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**MAF 10: Are there benefits to diversification across the  
largest African stock markets?**

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**ABSTRACT:**

This study examines the co-movements of selected African stock exchanges, including Nigeria, Morocco, Egypt and South Africa, as well as the USA, in local currency and in USD terms, for the period January 2004 to June 2014. The study sheds light on African market cointegration before, during, and post the financial crises of 2007/2008 to identify whether there are benefits to diversification in stock exchanges across Africa and how this has changed over time. Only the four biggest exchanges are examined, to eliminate the effects of illiquidity and ensuring the size of indices used result in conclusions that are practical to investors. This study looks at long term relationships using cointegration, and the direction of the relationships using causality tests. We find no consistent cointegration relationships over the periods tested. There are no consistent causality relationships between the various countries. The implication of these results are that there are likely benefits to diversification across the four African exchanges examined.

**Keywords:**

Cointegration, African Exchanges, Diversification in Africa, Investment in Africa.

## 1. INTRODUCTION

“The benefits of international diversification have been recognized for decades”  
(French & Poterba, 1991)

Stock market integration can be defined as a condition in which stock markets move together and have the same expected risk adjusted returns (Sharma & Seth, 2012). The benefits of international diversification can only be realised if the markets do not move together.

As will be discussed in the literature review below, often tests for integration are performed around crises, for example: the 1987s equities crisis (Arshanapalli & Doukas, 1993; Longin & Solnik, 1995; Butler & Joaquin, 2002; Meric & Meric, 1989) or the Asian crisis in 1997 (Ghosh, Johnson & Saidi, 1999; Kamin, 1999; Wang, Yang & Bessler, 2003), as this is when the main benefits from diversification are gained (Butler & Joaquin, 2002). Diversification aims to decrease variance of returns (Markowitz 1952), and during a crisis the market has a high variance from expected returns and thus benefits can be had from diversification.

Given the above benefits of diversification, the objective of this paper is to shed light on whether a diversification benefit can be gained from investing across Africa, from a practical perspective. Practical in this sense, implying an investor is investing in just equities, and on a global basis. As these diversification benefits are most needed in times of financial crisis, this study thus examines whether there are the benefits discussed above, before during and after the financial crisis of 2007/2008 by investing across the four largest African exchanges. This is relevant as due to globalisation markets have become more cointegrated and the benefits are potentially being lost.

This study aims to test the cointegration, and causality relationships among four of Africa’s largest and most liquid exchanges to determine whether there are diversification benefits to international and African investors investing across the continent. More specifically this paper examines the long-term relationships between indices in the different markets, and the strengths of these interactions, as well as the direction of the relationships. The results of the tests performed will be useful for investors in the compilation of a diversified portfolio, specifically using exchanges within Africa. The outcome of this study should also increase our understanding of how the different large African markets react with respect to each other, especially in times of a global crisis, as this is when the benefits of diversification are most necessary.

This study examines four African stock markets, namely the Johannesburg Stock Exchange (JSE), Nigeria Stock Exchange (NSE), Casablanca Stock Exchange (CSE), and the Egyptian Stock Exchange (EGX). These are compared with US stock exchanges, represented by Standard & Poor’s 500 index (S&P 500). The objective is to establish where there are benefits to investing across Africa from a local perspective, examining the relationships among the African exchanges. We then look from an international perspective examining the relationships between the African exchanges and the S&P 500.

The four exchanges were selected because of their size and liquidity, which make them a viable investment option for large institutional and foreign investment. All four exchanges are also members of the World Federation of Exchanges (WFE). Being registered with the WFE is significant as of the end of 2012 only four African stock exchanges have fulfilled the criteria entitling them to become members of this regulatory body (Riscura, 2013).

The reasons for the inclusion of the S&P 500 are twofold: Firstly, the United States Dollar (USD) is used as a proxy for relative value across the African exchanges, enabling us to see in USD terms if they are integrated. The USD was chosen because it is the “dominant medium for international transactions” (Goldberg, 2010), and is arguably the most obvious choice as a base for value movements. International investors needing to compare the performance of African stocks to other international investments would require the returns to have a relative value base, and in this case the USD is being used as that base. Raj and Dahl (2008) also test stock prices in local and USD terms, and find the currency denomination used affected their cointegration results. This could be of specific benefit to international investors.

