operationalization of some trade facilitation agreements (Trade for Peace program of 2007 and regional Customs Gaurantee Scheme of 2012) Table 4.7b paints a different picture on the structure of integration of African stock markets. The trace and maximum eigenvalue test confirms only two and only one cointegration equitions respectively.

Based on these results from the Johansen tests, it can be concluded that the COMESA membership has caused the respective members' markets to share a long run equlibrium with policy alignment and increased international trade playing a key role in synchronising the markets over time. This is, not so entirely surprising finding in view of the extent of efforts towards integrating COMESA markets through the removal of trade restriction and impediments to smooth information flow (Economic Commission for Africa 2011). Carmignani (2005), also noted that the increased convergence of the COMESA markets could emanating from the strategic objective of the regional bloc to establish a currency union by 2025. Pursuant to this, the COMESA countries a set of convergence criteria (COMESA Annual Report 2014). Additionally, the more advanced and liquid equity markets of Mauritius and Egypt have long been supporting intiatives for stock exchange collaboration on the African continent a factor that help explaining the existence of a long run relationship between COMESA markets. With such level of cointegration, it implies that scant benefits of cross-border asset diversification by investors prevails among these countries. Volatility spillovers are likely to be quite significant across these markets and risks levels and sources are likely to be similar. Thus, when seeking to diversify their portfolios, investors should focus more on countries and markets that are outside the bloc. These results, however, contradict what has been reported in other studies. For instance, as discussed above, Jefferis (1999) concluded that integration of Southern African markets and other international markets was still in its infancy and Alagidede (2008) reported weak stochastic trends first among South and East African stock markets. However, given that the study was conducted a while ago, it is possible that the level of convergence has increased over time.

**Table 4. 6a Johansen cointegration tests – 2009 to 2015**

| | | Trace Test - Un restricted Cointegration | | |
|---|---|---|---|---|
| Hypothesised Number of Cointegrating Equations | Eigenvalue | Trace Statistic | Critical Value at 5% | Prob** |
| 0* | 0.697631 | 310.8597 | 95.75366 | 0.0000 |
| 1* | 0.651182 | 230.7205 | 69.81889 | 0.0000 |
| 2* | 0.565372 | 160.1557 | 47.85613 | 0.0000 |
| 3* | 0.486087 | 104.3269 | 29.79707 | 0.0000 |
| 4* | 0.386115 | 59.72493 | 15.49471 | 0.0000 |
| 5* | 0.332001 | 27.03244 | 3.841466 | 0.0000 |

| | | Rank Test - Un restricted Cointegration | | |
|---|---|---|---|---|
| Hypothesised Number of Cointegrating Equations | Eigenvalue | Max Eigen Statistic | Critical Value at 5% | Prob** |
| 0* | 0.697631 | 80.13928 | 40.07757 | 0.0000 |
| 1* | 0.651182 | 70.56474 | 33.87687 | 0.0000 |
| 2* | 0.565372 | 55.82879 | 27.58434 | 0.0000 |
| 3* | 0.486087 | 44.60200 | 21.13162 | 0.0000 |
| 4* | 0.386115 | 32.69248 | 14.26460 | 0.0000 |
| 5* | 0.332001 | 27.03244 | 3.841466 | 0.0000 |

Max Eigen value and trace test indicate 6 cointegrating equations at 5%
* Denotes rejection of null hypothesis at 5% significance level

**Table 4. 7b Johansen cointegration tests – 2004 - 2008**

| | | Trace Test - Un restricted Cointegration | | |
|---|---|---|---|---|
| Hypothesised Number of Cointegrating Equations | Eigenvalue | Trace Statistic | Critical Value at 5% | Prob** |
| 0* | 0.554650 | 117.6522 | 95.75366 | 0.0007 |
| 1* | 0.413670 | 72.35409 | 69.81889 | 0.0309 |
| 2 | 0.274341 | 42.45722 | 47.85613 | 0.1463 |
| 3 | 0.228944 | 24.49945 | 29.79707 | 0.1801 |
| 4 | 0.145064 | 9.939805 | 15.49471 | 0.2854 |
| 5 | 0.020554 | 1.163017 | 3.841466 | 0.2808 |

| | | Rank Test - Un restricted Cointegration | | |
|---|---|---|---|---|
| Hypothesised Number of Cointegrating Equations | Eigenvalue | Max Eigen Statistic | Critical Value at 5% | Prob** |
| 0* | 0.554650 | 45.29813 | 40.07757 | 0.0118 |
| 1 | 0.413670 | 29.89686 | 33.87687 | 0.1389 |
| 2 | 0.274341 | 17.95777 | 27.58434 | 0.4987 |
| 3 | 0.228944 | 14.55965 | 21.13162 | 0.3210 |
| 4 | 0.145064 | 8.776788 | 14.26460 | 0.3052 |
| 5 | 0.020554 | 1.163017 | 3.841466 | 0.2808 |

Max Eigen value and trace test indicate 1 and 2 cointegrating equations at 5% respectively* Denotes rejection of null hypothesis at 5% significance level

### 4.4.2 Vector error correction model (VECM)

Subsequent to establishing that there are cointegrating relationships between/among the six markets, (VECM) was estimated and the findings are summerised in Table 4.8. The error correction co-efficients are negative as well. Suggesting that all the variables corrects for previous period's disequilibrium. That is to say, to maintain the long-run relationship, between the series, all the indices are reverting back to the long run relationship by correcting for the short run deviations. This ensures that the variables' long-run relationship is maintained in such a way that shows the presence of cointegration. Therefore, although the long run tests show that there might be insignificant diversification benefits, the fact that the series have to significantly correct for short run deviations shows that the diversification benefits are still significant. This adds different diversification opportunities, especially for more active short run traders, in addition to the significant opportunities for diversification in the long run as reported by Jefferis (1999), Aziakpono and Chinzara (2009) and Graham *et al.*(2012).

**Table 4. 8 Error Correction Coefficient Estimates**

| Dependent-Variable | ECM - Coefficient | Std. Error | t-Statistic | Prob |
|---|---|---|---|---|
| D(EGX_100) | -1.191216 | 0.249353 | -4.777238 | 0.0000 |
| D(LUSEALSI) | -0.801234 | 0.210946 | -3.798284 | 0.0004 |
| D(NSEASI) | -0.512497 | 0.345640 | -1.482748 | 0.0444 |
| D(SEMDEX) | -0.520595 | 0.211144 | -2.465593 | 0.0172 |
| D(USEALSI) | -0.664632 | 0.393020 | -1.691089 | 0.0970 |
| D(ZSEIND) | -1.322940 | 0.269389 | -4.910898 | 0.0000 |

EGX 100 Price Index (EGX100) , Nairobi Securities Exchange All Share Index (NSEASI), Stock Exchange of Mauritius Index (SEMDEX), Ugandan Stock Exchange All share index (USEALSI), Lusaka Stock Exchange All share index (LuSEALSI), The Zimbabwe Stock Exchange Industrial index (ZSEInd.)

## 4.5 Causality tests

This section summerises the findings upon conducting the causality tests among the six market indices.

### 4.5.1 Vector Autoregressions (VAR)

The VAR estimation output in Table 4.10 below on the VAR equations specified in chapter 3. In addition, as mentioned in chapter 3, the two lags employed in the estimation output based on the AICand SBIC information criterion. Very few lags are significant from the VAR output below, indicating weak short-run causality among the variables. For EGX100 equation, own lags, as well as the lags on other variables, are all insignificant. On the other hand, in the NSEASI and USEALSI equations, the one period EGX100 lags are significant (0.151** and 0.209***, respectively). This is indicative of unidirectional causality flowing from EGX100 towards both series. For LUSEALSI, the second-period lags on the NSEASI and SEMDEX are positive and significant (0.262* and 0.442**, respectively). While in the SEMDEX equation, the one period lag on the LUSEALSI is also significant and positive (0.169*). This indicates the presence of two-way causality between the LUSEALSI and SEMDEX and one way causality between the LUSEALSI and the NSEASI, running from the latter to the former. For the NSEASI, in addition to the one period lag on EGX100, the USEALSI two period lag is significant (0.328**). On the other hand, the two period lag of the NSEASI is also significant in the USEALSI equation (0.576***), indicative of bidirectional causality between the two. For the ZSEIND, however, there is no causality between this series and any of the other series.