According to Graham et al. (2013), “The diversification benefits, if any, may be contaminated by foreign exchange risk when returns from prices denominated in local currency are used”. This study thus also attempts to remove the effects of currency depreciation and exchange rate changes, although imperfectly.

A significant benefit of this study, when compared to previous literature, is that this study has real-world application. The indices used in this study have the required size and liquidity to make them viable investment options, as they represent the largest and most liquid stocks. The aforementioned factors result in this study having application value to institutional and larger individual investors. In previous studies, Graham et al. (2013) use the Morgan Stanley Capital International (MSCI) indices, Collins and Biekpe (2003) use local benchmark indices, and Chen et al. (2014) use MSCI, Russell’s’ Frontier markets and the S&P indices.

The results of this study are similar to other African studies. No relationships are found over the full period January 2004 to June 2014, using either the Johansen or Engle-Granger cointegration tests, and no cointegration relationships for longer than a single sub-period are found using the Engle-Granger or Johansen tests for cointegration.

The remainder of this study will be organised as follows. Section 2 provides a review of the literature relating to market integration in order to give the study the required context and background. Sections 3 and 4 deal with the data collected in the study, as well as the research approach. Section 5 provides an analysis of the results found from the data, and Section 6 brings the information together in a summary of the outcomes of the research and a conclusion. Appendix A has unit root tests results referred to in section 5 below and Appendix B has a complete list of Acronyms and abbreviations used in this study.

## 2. REVIEW OF RELATED LITERATURE

In our introduction we discussed the need for diversification when building an optimum portfolio. As stated by Markowitz (1952), “Diversification is both observed and sensible; a rule of behavior which does not imply the superiority of diversification must be rejected both as a hypothesis and as a maxim.”

### 2.1 Integration of African stock markets

#### 2.1.1 Why African stock markets?

High growth in emerging and frontier markets attracts foreign direct investment (Speidell, 2011). Investing in a frontier market is associated with risk. Thus if the African frontier markets are cointegrated with emerging or developed markets it may be beneficial to invest in the less risky emerging or developed markets.

Market integration of developing African stock exchanges is fundamental to economic development (Jefferis, 1995; Kenny & Moss, 1998; Piesse & Hearn, 2002; Bekaert, Harvey & Lumsdaine, 2002). The degree to which these African stock exchanges are globally integrated is important for this primary goal, as this attracts foreign direct investment (Kenny & Moss, 1998).

Financial development has also been proven to have a causal effect on the rate of economic growth (Irving, 2005). Financial integration also has implications for financial stability (Sharma & Bodla, 2010), with markets that are more integrated also being more financially stable. Consequently, such well-integrated stock exchanges can play an important role in the promotion of African economic growth. Research aimed at understanding the financial integration of African stock markets is therefore important for the future growth and success of Africa.

#### 2.1.2 Findings from previous literature on emerging markets

Since the early 1990s emerging markets have become a more viable asset class, leading to a growing interest in African market integration. During the 1990s several significant events occurred, including the Mexican peso crisis, the Asian crisis, and the Russian and Brazilian bond defaults. These have provided data and spurred further interest in the integration of emerging and global markets (Collins & Biekpe, 2003). Harvey argues that emerging markets are segmented from world markets because their returns are influenced by local rather than international factors (Harvey, 1995). The same study finds that including emerging market equities in a portfolio can increase returns and decrease volatility (Harvey, 1995).

Alagidede, Panagiotidis and Zhang (2011) explore the implications of integration among African economies and stock exchanges to assess the effectiveness of portfolio diversification. They find few long term relationships between African countries and even between African countries and the rest of the world. They conclude that investors could diversify their portfolios by including African stocks, because international stock market shocks would have little effect on African stock markets because of this lack of integration. Alagidede et al. (2011) also show the relevance of

research in deciding whether African shares should be used to diversify an investment portfolio. However, much research still needs to be done in terms of African stock market integration.

Previous studies seem to focus on specific regions rather than Africa as a continent, thus this study is relevant for global investors looking to invest in Africa.