## Table 4. 9 Vector Autoregressions Estimates

| | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| **EGX100(-1)** | 0.006964 | 0.025734 | 0.151458 | 0.054831 | 0.209067 | 0.077104 |
| **T-statistics** | [ 0.04952] | [ 0.48186] | **[ 2.20754]** | [ 1.49970] | **[ 2.60619]** | [ 0.80181] |
| | | | | | | |
| **EGX100(-2)** | -0.104629 | 0.067809 | -0.035172 | 0.004468 | -0.054378 | -0.000571 |
| **T-statistics** | [-0.75657] | [ 1.29108] | [-0.52128] | [ 0.12427] | [-0.68928] | [-0.00603] |
| | | | | | | |
| **LUSEALSI(-1)** | 0.338761 | -0.156295 | 0.263617 | 0.169247 | 0.148399 | 0.145383 |
| **T-statistics** | [ 1.00936] | [-1.22622] | [ 1.60991] | **[ 1.93958]** | [ 0.77511] | [ 0.63346] |
| | | | | | | |
| **LUSEALSI(-2)** | 0.345915 | -0.017988 | -0.234457 | -0.097636 | -0.217359 | -0.042231 |
| **T-statistics** | [ 0.99964] | [-0.13687] | [-1.38872] | [-1.08522] | [-1.10111] | [-0.17847] |
| | | | | | | |
| **NSEASI(-1)** | 0.170829 | -0.084384 | -0.122424 | -0.038468 | -0.134727 | -0.079173 |
| **T-statistics** | [ 0.44655] | [-0.58082] | [-0.65592] | [-0.38675] | [-0.61736] | [-0.30265] |
| | | | | | | |
| **NSEASI(-2)** | -0.382072 | 0.262047 | 0.188865 | 0.064148 | 0.575979 | 0.173892 |
| **T-statistics** | [-1.02038] | **[ 1.84275]** | [ 1.03381] | [ 0.65892] | **[ 2.69650]** | [ 0.67912] |
| | | | | | | |
| **SEMDEX(-1)** | 0.554081 | 0.084857 | 0.051694 | 0.136642 | 0.208848 | 0.377302 |
| **T-statistics** | [ 1.01683] | [ 0.41005] | [ 0.19444] | [ 0.96448] | [ 0.67187] | [ 1.01254] |
| | | | | | | |
| **SEMDEX(-2)** | -0.073180 | 0.442751 | -0.161624 | 0.134168 | -0.259564 | 0.138636 |
| **T-statistics** | [-0.13929] | **[ 2.21904]** | [-0.63054] | [ 0.98224] | [-0.86608] | [ 0.38589] |
| | | | | | | |
| **USEALSI(-1)** | -0.180346 | 0.039275 | 0.109912 | 0.022936 | 0.049759 | -0.252056 |
| **T-statistics** | [-0.56270] | [ 0.32267] | [ 0.70290] | [ 0.27524] | [ 0.27216] | [-1.15006] |
| | | | | | | |
| **USEALSI(-2)** | 0.293563 | -0.174005 | 0.328486 | -0.030669 | 0.066352 | 0.298829 |
| **T-statistics** | [ 0.89110] | [-1.39077] | **[ 2.04369]** | [-0.35806] | [ 0.35307] | [ 1.32647] |
| | | | | | | |
| **ZSEIND(-1)** | -0.187288 | 0.071707 | -0.056173 | 0.043038 | -0.091880 | 0.004447 |
| **T-statistics** | [-0.89333] | [ 0.90061] | [-0.54916] | [ 0.78956] | [-0.76825] | [ 0.03102] |
| | | | | | | |
| **ZSEIND(-2)** | 0.028166 | -0.048611 | -0.125055 | -0.053770 | -0.156611 | -0.205235 |
| **T-statistics** | [ 0.13364] | [-0.60735] | [-1.21620] | [-0.98131] | [-1.30266] | [-1.42408] |
| | | | | | | |
| **C** | -1.200552 | 1.260868 | 0.161224 | -0.008700 | 0.684096 | -0.631791 |
| **T-statistics** | [-0.97486] | **[ 2.69589]** | [ 0.26833] | [-0.02717] | [ 0.97377] | [-0.75021] |
| | | | | | | |
| **R-squared** | 0.150122 | 0.265422 | 0.314397 | 0.216556 | 0.320899 | 0.188293 |
| **Adj. R-squared** | -0.031994 | 0.108013 | 0.167483 | 0.048675 | 0.175377 | 0.014356 |

EGX 100 Price Index (EGX100) , Nairobi Securities Exchange All Share Index (NSEASI), Stock Exchange of Mauritius Index (SEMDEX), Ugandan Stock Exchange All share index (USEALSI), Lusaka Stock Exchange All share index (LuSEALSI), The Zimbabwe Stock Exchange Industrial index (ZSEInd.)

### 4.5.2 Granger-causality tests

Table 4.11 summerises the findings of the Granger-causality block tests. For EGX100, there seems to be no causality flowing from any of the five indices. However, the EGX100 Granger-causes the NSEASI (p-value = 7.7%) and the USEALSI (p-value = 2.7%), denoting unidirectional causality between the EGX100 and these variables. This result suggest that information is incorporated slightly more quickly on the Egyptian market relative to the other markets. This, not so surpring a finding given that Egypt is one of the dominant markets by market capititalisation on the African continent (ASEA year book 2014). In literature, it well documented that dominant markets have a tendency to lead smaller markets. For the LUSEALSI, only the lags of the SEMDEX (p-value = 7.4%) Granger cause the LUSEALSI, while the lags on the LUSEALSI Granger-causes the NSEASI (p-value = 6.0%) and the SEMDEX (5.0%). This denotes a unidirectional causality between the LUSEALSI and the NSEASI and a bidirectional causality between the LUSEALSI and the SEMDEX. Lags of the USEALSI (p-value = 9.6%) Granger-causes the NSEASI, while the lags on the NSEASI (p-value = 2.1%) also Granger-causes the USEALSI. It is reasonable for the returns for these two markets to influence each other since they all members of the East African Community. This denotes a bidirectional causality between these two indices. Looking at joint causality, the lags on the other variables Granger-cause the LUSEALSI (p-value = 3.9%) and the USEALSI (p-value = 3.6%). There is no causality between the ZSEIND and any other variables employed in the estimation, however.

**Table 4. 11 Granger-causality/Block exogeneity Wald tests**

| Dependent variable: EGX100 | | | | Dependent variable: LUSEALSI | | | |
|---|---|---|---|---|---|---|---|
| Excluded | Chi-sq | df | Prob. | Excluded | Chi-sq | Df | Prob. |
| LUSEALSI | 1.686 | 2 | 0.430 | EGX100 | 1.906 | 2 | 0.386 |
| NSEASI | 1.258 | 2 | 0.533 | NSEASI | 3.774 | 2 | 0.152 |
| SEMDEX | 1.040 | 2 | 0.594 | SEMDEX | 5.211 | 2 | 0.074 |
| USEALSI | 1.102 | 2 | 0.576 | USEALSI | 2.031 | 2 | 0.362 |
| ZSEIND | 0.815 | 2 | 0.665 | ZSEIND | 1.178 | 2 | 0.555 |
| All | 8.387 | 10 | 0.591 | All | 19.144 | 10 | 0.039 |
| **Dependent variable: NSEASI** | | | | **Dependent variable: SEMDEX** | | | |
| Excluded | Chi-sq | df | Prob. | Excluded | Chi-sq | Df | Prob. |
| EGX100 | 5.132 | 2 | 0.077 | EGX100 | 2.266 | 2 | 0.322 |
| LUSEALSI | 5.617 | 2 | 0.060 | LUSEALSI | 5.999 | 2 | 0.050 |
| SEMDEX | 0.422 | 2 | 0.809 | NSEASI | 0.593 | 2 | 0.743 |
| USEALSI | 4.694 | 2 | 0.096 | USEALSI | 0.202 | 2 | 0.904 |
| ZSEIND | 1.782 | 2 | 0.410 | ZSEIND | 1.583 | 2 | 0.453 |
| All | 13.539 | 10 | 0.195 | All | 11.742 | 10 | 0.303 |
| **Dependent variable: USEALSI** | | | | **Dependent variable: ZSEIND** | | | |
| Excluded | Chi-sq | df | Prob. | Excluded | Chi-sq | Df | Prob. |
| EGX100 | 7.247 | 2 | 0.027 | EGX100 | 0.642 | 2 | 0.725 |
| LUSEALSI | 2.235 | 2 | 0.327 | LUSEALSI | 0.496 | 2 | 0.780 |
| NSEASI | 7.717 | 2 | 0.021 | NSEASI | 0.560 | 2 | 0.756 |
| SEMDEX | 1.139 | 2 | 0.566 | SEMDEX | 1.222 | 2 | 0.543 |
| ZSEIND | 2.290 | 2 | 0.318 | USEALSI | 3.057 | 2 | 0.217 |
| All | 19.320 | 10 | 0.036 | All | 12.398 | 10 | 0.259 |

EGX 100 Price Index (EGX100) , Nairobi Securities Exchange All Share Index (NSEASI), Stock Exchange of Mauritius Index (SEMDEX), Ugandan Stock Exchange All share index (USEALSI), Lusaka Stock Exchange All share index (LuSEALSI), The Zimbabwe Stock Exchange Industrial index (ZSEInd.)

Table 4.11a is a presentation of bi-variate causality tests for the series under study. Bi-directional feed back is confirmed between Zambia and Egypt capital market. The causal effect from Egypt is much stronger (4.95%) compared to Zambia (10.00%). Size difference between these markets can be a key to explaining this observation. On the other hand, uni-directional feedback is confirmed flowing from Mautius to Zambia (7.8%), Kenya to Zimbabwe (3.2%) and Uganda to Zimbabwe (0.4%). Common to these pairs is China as a source of raw material export destination (Comesa annual report 2012). When markets share a common foreign markets its natural to expect significant feedback mechanism between them. The rest of the other pairs, on the contrary, provide no evidence of causality between them.

### Table 4.10a Bi-variate granger causality tests results

| HYPOTHESIS | F-STATISTIC | Prob. | CONCLUSION |
|---|---|---|---|
| | | | |
| LUSEALSI does not Granger Cause EGX_100 | 2,3776 | 0,1009 | Bi- directional causality |
| EGX_100 does not Granger Cause LUSEALSI | 3,1508 | 0,0495 | |
| | | | |
| NSEASI does not Granger Cause EGX_100 | 0,0707 | 0,9318 | No Causality |
| EGX_100 does not Granger Cause NSEASI | 1,5663 | 0,2167 | |
| | | | |
| SEMDEX does not Granger Cause EGX_100 | 1,8604 | 0,1639 | No Causality |
| EGX_100 does not Granger Cause SEMDEX | 1,4137 | 0,2507 | |
| | | | |
| USEALSI does not Granger Cause EGX_100 | 0,1896 | 0,8277 | No Causality |
| EGX_100 does not Granger Cause USEALSI | 1,7860 | 0,1759 | |
| | | | |
| ZSEIND does not Granger Cause EGX_100 | 0,5877 | 0,5586 | No Causality |
| EGX_100 does not Granger Cause ZSEIND | 0,0656 | 0,9365 | |
| | | | |
| NSEASI does not Granger Cause LUSEALSI | 1,5202 | 0,2265 | No causality |
| LUSEALSI does not Granger Cause NSEASI | 1,1512 | 0,3227 | |
| | | | |
| SEMDEX does not Granger Cause LUSEALSI | 2,6444 | 0,0788 | Unidirectional causality SEMDEX to LUSEALSI |
| LUSEALSI does not Granger Cause SEMDEX | 1,1641 | 0,3187 | |
| | | | |
| USEALSI does not Granger Cause LUSEALSI | 0,3327 | 0,7182 | No Causality |
| LUSEALSI does not Granger Cause USEALSI | 0,3467 | 0,7084 | |
| | | | |
| ZSEIND does not Granger Cause LUSEALSI | 1,5392 | 0,2224 | No causality |
| LUSEALSI does not Granger Cause ZSEIND | 0,3472 | 0,7080 | |
| | | | |
| SEMDEX does not Granger Cause NSEASI | 0,0252 | 0,9751 | No causality |
| NSEASI does not Granger Cause SEMDEX | 0,4965 | 0,6110 | |
| | | | |
| USEALSI does not Granger Cause NSEASI | 0,3171 | 0,7294 | No Causality |
| NSEASI does not Granger Cause USEALSI | 1,3531 | 0,2657 | |
| | | | |
| ZSEIND does not Granger Cause NSEASI | 0,3579 | 0,7006 | Unidirectional causality NSEASI to ZSEIND |
| NSEASI does not Granger Cause ZSEIND | 3,6329 | 0,0320 | |
| | | | |
| USEALSI does not Granger Cause SEMDEX | 1,1083 | 0,3364 | No Causality |
| SEMDEX does not Granger Cause USEALSI | 0,0008 | 0,9992 | |
| | | | |
| ZSEIND does not Granger Cause SEMDEX | 1,4258 | 0,2479 | No Causality |
| SEMDEX does not Granger Cause ZSEIND | 1,8464 | 0,1661 | |
| | | | |
| ZSEIND does not Granger Cause USEALSI | 0,9703 | 0,3845 | Unidirectional Causality USEALSI to |
| USEALSI does not Granger Cause ZSEIND | 6,0295 | 0,0040 | |

EGX 100 Price Index (EGX100) , Nairobi Securities Exchange All Share Index (NSEASI), Stock Exchange of Mauritius Index (SEMDEX), Ugandan Stock Exchange All share index (USEALSI), Lusaka Stock Exchange All share index (LuSEALSI), The Zimbabwe Stock Exchange Industrial index (ZSEInd.)

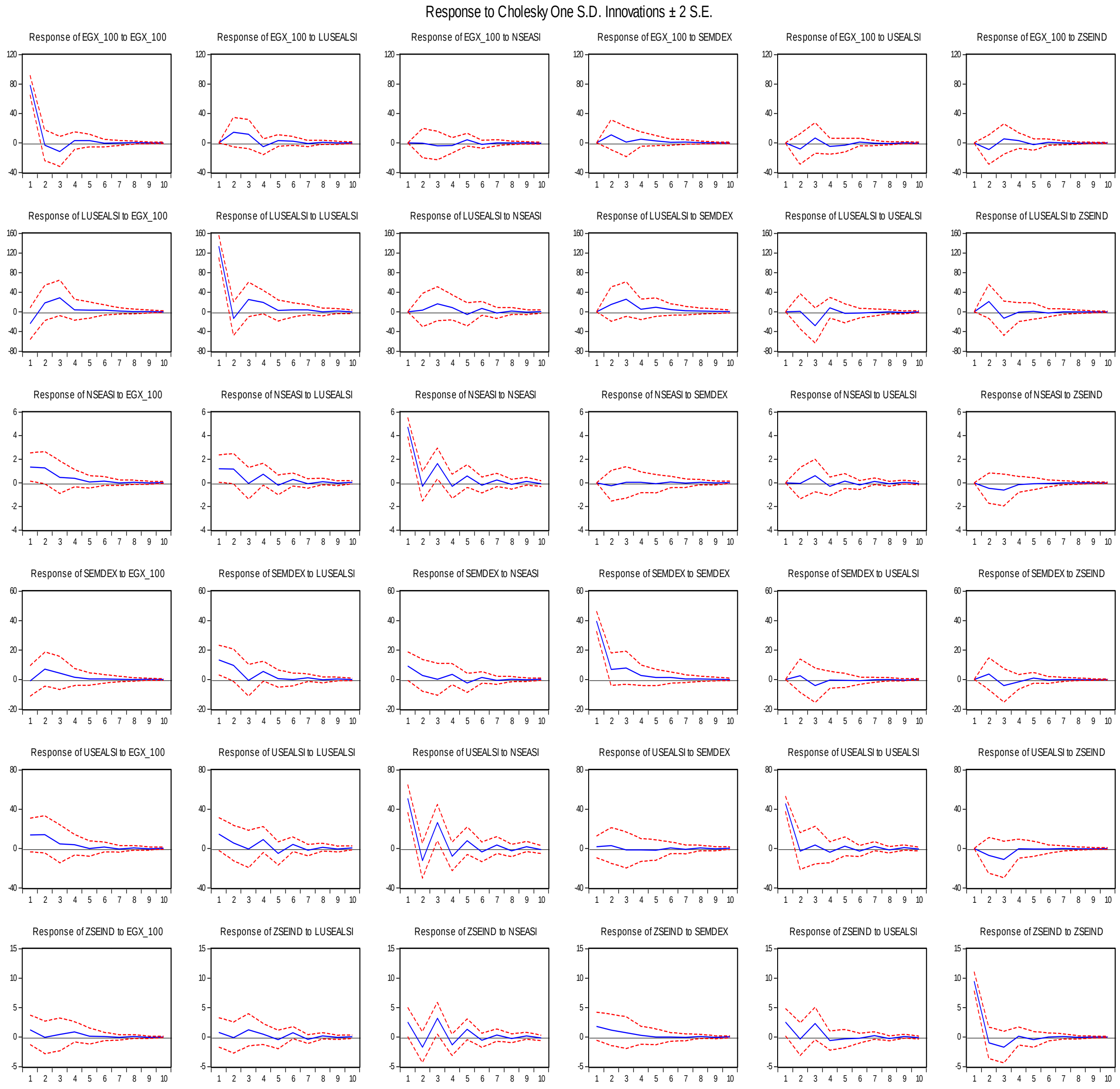
### 4.5.3 Impulse response functions

As mentioned in the previous chapter, impulse response functions allow for the tracing out of the sensitivity of the dependent elements in the VAR system to one standard deviation of shocks to each of the variables, including itself (Seymen, 2008). This enables determination of the immediacy of the response, the significance of the response and how long the effect takes to pass through the system. As mentioned before, this study employed Cholesky decomposition, a procedure that uses the decomposition of a positive-definite matrix into the product of a lower triangular matrix and its conjugate transpose, useful for efficient numerical solutions and for solving systems of linear equations (Martin and Wilkinson, 1995).

Generally the results shows that the response of markets to own standard deviation shock starts of high and positive, rapidily drops off, turning negative in some instances and then eventually dies off. For the EGX100, there is a significant immediate response to own one standard error shock, which, however, quickly dissipates and becomes negative in period 3. Response to innovations in the other variables is delayed as it only becomes significant and positive (LUSEALSI and SEMDEX) and negative (ZSEIND) in period 2. This is rather expected given the small size of these markets relative to their Egyptian counter part (Wang et al 2010). There is also a negative response to one standard error shock in the USEALSI, in period 2 and 4. All these shocks disappear through the system by period 5. For LUSEALSI, there is an immediate and significantly positive response to own one standard error innovations. Response to the shocks in the other variables is delayed as it only becomes significant and positive (SEMDEX, ZSEIND and NSEASI) and negative (USEALSI) in period 3. There is an immediate negative response to shocks in the EGX100, which becomes positive in period 3. All these shocks quickly dissipate through the system by the end of period 5.