### 2.1.3 Previous literature on African market cointegration

Adjasi and Biekpe (2006) show that long term relationships exist between several African stock markets. South Africa was shown to be affected in the long term by reactions from other markets, such as Egypt, Kenya, Mauritius, Nigeria, and Ghana. The South African market must regularly monitor developments in these other markets, due to their long run impacts. They also showed that South Africa, being the larger market, was helping to correct any disequilibrium and that the country had a significant effect on the relatively inactive Ghanaian market. This study brings to light not only the presence of South Africa as a major influence in Africa, but also the extent to which economies affect each other. Egypt, in particular, has been shown to have a long running effect on South Africa. This study will ascertain whether this long term effect still exists.

Graham et al. (2012) tests the strength of co-movements between the US and 22 Emerging markets, including Egypt, Morocco, and South Africa, using the Wavelet analysis tool. The key findings from the study were as follows: Stock market integration is constantly changing over time and there is more of a trend of co-movements over the long term, and more short term co-movements after 2006. Thus there are still benefits to American investors to investing in emerging markets, but more so in the short-term.

Middle East and North Africa region (MENA) market integration has been tested by Yu and Hassan (2008), and Graham et al. (2013). Yu and Hassan (2008) compare MENA stock exchanges to those in the USA, UK, and France to see if the market returns are cointegrated, for the period 1 January 1999 to 31 December 2005. They find cointegration between the Gulf Cooperation Council (GCC) and Non-GCC markets tested, and well as the US stock market exhibiting Granger causality with non-GCC markets.

The study by Graham et al. (2013) is similar to this study, in that it looks at co-movements with the USA and co-movements within the MENA region. Using data from June 2002 to June 2010, this study finds there are co-movements with the USA (S&P 500) in the long term. However, the relationship does not exist in the short term, implying the benefits of diversification in the short term (Graham et al., 2013). This study by Graham et al. (2013) also finds a rise in co-movements after the onset of the financial crisis in 2008. This is consistent with other research on increased cointegration in times of greater volatility.

### 3. DATA

The following indices were used to represent the four African countries equities markets: Johannesburg Stock Exchange Top 40 Index (JSE Top 40 – representing South Africa); Nigeria Stock Exchange Allshare Index (NGSE – representing Nigeria) and Nigeria Stock Exchange Top 30 Index (NSE 30 – representing Nigeria); Egyptian Stock Exchange Top 30 (EGX 30 – representing Egypt); Casablanca Stock Exchange Top 25 (CFG 25 – representing Morocco). The data used was the weekly closing prices of the respective indices. Liquidity and the index being practically investable are key in this study and thus weekly tests were run to include the NSE 30 which best represents liquid and practically investable stocks.

The period of analysis is from 1 January 2004 to 30 June 2014. This period is further divided into three sub-periods to address the potential impact of the global financial crisis on the African stock exchanges, as well as their integration with global markets. The crisis period for the purposes of this study is considered to run from October 2007 to the end of March 2009, with the post-crisis period starting at the beginning of April 2009. It is difficult to pinpoint the exact start and end of the crisis. However, using the S&P 500 as a proxy for US stocks it can be seen that the decline in the S&P 500 index started in October 2007 and the S&P 500 reached a low in March 2009. Most of the benefits of diversification would be gained during the crisis period. Analysis of the preceding and subsequent periods provides further insight into whether there has been a change in the relationship between the African exchanges, and those in the USA.

The reasons for having the longer periods are twofold. Firstly, the number of observations decreased substantially which required a longer period to get a statistically significant number of observations. Secondly, weekly data was only available for the NSE 30 from 1 January 2007. Thus it makes sense to split the data into three periods to get an even observation distribution over the period tested.

The periods for the weekly data have been split as follows:

- Period 1: January 2004 – December 2006
- Period 2: January 2007 – December 2010
- Period 3: January 2011 – June 2014

#### 3.1 Data Issues

It is important to note that in using an index, there is always the issue of “capping”. As with most indices, the maximum weighting of a stock in an index is limited. This means by using an index we are not capturing the complete movement of stocks in the movement of the index. This affects the cointegration relationships between various exchanges.