For NSEASI, there is a significant response to own shocks and shocks to EGX100 and LUSEALSI. The response to own shocks drops to zero and rise again in period 3. There is also a delayed and negative response to shocks in ZSEIND and SEMDEX as well as delayed but positive response to shocks in USEALSI. These responses become insignificant by period 7. For SEMDEX, there is a significantly positive and immediate response to own one standard error shock as well as to shocks in the LUSEALSI and the NSEASI. These, however, quickly pass through the system; by period 5, the responses are insignificant. There is also a delayed positive response in the SEMDEX to standard error shocks in ZSEIND and the EGX100. However, just as in the case of the other variables, these shocks quickly dissipate through the system. For USEALSI, there is an immediate and positive response to one standard error own shock and to shocks in NSEASI, EGX100 and LUSEALSI. There is also a delayed response to shocks in the ZSEIND and the SEMDEX. All these shocks slowly dissipate through the system until period 7. For ZSEIND, there is an immediate and positive response to own shocks. There is also positive but less significant immediate response to the shocks in the other indices. Overally, the findings compounds the observation in (Saleem 2013) that shocks within the markets have significant influence on return behaviour on African exchanges.

**Figure 4. 2 Impulse response functions**

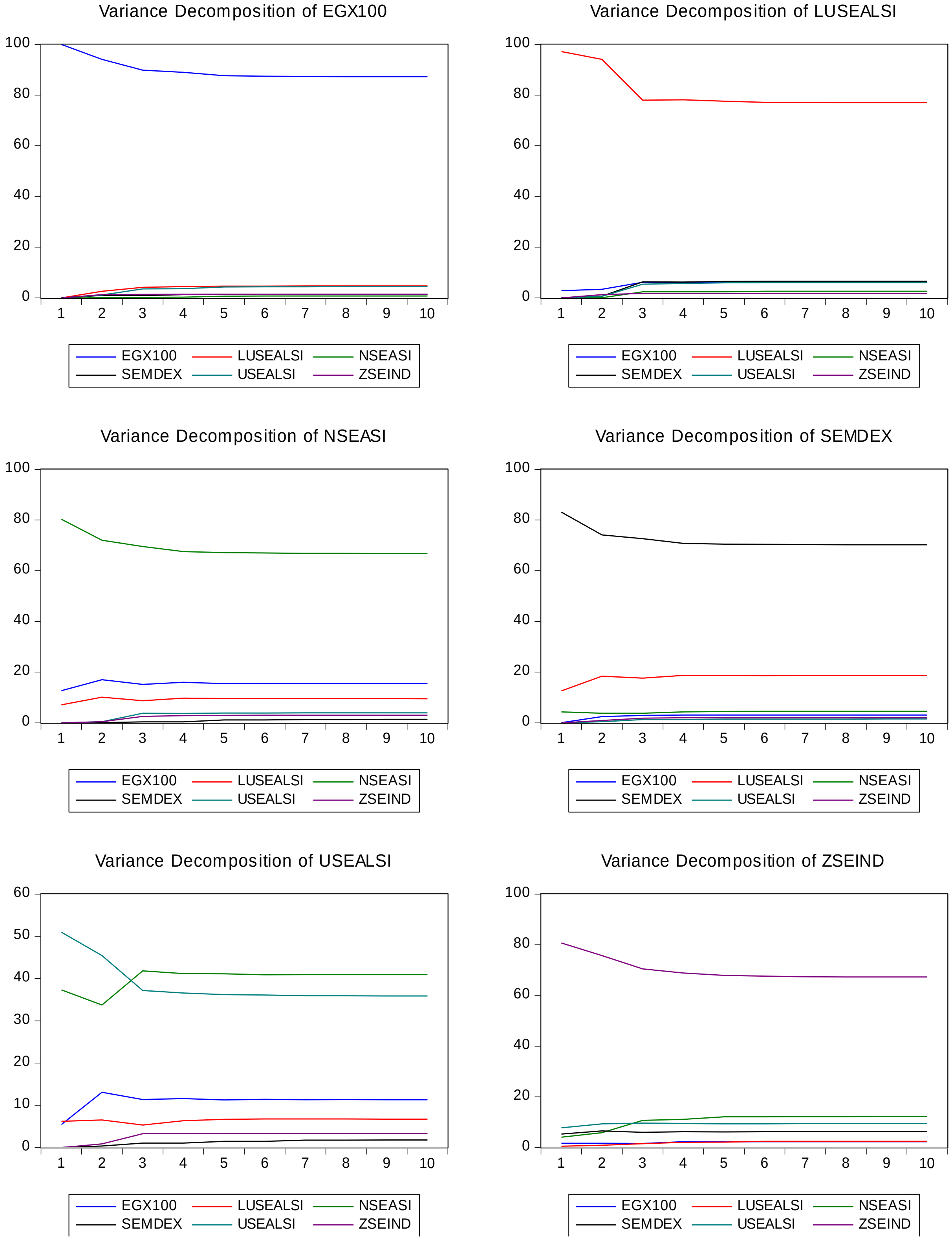


### 4.5.4 Variance decompositions

Figure 4.3 shows the variance decompositions for the six indices. Variance decompositions seek to determine what percentage of total variance in one variable is attributable to shocks in the variable itself and other variables in the system. For EGX100, an initial 100% of the variance is attributable to shocks in itself. However, this subsequently falls gradually to about 90% from period 3 onwards. Innovations in the LUSEALSI and the USEALSI explain the other 10%. For LUSEALSI, shocks in itself account for 98% of its variance, which rapidly falls to 76% from period 3 onwards. The other 24% is jointly explained by the response to the innovations in EGX100, USEALSI and SEMDEX. For the NSEASI, an initial 80% of the variance is explained by innovations in itself. This falls to about 75% from period 3 onwards. The other 10% and 15% of the variance are explained by the response to the innovations in the EGX100 and the LUSEALSI, respectively. The remaining three explain less than 1% of the variance in NSEASI. As in Gabrihiot and Syim (2015), these results confirms that greater constituent of variation in stock returns in the COMESA region are attributable to own shocks.

For SEMDEX, an initial 80% of the variance is explained by the response to own shocks. This drops to nearly 75% from period 2 onwards. The other 20% is explained by the innovations in the LUSEALSI while the remaining 5% is jointly explained by the response to the shocks in the remaining four indices. For the USEALSI, an initial 50% of total variance is attribuTable to the response to own shocks. This falls to about 38% from period 3 onwards. Also, in period 1, 35% of the variance in the USEALSI is due to a response to the shocks in NSEASI, 5% to shocks in EGX100 and the 5% to shocks LUSEALSI. From period 3, shocks in NSEASI become responsible for 43% of the variance, 10% from EGX100, 5% from shocks in LUSEALSI and the remaining 4% jointly from shocks in the ZSEIND and the SEMDEX. For the ZSEIND, an initial 80% of the variance can be attributed to the response to own shock. This falls to about 70% in period 3. The remaining 30% is explained by the response to shocks in the other five variables jointly, with the response to the shock in the NSEASI explaining about 5%. The decomposition of variance based on innovations in the variables in the same system shows that these markets do affect each other also in the short run, in addition to the long run relationships established above. This erodes the significant short run diversification opportunities available for the most active traders with very short investment horizons.

**Figure 4. 3 Variance decompositions**



## 4.6 Volatility linkages

### 4.6.1 Volatility patterns

Under the GJR-GARCH-M (1.1), the risk premium coefficient is statistically significant and for SEMDEX, suggesting that investors on the Mauritian market are compensated for bearing greater risk, unlike LUSEALSI and ZSEIND where the risk premium coefficient is negative and statistically significant. This negative coefficient implies that an increase in risk leads to a decrease in returns on the Zambian and Zimbabwean markets. The other implication borne is that in times when volatility is high, investors may not respond to the standard deviation of stocks from their historical mean but to other factors such as skewness (Mandimika and Chinzara, 2010). Although this risk premium coefficient is negative for the Egyptian, Kenyan and Ugandan markets, it is statistically insignificant.

Volatility persistence for all the markets as shown by $\alpha_1 + \beta_1$ is less than one except for the Mauritian market. A greater than one value is suggestive of strong volatility persistence, that is, a shock will persist for a long period into the future (Magnus and Fosu, 2016). Devaney (2001) showed the importance of volatility persistence as it determined the relationship between volatility and return since the changes in the risk premium are only justified by persistent volatility. The asymmetry term, $\gamma$ is only positive and statistically significant for the Mauritian market, implying that undesirable shocks have a sizable impact on volatility more than favourable shocks of the same extent. This term is not statistically significant for the Egyptian, Kenyan, Ugandan and Zimbabwean markets which suggest that the volatility spillover mechanisms in these markets are symmetrical (the GJR-GARCH-M model collapses to a standard GARCH-M model). This entails that besides bad news, good news of the same extent have the same influence on volatility. On the other hand, the asymmetry term is negative and statistically significant for the Zambian market, which suggests that good news has a greater influence on volatility than bad news of the same magnitude, which is contrary to the leverage effect. However, the evidence provided shows asymmetry in the volatility spillover mechanism on the Kenyan market. The GJR-GARCH-M (1.1) model only satisfies the non-negativity conditions for the Kenyan, Mauritian and Ugandan markets since $\alpha_1 + \beta_1$ is greater than zero. This suggests that the model is only admissible in these markets That is to say, this model can only be estimated for these markets only as it appears coherent with the underlying data generating process.

**Table 4. 10 The GJR-GARCH-M (1.1) model for all the series**

| | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| **Θ** | -11.3445 | -2.6749*** | -1.3405 | 3.7353*** | -0.9376 | -1.7577*** |
| $\alpha_0$ | 82.6393 | 10.7076*** | 5.0777 | -4.0964*** | 5.8477 | 30.0219 |
| $\alpha_1$ | 0.0227 | 0.1459*** | 0.1797 | 0.1358*** | 0.2209 | 0.1347 |
| $\gamma_i$ | -0.0390 | -3.9875*** | 0.2087 | 0.0742*** | 0.1643 | -0.7492 |
| $\beta_1$ | 0.0809 | 0.6533*** | 0.4988** | 1.0241*** | 0.5318** | 0.5750* |
| $\alpha_1 + \gamma_i$ | -0.0163 | -3.8416 | 0.3884 | 0.2100 | 0.3852 | -0.6145 |
| $\alpha_1 + \beta_1$ | 0.1036 | 0.7992 | 0.6785 | 1.1599 | 0.7527 | 0.7097 |
| **AIC** | 7.2347 | 6.2774 | 5.9585 | 31.1554 | 6.3192 | 6.9185 |
| **SBC** | 7.4578 | 6.5005 | 6.1816 | 31.3786 | 6.5423 | 7.1416 |
| **HQ** | 7.3234 | 6.3661 | 6.0473 | 31.2442 | 6.4079 | 7.0072 |
| **LogL** | -249.8327 | -215.8490 | -204.5283 | -1099.019 | -217.3329 | -238.6078 |

***, ** and * denote significance at the 1%, 5% and 10% levels respectively. LogL denotes the log likelihood.**

For the E-GARCH-M (1.1), the risk premium coefficient is negative for all the markets except the Mauritian market. This same pattern was also observed under the GJR-GARCH-M (1.1) model. However, the risk premium under the E-GARCH-M (1.1) model is only statistically significant for the Egyptian market and low level of significance suggests a weak connection between risk and return on this market. The absence of a risk premium in all the other markets might imply that investors in these markets respond to risk factors other than the conditional variance of stocks. The volatility persistence parameter (C(6)) is statistically significant and less than 1 in all the markets. However, a large value is noted for the Mauritian market, which suggests a high degree of volatility persistence than all the other markets. This same volatility pattern for the Mauritian market was also observed under the GJR-GARCH-M (1.1) model specification. The asymmetry term (C(5)) is statistically insignificant for all the markets, implying that both bad news and good news of the same scale have the same impact on stock market volatility. These results are consistent with the evidence on the Egyptian, Kenyan, Ugandan and Zimbabwean markets under the GJR-GARCH-M (1.1) model specification. Therefore, the confirmation under the E-GARCH-M (1.1) model specification suggests symmetric volatility spillover mechanism.

**Table 4. 11 The E-GARCH-M (1.1) model for all the series**

| | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| **Θ** | -2.713625* | -2.836400 | -2.392786 | 1.399524 | -1.056581 | -2.529753 |
| **C(3)** | 2.911101*** | 6.742998 | 1.383389 | 0.066269 | 4.669747*** | 2.011007** |
| **C(4)** | -0.299489* | -0.147905 | 0.578557 | 0.217767 | 0.494043 | -0.304082 |
| **C(5)** | 0.183289 | -0.019750 | -0.079825 | 0.149569 | -0.029053 | 0.071468 |
| **C(6)** | 0.347615*** | -0.670116*** | 0.378961* | 0.823778*** | -0.573627* | 0.516293** |
| **AIC** | 7.207859 | 5.433139 | 5.935846 | 4.554023 | 6.277848 | 6.313642 |
| **SBC** | 7.430940 | 5.656220 | 6.158927 | 4.777104 | 6.500929 | 6.536723 |
| **HQ** | 7.296571 | 5.521851 | 6.024558 | 4.642735 | 6.366560 | 6.402354 |
| **LogL** | -248.8790 | -185.8764 | -203.7225 | -154.6678 | -215.8636 | -217.1343 |

*****, ** and * denote significance at the 1%, 5% and 10% levels respectively.**

### 4.6.2 Residual diagnostics

The residual diagnostic tests allow for the assessment of the validity of the model used. This study used Engle's (1982) ARCH-LM test to assess the goodness of fit for the GJR-GARCH-M (1.1) and the E-GARCH-M (1.1). As stated in chapter 3, both the GJR-GARCH-M (1.1) model and E-GARCH-M (1.1) model were estimated and the results were reported in this section. Table 4.11 shows that the GJR-GARCH-M (1.1) failed to fully capture all the non-linear dependence in the EGX100, LUSEALSI and SEMDEX as there were some ARCH effects remaining in the residuals as indicated by the statistically significant Engle ARCH LM statistics (Brooks, 2008). This implies that the E-GARCH-M (1.1) as reported in Table 4.12 can, therefore, be used in the Egyptian, Zambian and Mauritian markets since it captures all the non-linear dependence in the residuals, as shown by the statistically insignificant Engle ARCH LM statistics. However, for the Kenyan, Ugandan and the Zimbabwean markets, the GJR-GARCH-M (1.1) model may be used to model volatility. Although, the GJR-GARCH-M (1.1) was a better fit for some of the markets, information criteria and the log likelihood show that the E-GARCH-M (1.1) is appropriate to model volatility in all the markets. The smallest values for the AIC, SBIC and HQ were observed under the E-GARCH-M (1.1) and the highest value was observed for the same model. In addition, the non-negativity condition was violated for half the markets. The volatility linkages were thus determined using the E-GARCH-M (1.1).

From the E-GARCH-M (1.1), there seems to be no relationship between the risk and return for the Egyptian, Kenyan, Ugandan, Zambian and Zimbabwean markets, where the risk is proxied by the conditional variance of stocks. This suggests that investors in these markets respond to other risk factors. The E-GARCH-M (1.1) model also shows that the volatility clustering effects are moderate in all the markets except for the Mauritian market. This implies that for the other five markets, a similar volatility structure is assumed and this has diversification implications. The asymmetry term is insignificant for all the markets, implying that both good news and bad news of the same magnitude have the same impact on volatility. Overall, it can be noted that all these markets tend to have volatility linkages except for the Mauritian market.

**Table 4. 12 The heteroscedasticity test**

| Engle ARCH LM statistic | EGX100 | LUSEALSI | NSEASI | SEMDEX | USEALSI | ZSEIND |
|---|---|---|---|---|---|---|
| GJR-GARCH (1.1) | 58.9999*** | 58.8486*** | 15.2396 | 58.9999*** | 9.4004 | 16.8231 |
| E-GARCH (1.1) | 12.7454 | 9.8816 | 15.6897 | 8.1076 | 11.1540 | 5.8056 |

*****, ** and * denote significance at the 1%, 5% and 10% levels respectively.**

## 4.7 Chapter summary

Extensive set of tests used to explore statistically the relationships between COMESA markets is the key theme in this chapther. The cointegration tests showed that, markets in COMESA trade bloc, are cointegrated to such an extent that the diversification benefits are at most negligible. Nevertheless, the short-run dynamics examinations revealed that the weak short-run causality among these series could be exploited to investors' advantage. That is, short-run diversification benefits are still present. A subsequent examination of the volatility linkages among these markets revealed that the volatility structure in terms of volatility persistence, leverage effects and risk premium are all similar, with the exception of the Mauritian market. This points out to the likelihood of volatility spillovers across these markets and the presence of very low diversification benefits. Investors may, therefore, focus on Mauritius as the more plausible diversification destination as well as another market outside the COMESA bloc. The following chapter presents the conclusions that can be drawn from the results and recommendations for policy and future research.

# CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

## 5.1 A review of the study objectives

Over the years, the world has increasingly become globalised and as such, this has presented investors with both opportunities and risks in their quests for higher risk-adjusted returns. The former, the opportunities, include factors such as the enhanced ability to diversify portfolios afforded by improved infrastructure and access to international market. The latter, the risks, mainly comprise of diminishing diversification benefits owing to increased comovements among markets and the resultant contagion and volatility spillovers. Owing to the latter, it is considered imprudent, at the least, and irrational, at most, to establish positions in markets that move in tandem and have a higher propensity to deteriorate synchronously (Bodie, Kane and Marcus, 2009). Thus, with globalisation on the rise, international diversification has increasingly become relevant in investment theory and practice (Hui, 2005). African market initially were the preferred destinations for foreign investors looking to diversify their portfolios due to the financial sector reforms in these markets. Deregulated markets saw fund flows, mainly in the form of FDI and FPI, a phenomenon that has contributed towards integration of African equity markets (Chinzara and Aziakpono, 2009a). Further, the establishment of regional trading blocs such as the SADC and COMESA has increased the magnitude of integration and policy alignment among these markets. Therefore, quantifying the extent to which these markets are integrated can provide vital information to investors who seek to diversify their portfolios. Therefore, this study examined whether COMESA markets are integrated and whether there are any volatility linkages among these markets. More explicitly, the study sought out to determine:

- the extent to which COMESA markets are integrated in the long-run
- whether there are short-run causal interactions among COMESA markets
- whether there are volatility spill-over effects among these COMESA markets
- the extent to which diversification across COMESA markets can be beneficial

Based on these objectives, the study employed a set of six indices from six COMESA markets to test the magnitude of integration and volatility linkages among these markets. For the method of analysis – long-run cointegration tests, short-run causality tests and volatility models were employed to address the objectives. A summary of findings corresponding to each objective earlier stated is provided below:

## 5.2 Summary of findings

### 5.2.1 Are COMESA markets cointegrated?

The results from the three cointegration tests executed – the Engle-Granger, ARDL and the Johansen tests – provided confirmation consistent with the existance of long-run cointegrating relationships between the six equity indices examined. For the Engle-Granger, the p-values on two test statistics, namely the tau-statistic and the z-statistic, were all at least less than 10%, meaning that the null supposition of absence of cointegration could be rejected in favour of the alternative hypothesis that these markets share a long run relationship. The Johansen cointegration technique, also employs two statistics or tests – the trace and the maximum eigenvalue. Based on both tests statistics, it was established that at least six cointegrating vectors are present in the VAR system of the six indices. Therefore, the null premise of no cointegration can also be discarded for the alternative that these markets are indeed cointegrated. Given that the ARDL tests led to the same conclusion of cointegration among these six markets, the results are considered robust. These results are in line with the priori expectation that, because these markets belong to one trading bloc – COMESA, the markets should be cointegrated with the passage of time. This is a result of policy alignment and trade agreements that these countries engage in, which in turn, enhance structural and functional similarities

### 5.2.2 Are there significant short-run interactions among these markets?

The results from the the VECM from the Johansen test exhibited evidence that these series do correct for short-run disequilibrium so as to maintain the cointegrating relationship. In addition to the error correction models based on the Johansen tests, short-run causality were also run to establish the relationships among the variables. While the long-run cointegrating relationships indicated strong association among the COMESA markets, the short-run causality tests showed weak evidence of causality. The implication of this observation is that, while the long-run cointegration structure precludes effective diversification of portfolios across COMESA markets for longer investment horizons, it is still quite conceivable for investors to try and diversify their portfolios in the short-run. That is because the markets only have a strong long-run relationship, an active investment strategy that seeks to diversify portfolios in the short-run can still yield enormous diversification benefits.

### 5.2.3 Are there any volatility linkages among the COMESA markets?

The determination of whether there are any volatility linkages among the six markets warranted the estimation of volatility models, more precisely, the E-GARCH-M (1.1) and the GJR-GARCH-M (1.1). These volatility linkages were examined in terms of the uniformity of volatility structures in terms volatility persistence, leverage effects and risk premium. From the E-GARCH-M (1.1), no association was identified between the volatility and return for the Egyptian, Kenyan, Ugandan, Zambian and Zimbabwean markets, suggesting that investors in these markets determine their required returns based on other factors other than the risk levels. In addition, volatility-clustering effects were found to be moderate in all the markets except for the Mauritian market. The asymmetry term was found to be insignificant for all the markets, implying that both favourable as well as un-favourable news of the same degree has the same impact on volatility.

The GJR-GARCH-M (1.1), however, failed to fully capture all the non-linear dependence of some of the series as there were some ARCH effects remaining in the residuals as indicated by the statistically significant Engle ARCH LM statistic. Therefore, much of the conclusion concerning volatility linkages was based on the E-GARCH-M (1.1) model. Generally, with the exception of the Mauritian market, the other markets exhibit similar volatility structures in terms of volatility persistence, leverage effects and risk premiums. This implies that, despite the weak short-run causality, the benefits from short-run diversification can still be quite low due to the high likelihood of volatility spillovers across these markets. Investors may, therefore, focus on Mauritius as the more plausible diversification destination as well as another market outside the COMESA bloc.

## 5.3 Research Limitations and suggestions for future study

From this study, there are various recommendations that can be made for future studies. Firstly, future studies should attempt to employ a larger sample of indices in terms of the study period and a number of markets to be examined. Due to data limitations, this study managed to only conduct all the tests using six indices over a limited period but the COMESA traces its genesis to the mid-1960s and comprises of nineteen member states. Future studies could also focus on the long-term cointegrating relationships and short-term causality dynamics between COMESA markets and other markets that are outside the trading bloc. This will help investors to determine new investment and diversification destinations in other markets outside the bloc.

The focus of this side, due to data unavailability, was constrained to only the broad market indices. However, future studies should also attempt to measure the degree of association between markets' sectors, for instance, a study could look at the long-run and short-run association between COMESA markets' financial or resources sectors. This is because some sectors may exhibit less cointegration, causality and volatility linkages than what others may. This stems from the fact that when countries establish trading blocs such as COMESA, their focus of policy alignment may be skewed towards some macroeconomic aspects and industries and as such, the level of association across industries usually differs across industries. Thus, while the broad market indices may exhibit high associations that negate effective diversification, investors may still be able to diversify their portfolios by targeting certain industries or sectors.

## 5.4 Conclusion

This study employed various methods to determine whether there exist long-run cointegrating relationships, short-run causality linkages and volatility linkages among the six COMESA markets employed. For long-run cointegration, the Engle-Granger and the Johansen tests as well as ARDL method were employed while the VARs, Granger-causality tests, impulse response functions and variance decompositions were used in determining the short-run causality linkages. For the latter, the E-GARCH-M and the GJR-GARCH-M models were employed. The long-run tests revealed strong cointegrating relationships, indicative of low diversification benefits, while the weak short-run causality structure revealed possible short-run diversification benefits. The examination of the volatility linkages, however, exhibited significant similarities in terms of volatility clustering, persistence and risk premiums, which further erodes any prospects of diversification benefits across the markets. Therefore, investors within the COMESA markets should rather focus on other markets outside the COMESA as diversification destinations.

## References

Abas, M. 2009. *Analysis of Stock Market Linkages: Chinese, Indian and Major Markets*. School of Business - University of Malaya, pp 1-84.

Adjasi, C.K., and Biekpe, N.B. (2006). Co-integration and dynamic causal links amongst African stock markets. *Investment Management and Financial Innovations*, 3 (4): pp 102-118.

African Development Bank (AFDB) (2013) NEPAD, Regional Integration and Trade Department.

African Securities Exchanges Association Annual Report and Statistics 2014.

Agyapong, D. (2014). Stock market integration in West African monetary zone: a linear and nonlinear cointegration approach. *Asian Economic and Financial Review*, 4 (5): pp 563-587.

Ahn, B.C. Capital flows and effects on financial markets in Korea: developments and policy responses. *BIS Papers* No 44.

Alagidede, P. (2009). Are African stock markets integrated with the rest of the world? *The African Finance Journal*, 11 (1): pp 37-53.

Alagidede, P. (2011). Return behaviour in Africa's emerging equity markets. *The Quarterly Review of Economics and Finance*, 51 (1): pp 133–140.

Alagidede, P., and Panagiotidis, T. (2009). Modelling Stock Returns in Africa's Emerging Equity Markets. *Stirling Economics Discussion Paper*.

Alagidede, P., Panagiotidis, T., and Zhang, X. (2011). Why a diversified portfolio should include African assets. *Applied Economics Letters*, 18 (14): pp1333-1340.

Alagidede, P., Panagiotidis, T., and Zhang, X. (2011). Why a diversified portfolio should include African assets. *Applied Economics Letters*, 18 (14): pp 1333-1340.

Alagidede,P. Return Predictability in Africa's Emerging Equity Markets. pp 1-24.

Ali, S., Butt, B.Z., and Rehman, K. 2011. Comovement Between Emerging and Developed Stock Markets: An Investigation through Cointegration Analysis. *World Applied Sciences Journal*, 12 (4): pp 395-403.

Allen, D.E., and MacDonald, G. (1995). The long-run gains from international equity diversification: Australian evidence from cointegration test. *Applied Financial Economics*, 5 (1): pp 33-42.

Antonios, A.M., and Pescetto, I.S. (2007). Market-wide and sectoral integration. *Managerial Finance*, 33 (3): pp 173-194.

Arouri, M.E., Bellalah, M., and Nguyen, D.K. (2010). The comovements in international stock markets: new evidence from Latin American emerging countries. *Applied Economics Letters*, 17 (13): pp 1323-1328.