In 2011 the Egyptian stock market struggled, largely due to political unrest in the country. The market capitalisation dropped from approximately 500 billion at the beginning of January 2011 to 374 billion in March 2011 and 291 billion in December 2011 (EGX, 2013). Our

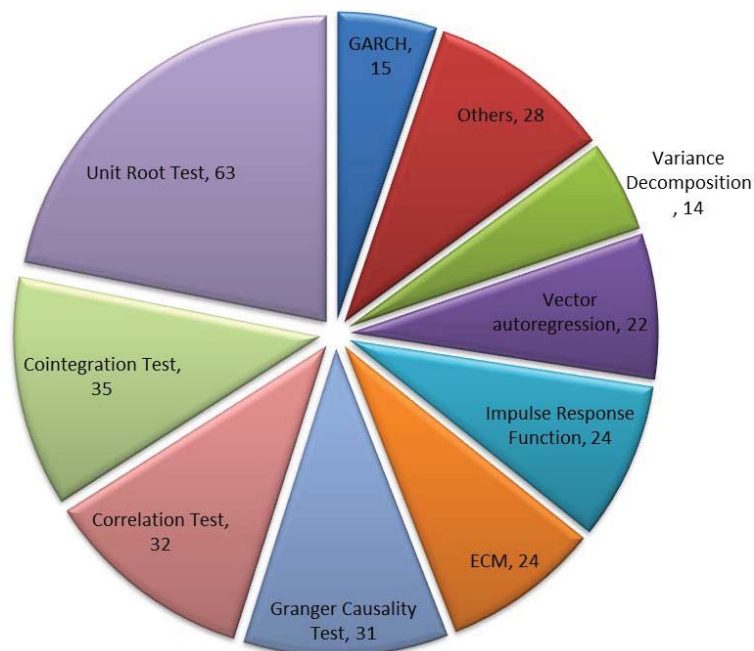
analysis shows that the Egyptian revolution did have an effect on the Stationary tests run on the weekly data.

#### 4. RESEARCH APPROACH

The research approach used here follows the most common approach for researching stock exchange integration and its effect on diversification. Sharma and Seth (2012), who analysed 105 research papers on stock market integration, identified the econometric tools used most frequently in this type of research. Figure 1 below shows that the majority of the studies examined used the unit root test to test for stationarity, followed by Johansen's cointegration test, the correlation test, the Granger causality test, followed by other tests (Sharma & Seth, 2012).

Based on their findings, the following methods of analysis, discussed below, were employed in this study: The unit root tests for stationarity, the cointegration tests (Both Engle-Granger and Johansen), and Granger pairwise causality tests. Correlation tests were not run on the data as although this may indicate a co-movement relationship it does not shed light on whether there is a causal relationship or the direction of the relationship. Both the Augmented Dickey-Fuller test and the Phillips-Perron unit root test were run on the data.

**Figure 1: Frequency of econometric tools used for data analysis**



(Source: Sharma & Seth, 2012)

#### **4.1 Unit root tests for stationarity**

A unit root test looks at whether a time series, such as a stock exchange index, is stationary, using an autoregressive model. The time series is stationary if the roots of its characteristic polynomial lie strictly inside the unit circle (Alexander, 2008). Testing for a unit root and cointegration can also determine market efficiency (Arshanapalli & Doukas, 1993). The null hypothesis implies that the data need to be differenced to make it stationary, while the alternative hypothesis states that the data is stationary. If we reject the above null hypothesis, we can conclude that the series is indeed integrated of order 1, rather than having a higher order of integration (Alexander, 2008).

#### **4.2 Cointegration and causality**

Cointegration is a measure of long term dependency between two stock exchange indices or other financial assets and is used to examine the co-movement of index prices in this paper. The null hypothesis for the cointegration tests is that the two indices are not cointegrated.

The Engle-Granger methodology performs an ordinary least square (OLS) regression of one integrated variable on the other integrated variables, and is used in this study to determine the extent of cointegration. The Johansen test is a vector autoregression (VAR) based cointegration test using the methodology developed in Johansen (IHS Global Inc., 2013).

Finally, once the error correction model (ECM) has been defined, it may to be used to test the Granger causality flows. Granger causality measures the lead-lag relationship between the two indices (Alexander, 2008).

The above tests indicate whether diversification benefits could be had by investing in the exchanges analysed in this study, as discussed in the introduction above.

### **5. RESULTS**

Below see the results of this study, including graphical representations of the various indices, the results of unit root, cointegration, and causality tests run on the weekly logged data in both local currency and USD.

#### **5.1 Tests performed and tests results found on weekly logged closing price data**

Unit root testing is a prerequisite for testing cointegration between the stock exchanges. The implication of cointegration is that, individually, the series may be non-stationary, while their linear combination may be stationary (IHS Global Inc., 2013). Thus below the test results begin with the unit root test results followed by the cointegration and Granger causality tests.



## 5.1.1 Unit root tests on weekly logged closing price data

**Table 1: Unit root tests results using the Augmented Dickey-Fuller (ADF) unit root test**

Weekly logged data	Augmented Dickey-Fuller test results											
	Full period		Periods 2&3		Period 1		Period 2		Period 3			
	T-stat	Prob	T-stat	Prob	T-stat	Prob	T-stat	Prob	T-stat	Prob		
Egypt local	-3.4216	0.0107	-1.4859	0.5399	-1.8150	0.3722	-1.1964	0.6762	-1.0777	0.7243		
Egypt USD	-3.4652	0.0093	-1.4876	0.5391	-1.7833	0.3877	-1.1961	0.6763	-2.0306	0.2736		
Morocco Local	-2.4131	0.1385	-1.1804	0.6841	-0.0674	0.9499	-2.0768	0.2544	-1.8063	0.3766		
Nigeria Local	-1.3439	0.6103	-1.7164	0.4222	-1.0737	0.7254	-0.7209	0.8379	0.2036	0.9722		
Nigeria USD	-1.3324	0.6159	-0.8351	0.8076	-1.0771	0.7241	-0.5599	0.8753	-0.2954	0.9219		
Nigeria Top 30 Local	-0.6985	0.8444	-0.6985	0.8444	N/A	N/A	-1.1313	0.7034	-0.0390	0.9529		
Nigeria Top 30 USD	-1.0877	0.7218	-1.0877	0.7218	N/A	N/A	-0.8426	0.8044	-0.4220	0.9016		
South Africa local	-1.2793	0.6406	-0.3728	0.9107	0.2360	0.9741	-1.7408	0.4093	0.0992	0.9649		
South Africa USD	-2.1185	0.2375	-2.0660	0.2588	-0.4716	0.8923	-1.4497	0.5572	-3.3308	0.0149		
USA	-0.8426	0.8057	-0.6602	0.8537	-0.5821	0.8700	-1.4098	0.5770	-0.2402	0.9296		

**Notes: Critical values of ADF are -2.86 at a 5% level and -3.44 at a 1% level (see MacKinnon, 1996). Lag length for ADF based on Schwartz information criterion. Egypt in both local currency and USD over the full period, and South Africa in USD for period 3 were found to be stationary at a 5% level.**

Where the null hypothesis was rejected at a 5 percent level, as was found for Egypt over the full period and South Africa in USD in period 3. Phillips-Perron, Elliott-Rothenberg Stock DF, Kwiatkowski-Phillips-Schmidt-Shin, Elliott-Rothenberg Stock and Ng-Perron tests were performed with the results in Appendix A. There were conflicting results from the unit root tests for Egypt over the full period in both USD and local currency. Given that this paper is mainly concerned with the change in relationship over the 3 periods, and there is no conclusive evidence of stationarity issues found in any of the individual periods (other than South Africa in USD period 3), cointegration tests have been performed on the data.

### 5.1.2 Engle-Granger Cointegration results and Granger Causality test results

It is important to note that South Africa in USD was found to be stationary in period 3, and thus these cointegration relationships are not statistically reliable. Period 2&3 was run as a separate period as the NSE 30 was only available from the beginning of period 2.

No long term cointegration relationships were noted over the full period. The following shorter period relationships can be seen: South Africa and the USA, in local currency, are cointegrated pre (period 1) and post (period 3), but not during the crisis (period 2). Nigeria Top 30 and the USA; Egypt and South Africa; Morocco and Nigeria, were all found to be cointegrated during the crisis period. It is interesting to note that no relationship was found between Nigeria and Nigeria Top 30. The NSE 30 was the only African stock exchange index with a cointegration relationship with the USA during the crisis.

In terms of the Granger causality in local currency there are few relationships, with South Africa leading the USA in period 1, and Egypt in period 2. The USA then leads Nigeria Top 30 and South Africa in periods 2 and 3 respectively. In USD, as South Africa was stationary in period 3, the only relationship is between Nigeria Top 30 and Nigeria. It should be noted that there is no sign of a constant cointegration relationship between Nigeria and Nigeria Top 30, which would seem counterintuitive. This however, does show that the choice of index can have a significant influence on the effects of cointegration and causality tests.