Aziakpono, M. J. (2006). Financial integration amongst the SACU countries: Evidence from interest rate pass-through analysis. *Journal of econometrics*, 30 (2): pp 1-23.

Aziakpono, M. J. (2008). Financial and monetary autonomy and interdependence between South Africa and the other SACU countries. *South African Journal of Economics*, 76 (2): pp 189-211.

Aziakpono, M. n.d. Financial Integration amongst the SACU Countries: Evidence from Interest Rate Pass-Through Analysis. Department of Economics-Rhodes University.

Aziakpono, M., Kleimeier, S., and Sander, H. (2007). Banking market integration in the SADC countries: Evidence from interest rate analyses. *Maastricht Research School of Economics of Technology and Organizations*.

Babetskii, I., Komárek, L., aand Komárková, Z. 2007. Financial Integration of Stock Markets among New EU Member States and Euro Area. Czech National Bank research project.

Baele, L., Ferrando, A., Hördahl, P., *et al*. 2004. Measuring financial integration in the Euro area. *European Central Bank Occasional Paper Series* No. 14.

Bekaert, G. (1995). Market Integration and Investment Barriers in Emerging Equity Markets. *The World Bank Economic Review*, 9 (1): pp 75-107.

Bekaert, G. (1995). Market Integration and Investment Barriers in Emerging Equity Markets. *The World Bank economic review*, 9 (1): pp 75-107.

Bekaert, G., and Harvey, C.R. *Research in emerging markets finance: looking to the future*. Columbia Business School, pp 1-20.

Bekaert, G., Harvey, C.R., and Lundblad, C. 2001 Does financial liberalization spur growth? *National Bureau of Economic Research (NBER) Working Paper series*.

Bekaert, G., Harvey, C.R., and Lundblad, C. 2001. Emerging Equity Markets and Economic Development. *Charvey Research Working Papers*.

Berben, R.P., and Jansen. W. J. 2001. Comovement in International Equity Markets: a Sectoral View.

Biekepe, N. and Collins , D. (2003) Contagion and Interdependence in African Stock markets. *The south African Journal of economics*. 71, pp 181-194.

Bodie, Z., Kane , A., and Marcus, J.A (2013) Essentials of Investments 9th ed. UK McGraw Hill Education.

Bonfiglioli, A., and Favero, C.A. (2005). Explaining co-movements between stock markets: The case of US and Germany. *Journal of International Money and Finance*, 24 (1): pp 1299-1316.

Bortolotti, B., De Jong, F., Nicodano, G., and Schindele, I. 2002. Privatization and Stock Market Liquidity. Social Science Research Network Electronic Paper.

Boujir, A., and Lahrech, A. (2008). Morocco & US Equity Markets Linkage after FTA Signature Implications for International Portfolio Diversification. *International Research Journal of Finance and Economics*, pp 112-123.

Bracker, K., Docking, D.S., and Koch, P.D. (1999). Economic determinants of evolution in international stock market integration. *Journal of Empirical Finance*, 6 (1): pp 1-27.

Bracker, K., Dockino, G., and Koch, P, (1999). Economic Determinants of Evolution in International Stock market Integration. Journal of Emperical Finance. 6: pp 1-27.

Brogaard, J., Hendershott, T., and Riordan, R. 2013. High Frequency Trading and Price Discovery. *European Central Bank (ECB) Working Paper Series* No 1602.

Carmignani, F. nd. The road to regional integration in Africa: Macroeconomic convergence and performance in COMESA. *Department of Economics University of Milan – BICOCCA Working Papers.*

Chelley-Steeley, P. L. (2005). Modelling equity market integration using smooth transition analysis: A study of Eastern European stock markets. *Journal of International Money and Finance*, 24(5), pp 818-831.

Chen, Z., and Knez, P.J. (1995). Measurement of Market Integration and Arbitrage. *Review of Financial Studies*, 8 (2): pp 287-325.

Chinzara, Z., and Aziakpono, M. (2009). Integration of the South African equity market into the world major stock markets: Implication for portfolio diversification. *The African Finance Journal, Special Issue*: pp 95-119.

Chinzara, Z., and Aziakpono, M. 2009. Integration of the South African equity market into the world major stock markets: Implication for portfolio diversification. *The African Finance Journal*, 34 (1): pp 95-119.

Chinzara, Z., and Aziakpono, M. J. (2009). Dynamic returns linkages and volatility transmission between South African and world major stock markets. *Journal of econometrics*, 33 (3): pp 65-94.

Chinzara, Z., and Kambadza, T.H.D. (2014). Evidence of segmentation among African equity markets. *The African Finance Journal*, 16 (1): pp 19-38.

Collins, D., and Biekpe, N. (2003). Contagion and interdependence in African stock markets. *The South African Journal of Economics*, 71 (1): pp 181-194.

Common Market for Eastern and Southern Africa (COMESA) International Trade Statistics Bulletin 2013 No.12

Common Market for Eastern and Southern Africa (COMESA) Investment Report 2011.

Common Market for Eastern and Southern Africa (COMESA) Investment Report 2012.

Common Market for Eastern and Southern Africa (COMESA) Investment Report 2013.

Daly, K.S. (2003). Southeast Asian Stock Market Linkages Evidence from Pre and Post October 1997. *ASEAN Economic Bulletin*, 20 (1): pp 73-85.

Darbar, S.M., and Deb, P. (2001). Co-movement in international equity markets. *The Journal of Financial Research*, 20 (3): pp 305-322.

Darrat, A.F., and Benkato, O.M. (2003). Interdependence and Volatility Spillovers Under Market Liberalization: The Case of Istanbul Stock Exchange. *Journal of Business Finance and Accounting*, 30 (8): pp 1089-1114.

de la Torre, A and Schmukler, S.L. (2003).Emerging Capital Markets and Globalization. *Stanford University Press and the World Bank*. Washington DC.

Donno, M. nd. Completeness in large financial markets. pp 1-25.

Economic Commission for Africa (2008) Assessing Regional Integration in Africa.

Emenike, K.O. Modelling Stock Returns Volatility In Nigeria using GARCH Models. *Munich Personal RePEC Archive (MPRA) Working Papers*.

Engle, R. F., Granger, C.W.J (1987) Cointegration and Error Correction: Representation, Estimation and testing. Econometrica 55. pp 251-276.

Eun, c.s., and Resnick B.G. (2009). International Financial Management 5th ed. Mcgraw Hill Education.

Fabozzi, F.J., Gupta, F., and Markowitz, H.M. (2002). The Legacy of Modern Portfolio Theory. *The Journal of Investing*, pp 7-22.

Frimpong, J.M., and Oteng-Abayie,E.R. (2006). Modelling and Forecasting Volatility of Returns on the Ghana Stock Exchange Using GARCH Models. *Munich Personal RePEc Archive (MPRA) Working Paper*.

Geda, A., and Kebret, H. (2007). Regional Economic Integration in Africa: A Review of Problems and Prospects with a Case Study of COMESA. *Journal of African Economies*, 17 (3): pp 357-394.

Gilmore, C.G., and McManus, G.M. (2002). International portfolio diversification: US and Central European equity markets. *Emerging Markets Review*, 3 (1): pp 69-83.

Glezakos, M., Merika, A. Kaligosfiris, H. (2007). Interdependence of Major World Stock Exchanges: How is the Athens Stock Exchange Affected? *International Research Journal of Finance and Economics*, 7(1): pp 24-39.

Graham, M., Kiviaho, J., and Nikkinen, J. (2012). Integration of 22 emerging stock markets: A three-dimensional analysis. *Global Finance Journal*, 23: 34–47.

Grahama, M., Kiviahob, J., Nikkinenb, J., and Omran, M. (2012). Global and regional co-movement of the MENA stock markets. *Journal of Economics and Business*, 65 (2013): pp 86-100.

Grubel, H.G. (1968). Internationally Diversified Portfolios: Welfare Gains and Capital Flows. *The American Economic Review*, 58 (5): pp 1299-1314.

Grubel, H.G., and Fadner, K. (1971). The Interdependence of International Equity Markets. *The Journal of Finance*, 26 (1): pp 89-94.

Hamavindu, M.N., and Floros, C. (2006). Integration and Volatility Spill overs in African Equity Markets Evidence from Namibia and South Africa. *The African Finance Journal*, 8 (2): pp 31-50.

Harvey, C.R. (1995). Predictable Risks and Returns in Emerging Markets. *The Review of Financial Studies*, 8 (3): pp 773-816.

Hassan, M. K., and Naka, A. Short-run and long-run dynamic linkages among international stock markets. *International Review of Economics and Finance,* 5 (4): pp 387-405.

Hearn, B, and Piesse, J. nd. Equity Market Integration versus Segmentation in Three Dominant Markets of the Southern African Customs Union: Cointegration and Causality Tests. *Working paper*.

Hearn, B., and Piesse, J. (2008). Opportunities and costs of portfolio diversification in SADC's smallest equity markets. *South African Journal of Economics*, 76 (3): pp 399-426.