### 5.1.3 Johansen Cointegration results and Granger Causality test results

When looking at the local currency results the Johansen tests show a long term (Period 2&3) and crisis period (2) relationship between Nigeria and Nigeria Top 30 which was expected, with Nigeria Top 30 leading Nigeria for periods 2&3. Egypt and Morocco show a cointegration relationship during the crisis period with Egypt leading Morocco. Post crisis there are relationships between South Africa and the USA, with South Africa causing the USA. South Africa and the USA are both found to lead Egypt.

**Table 2: Results from Engle-Granger cointegration tests and pairwise Granger causality tests for all periods in both local currency and USD**

Cointegration findings in local currency		Egypt	Morocco	Nigeria	Nigeria Top 30	South Africa	USA
Egypt							
Morocco							
Nigeria					2		
Nigeria Top 30							
South Africa						2	
USA							2, 1, 3

Cointegration findings in USD		Egypt	Morocco	Nigeria	Nigeria Top 30	South Africa	USA
Egypt							
Morocco							
Nigeria							
Nigeria Top 30						2	
South Africa							3
USA							3

A Pairwise Granger Causality test was run to try further understand the cointegration relationships identified above. The results of the Pairwise Granger causality tests are as follows:

- South Africa causes the USA (1)
- South Africa causes Egypt (2)
- Nigeria causes Morocco (2)
- The USA causes Nigeria Top 30 (2)
- The USA causes South Africa (3)

A Pairwise Granger Causality test was run to try further understand the cointegration relationships identified above. The results of the Pairwise Granger causality tests are as follows:

- Nigeria Top 30 causes Nigeria (2)
- South Africa causes Egypt (3)
- South Africa causes Nigeria (3)
- South Africa causes Nigeria Top 30 (3)
- No pairwise relationship was found for South Africa and the USA (3)

**Note:** The different time periods are represented by the number 1-3, 2&3 and the letter "f". "f" represents the full period, and numbers "1,2,3" represents the different respective periods. 2&3 represents period 2 and 3 together. The different numbers and "f" are only shown in the table when the null hypothesis for the Engle-Granger cointegration tests is rejected. The null hypothesis states that the pair of stock exchanges is not cointegrated at a five percent significance level. If a Granger causality relationship was found the direction is shown by means of which Country "causes" the other. The number in brackets denotes the period to which the causality relationship relates.

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Period key: Full period: 1 Jan 2004 – 30 Jun 2014; Period 2&3: 1 Jan 2007 – 30 Jun 2014; Period 1: 1 Jan 2004 – 31 Dec 2006; Period 2: 1 Jan 2007 – 31 Dec 2009; Period 3: 1 Jan 2010 – 30 June 2014

**Table 3: Results from Johansen cointegration tests and pairwise Granger causality tests for all periods in local currency and USD**

Cointegration findings in local currency					
	Egypt	Morocco	Nigeria	South Africa	USA
Egypt					
Morocco		2			
Nigeria					
Nigeria Top 30			2, 2&3		
South Africa					3
USA					3

Cointegration findings in USD					
	Egypt	Morocco	Nigeria	South Africa	USA
Egypt					
Morocco		2, 2&3			
Nigeria					
Nigeria Top 30			2, 2&3		
South Africa					2&3
USA					2, 2&3

A Pairwise Granger Causality test was run to try further understand the cointegration relationships identified above. The results of the Pairwise Granger causality tests are as follows:

- Egypt causes Morocco (2)
- South Africa causes USA (3)
- South Africa causes Egypt (3)
- USA causes Egypt (3)
- Nigeria Top 30 causes Nigeria (2&3)
- No pairwise relationship was found for Nigeria and Nigeria Top 30 (2)

A Pairwise Granger Causality test was run to try further understand the cointegration relationships identified above. The results of the Pairwise Granger causality tests are as follows:

- Egypt causes Morocco and vice versa (2,2&3)
- No pairwise relationship was found for Nigeria and Nigeria Top 30 (2)
- USA causes Nigeria (2)
- Nigeria Top 30 causes Nigeria (2&3)
- South Africa causes Nigeria (2&3)
- Nigeria causes the USA and vice versa (2&3)
- Nigeria Top30 causes South Africa and vice versa (2&3)

Note: The different time periods are represented by the number 1-3, 2&3 and the letter “f”. “f” represents the full period, and numbers “1,2,3” represents the different respective periods. 2&3 represents period 2 and 3 together. The different numbers and “f” are only shown in the table when the null hypothesis for the Johansen cointegration tests is rejected. The null hypothesis states that the pair of stock exchanges is not cointegrated at a five percent significance level. If a Granger causality relationship was found the direction is shown by means of which Country “causes” the other. The number in brackets denotes the period to which the causality relationship relates.

Period key: Full period: 1 Jan 2004 – 30 Jun 2014; Period 2&3: 1 Jan 2007 – 30 Jun 2014; Period 1: 1 Jan 2004 – 31 Dec 2006; Period 2: 1 Jan 2007 – 31 Dec 2009; Period 3: 1 Jan 2010 – 30 June 2014

In USD terms we see some noteworthy results, as this shows several long term relationships between the different indices. Nigeria Top 30 as well as South Africa are found to lead Nigeria for period 2&3 (January 2007 to June 2014). Nigeria Top 30 and South Africa are found to be cointegrated and have a causality effect on each other. Nigeria and the USA also are found to cause each for period 2&3. Egypt and Morocco also share this a long term relationship, both having a causality effect on each other.

Running a Johansen test offered very different results to those of the Engle-Granger test for cointegration. Two relationships appear quite prevalent in the results: Nigeria and Nigeria Top 30 appear to be cointegrated and Nigeria Top 30 leads Nigeria. Egypt is found to lead Morocco in local and USD terms.

## 5.2 Results discussion

Cointegration results when both Johansen and Engle-Granger Cointegration tests are combined show only two instances of cointegration. This is consistent with the results from Alagidede et al. (2011) and Jefferis and Okeahalam (1999:44), who suggest there were few or no long term relationships to be found respectively.

The first is the USA and South Africa in period 3 in local currency, where the USA was found to lead South Africa. This relationship is intuitive, as during this period the global markets saw large drops in value and this movement did start in the USA. The second case is between Nigeria and Nigeria Top 30 in period 2 in USD, where it was found that Nigeria Top 30 caused the movement in Nigeria. However, one would expect to see a relationship between Nigeria Top 30 and Nigeria, and it is interesting to note there was only a relationship found for one period.

Collins and Biekpe (2003) find contagion in Egypt and South Africa and also that other smaller African markets did offer diversification to more developed markets, and also that African market interactions appeared to be regional. The findings of this study support the finding that African markets do offer diversification benefits, but there is little evidence to support regional market integration.

Wang et al. (2003), studying the same countries but also including Zimbabwe, found limited cointegration between African countries and also between African countries and the USA. There was some cointegration between South Africa and the USA as well as Nigeria and the USA, but this was very limited. Graham et al. (2013), looking at the MENA region, did find long term linkages with the USA and Egypt was included in their sample. This differs from the results in this study, where cointegration between the Egypt and the USA was only evident in period 3 and only using the Johansen cointegration test.

Chen et al. (2014) find there was integration, and the US market caused frontier market movements, and supported the leading market hypothesis. They also expected the leading markets to become more integrated with frontier markets in the future. This is supported by the results of the Johansen cointegration test run on the data in USD. However, in local

currency terms, or using both Johansen and Engle-Granger tests, this study's results do not support the conclusion of Chen et al. (2014).

## 6. CONCLUSION AND AREAS FOR FURTHER RESEARCH

### 6.1 Conclusion

The cointegration tests on the weekly logged closing prices offer several long term relationships for the period 1 January 2007 – 30 June 2014 in USD. These relationships did not show in local currency except for Nigeria and Nigerian Top 30. These long term relationships were only shown when using the Johansen tests.

There might be a variety of reasons explaining the movement in the various exchanges and this study is limited to looking at cointegration with some brief explanations as to the reasons. The use of local currency verses USD offered differing results. The number of cointegration relationships over time did not tend to increase. These results imply that there are potential benefits from diversification, which could be obtained by investors, over the long term, across the four African exchanges, with this finding being practical due to the size and liquidity of the indices used.