Henry, P.H. 2003. Capital account liberalization, the cost of capital, and economic growth. *National Bureau of Economic Research (NBER) Working Paper series.*

Hui, T. 2006. (2005). Portfolio diversification: a factor analysis approach. *Applied Financial Economics*, 15 (12): pp 821-834.

Irving, J. (2005). Regional Integration of Stock Exchanges in Eastern and Southern Africa: Progress and Prospects. *International Monetary Fund (IMF) Working Paper*.

Janakiramanan, S., and Lamba, A.S. (1998). An empirical examination of linkages between Pacific-Basin stock markets. *Journal of International Financial Markets, Institutions and Money*, 8: pp 155–173.

Jefferis, K.R., and Okeahalam, C.C (1999). International Stock Market Linkages in Southern Africa. *South African Journal of Accounting research*, 13(2): pp 27-51.

Johansen, S. (1988); Statistical Analysis of Cointegration Vectors. Journal of Economics Dynamics and Control 12: pp 231-254.

Jordan, D.J., Miller, T. W., and Dolvin, S.D (2008). Fundamentals of Investments Valuation and Management 5th ed. McGraw Hill Education.

Kambadza, T.H.D., and Chinzara, Z. 2012. Returns Correlation Structure and Volatility Spillovers Among the Major African Stock Markets. *Economic Research Southern Africa (ERSA) working paper* 305.

Kambaza, T.Z., and Chinzara, Z. (2104). Evidence of Segmentation among African Equity Markets. *The African Finance Journal*, 16 (1): pp 19-38.

Kearney, C., and Lucey, B.M. (2004). International equity market integration: Theory, evidence and implications. *International Review of Financial Analysis*, 13 (1): pp 571-583.

Kenen, P.B. (2007). The benefits and risks of financial globalization. *Cato Journal*, 27 (2): pp 179-183.

Kenen, P.B. (2007). The benefits and risks of financial globalization. *Cato Journal*, 27 (2): pp 179-183.

Kodongo, O., and Ojah, K. (2011) Foreign exchange risk pricing and equity market segmentation in Africa. *Journal of Banking & Finance*, 35: pp 2295–2310.

Kose, M.A., Prasad, E., Rogoff, K., and Wei, S. (2006). Financial Globilization: *A Reappraisal. National Bureau Economic Research (NBER) Working Papers*.

Kose, M.A., Prasad, E.S., and Terrones, M.E. 2003. Financial Integration and Macroeconomic Volatility. *International Monetary Fund (IMF) Staff Papers* Vol 50.

Lamba, A.S., and Otchere, I. (2001). An Analysis of the Dynamic Relationships Between the South African Equity Market and Major World Equity Markets. *Multinational Finance Journal*, 5 (3): pp 201-224.

Lane, P.R., and Miesi-Ferreth. (2003). International Financial Integration. IMF Staff Papers, 50 (1): pp 82-113.

Lessard, D.R. (1973). International Portfolio Diversification: A Multivariate Analysis for a Group of Latin American Countries. *The Journal of Finance*, 28 (3): pp 619-633.

Levine, R., and Zervos, S. (1998). Capital Control Liberalization and Stock Market Development. *World Development,* 26 (7): pp 1169-1183.

Maghyereh, A., and Al-Zuobi, A. (2005). Free trade agreements and equity market integration: the case of the US and Jordan. *Applied Financial Economics*, 15 (14): pp 995-1005.

Maneschiöld, P. (2006) Integration between the Baltic and International Stock Markets. *Emerging Markets Finance and Trade*, 42 (6): pp 25-45.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, 7(1): pp 77-91.

Masih, R., and Masih, A.M. (2001). Long and short term dynamic causal transmission amongst international stock markets. *Journal of International Money and Finance*, 20: 563–587.

Mongelli, F.P. 2002. New Views on the Optimum Currency Area Theory: What is EMU Telling US? PP 1-51.

Mougani, G. 2012. An Analysis of the Impact of Financial Integration on Economic Activity and Macroeconomic Volatility in Africa within the Financial Globalization Context. *African Development Bank Working Paper Series* No 144, Tunis, Tunisia.

Muuka, G.N., Harrison, D.E., and McCoy, J.P. (1998). Impediments to Economic Integration in Africa: The Case of COMESA. *Journal of Business in Developing Nations* , 2 (3).

Naceur, S.B., Ghazouani, S., and Omran, M. (2008). Does stock market liberalization spur financial and economic development in the MENA region? *Journal of Comparative Economics*, 36 (1): pp 673–693.

Nielsen, H., Uanguta, E., and Ikhide, S. (2005). Financial integration in the common monetary area. *South African Journal of Economics*, 73 (4): pp 710-721.

Ntim, C. G. (2012). Why African Stock Markets Should Formally Harmonise and Integrate their Operations. *African Review of Economics and Finance*, 4 (1): pp 53-72.

Ntim, C.G. (2012). Why African Stock Markets Should Formally Harmonise and Integrate their Operations. *African Review of Economics and Finance*, 4 (1): pp 53-72.

Obstfeld, M. (1994). Risk-Taking, Global Diversification, and Growth. *The American Economic Review*, 84 (5): pp 1310-1329.

Onour, I. (2009). Financial Integration of North Africa Stock Markets. *Munich Personal RePEc Archive (MPRA) Working Paper*.

Onyuma, S.O. (2006). Regional integration of stock exchanges in Africa. *African Review of Money Finance and Banking*, pp 97-122.

Pierre-Richard Agénor, P. 2003. Benefits and Costs of International Financial Integration: Theory and Facts. *World Bank Working Paper*.

Piesse, J., and Hearn, B. (2005). Regional integration of equity markets in Saharan Africa. *South African Journal of Economics*, 73 (1): pp 36-53.

Piesse,J., and Hearn, B. 2010 (2002). Equity market integration versus segmentation in three dominant markets of the Southern African Customs Union: cointegration and causality tests. *Applied Economics*, 34 (14): pp 1711-1722.

Portes, R and Rey, H. 2000. The Determinants of Cross-Border Equity Flows, pp 1-25.

Portes, R., and Rey, H. (2000). The Determinants of Cross-Border Equity Flows. *Centre for Economic Performance*. London.

Sabri, N. R. (2002). Increasing linkages of stock markets and price volatility. *Financial Risk and Financial Risk Management*, 16 (1): pp 349-373.

Sabri, N. R. (2002). Increasing linkages of stock markets and price volatility. *Financial Risk and Financial Risk Management*, 16: pp 349–373.

Shams, R. (2005). The Drive to Economic Integration in Africa. *Hamburgisches Welt-Wirtschafts-Archiv (HWWA) Discussion Paper*.

Sharma, S.C., and Ratanapakorn, O. (2002). Interrelationships among Regional Stock Indicies. *Review of Financial Economics*, 11(1): pp 91-108.

Smith, G., and Jefferis, K. (2005). The Changing Efficiency of African Stock Markets. *South African Journal of Economics*, 73 (1): pp 54-67.

Solink, B. H. (1974). Why not Diversify Internationally? financial Analyst Journal 30(4), pp 48-54.

Stavarek, D., Repkova, I., and Gajdosova, K. 2011. Theory of financial integration and achievements in the European Union. *Munich Personal RePEc Archive (MPRA) Paper* No. 34393.

Sun, R., and Zhang, X. 2009. Spillovers of the U.S Subprime Financial Turmoil to Mainland China and Hong Kong SAR: Evidence from Stork Markets. International Monetary Fund (IMF) Working Papers.

Taylor, M.P., and Sarno, L. (1997). Capital Flows to Developing Countries: Long- and Short-Term Determinants. *The World Bank Economic Review*, 11 (3): pp 451-470.

Taylor, M.P., and Tonks, I. (1989). The Internationalisation of Stock Markets and the Abolition of U.K. Exchange Control. *The Review of Economics and Statistics*, 71 (2): pp 332-336.

Taylor, M.P., and Tonks, I. 1989. The Internationalisation of Stock Markets and the Abolition of U.K. Exchange Control. The Review of Economics and Statistics, 71 (2): pp 332-336.

Tobin, J., 1969. A General Equilibrium Approach to Monetary theory. Journal of Money, Credit and banking. pp 1 15-29.

United Nations Development Programme (2003) UNDP African Stock Markets Handbook.

Vo, X. V. 2006. *The Determinants of International Financial Integration.* School of Economics - University of New South Wales.

Wang, Z., Yang, J., and Bessler, D. A. 2010 (2003). Financial crisis and African stock market integration. Applied Economics Letters, 10 (9): pp 527-533.

Wang, Z., Yang, J., and Bessler, D.A. (2003). Financial crisis and African stock market integration. *Applied Economics Letters*, 10 (9): pp 527-533.

World Bank (2002), Capital Market Integration in the East African Community, Washington DC.

Yartey, C. A., and Adjasi, C. K. (2007). Stock Market Development in Sub-Saharan Africa: Critical Issues and Challenges. International Monetary Fund (IMF) Working Paper.

Yu, J., and Hassan, M.K. (2006). Global and regional integration of the Middle East and North African (MENA) stock markets. *The Quarterly Review of Economics and Finance, 48 (2008)*: pp 482–504.