### 6.2 Areas for further research

In addition to running the tests on logged data the tests were also run on unlogged data and yielded differing results thus the effect of logging should be investigated further. As with logging, capping the weightings of stocks in an index would also have an effect on the results, which has not been noted in this study but should be explored further. It has also been noted through discussions with emerging market analysts that the stationarity found between South Africa and the USA in period 3 is an emerging market phenomenon that is not limited to South Africa (Wales, personal communication 2015, June 17). This would be an interesting topic to research further. The extent of the link between the Nigerian All Share index and the Nigerian Top 30 index would also be interesting to explore further.

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## APPENDIX A

Where stationarity was found using the Augmented Dickey-Fuller unit root tests in section 5.1, further testing was performed to confirm that the data is stationary. The below table shows the results of the various unit root tests.

**Table 4 - Unit root test results for additional tests performed on weekly logged data**

Egypt Local (Full period)	Phillips-Perron test statistic		Elliott-Rothenberg-Stock DF-GLS test statistic		Kwiatkowski-Phillips-Schmidt-Shin		Elliott-Rothenberg-Stock test statistic		Ng-Perron test statistics					
	Adj. t-Stat	Prob.*	Test critical values:	t-Statistic	Asymptotic critical	LM-Stat.	Test critical values:	P-Statistic	Asymptotic critical values*:	MZA	MZt	MSB	MPT	
	-3.173757	0.0221	1% level 5% level 10% level	0.701832	1% level 5% level 10% level	0.69066	1% level 5% level 10% level	131.996	1% level 5% level 10% level	0.50489	-13.8 -8.1 -5.7	0.71003	1.40632	117.85
Egypt USD (Full Period)	Phillips-Perron test statistic		Elliott-Rothenberg-Stock DF-GLS test statistic		Kwiatkowski-Phillips-Schmidt-Shin		Elliott-Rothenberg-Stock test statistic		Ng-Perron test statistics					
	Adj. t-Stat	Prob.*	Test critical values:	t-Statistic	Asymptotic critical	LM-Stat.	Test critical values:	P-Statistic	Asymptotic critical values*:	MZA	MZt	MSB	MPT	
	-3.191776	0.021	1% level 5% level 10% level	0.465162	1% level 5% level 10% level	0.583591	1% level 5% level 10% level	123.6986	1% level 5% level 10% level	0.34031	-13.8 -8.1 -5.7	0.4726	1.38872	110.658
South Africa USD (Period 3)	Phillips-Perron test statistic		Elliott-Rothenberg-Stock DF-GLS test statistic		Kwiatkowski-Phillips-Schmidt-Shin		Elliott-Rothenberg-Stock test statistic		Ng-Perron test statistics					
	Adj. t-Stat	Prob.*	Test critical values:	t-Statistic	Asymptotic critical	LM-Stat.	Test critical values:	P-Statistic	Asymptotic critical values*:	MZA	MZt	MSB	MPT	
	-3.218879	0.0205	1% level 5% level 10% level	0.701832	1% level 5% level 10% level	0.186489	1% level 5% level 10% level	2.627894	1% level 5% level 10% level	-10.8178	-13.8 -8.1 -5.7	-2.31099	0.21363	2.32404

## APPENDIX B - ACRONYMS AND ABBREVIATIONS

Below is a list of the acronyms and abbreviations used throughout the study for ease of reference.

ADF	Augmented Dickey-Fuller
CSE	Casablanca Stock Exchange
CFG 25	Casablanca Stock Exchange Top 25 Index
ECM	Error correction model
EGX	Egyptian Stock Exchange
EGX 30	Egyptian Exchange Top 30 Index
GCC	Gulf Cooperation Council
JSE	Johannesburg Stock Exchange
JSE Top 40	Johannesburg Stock Exchange Top 40 Index
MENA	Middle East and North Africa region
MSCI	Morgan Stanley Capital International
NGSE	Nigerian Stock Exchange All Shares Index
NSE	Nigeria Stock Exchange
NSE 30	Nigeria Stock Exchange Top 30 Index
OLS	Ordinary Least Square
S&P 500	Standard and Poor's 500
SMF	Stock Exchange of Mauritius
USD	United States Dollar
VAR	Vector Autoregressions
WFE	World Federation of Exchanges