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Testing Linkages amongst 5 African Emerging Markets

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Abstract:
The goal of most empirical studies in econometrics and other social sciences is to determine whether a change in one variable causes a change in or help to predict another variable. Granger causality modeling approach is quite popular in experimental and non – experimental fields which involve some dynamic econometric time series methodologies. In this research, granger causality and co-integration tests were employed in the empirical modeling of five selected African countries and the data was obtained from Morgan Stanley Capital International (MSCI) index. The results alternated between unidirectional and non-causality among the selected tests, we tested for stationarity in the variables using the Augmented Dickey – Fuller (ADF) procedure. The variables proved to be integrated of either I(1) or I(2). Johansen co-integration test reveals that at 5% level of significance, we have at least four co-integrating pairs among the variables. This verifies the fact that when two or more time series are co – integrated, there must be either bi-directional or unidirectional Granger causality between them. Our findings reveal that Tunisia Granger cause Kenya and also Tunisia Granger cause Morocco.

Keywords: *Granger causality, linkage, stock performance, market capitalization*

1. Introduction

The rising consciousness of investors about the equity markets around the globe serves as a drive for researchers to prove into the performance of the world equity markets without any exception. With time, figures have shown an indication of a surge in world stock markets with emerging markets accounting for significant amount of this rise. Elsewhere in Africa, new stock markets have as well been established.

The history about the expansion of African stock goes beyond just a numerical addition; it makes a development in stock markets across the African region. "Stock market development has been central to the domestic financial liberalization programs of most African countries' [1]. In the period before 1980, Africa could only boast of five stock markets in the sub – Saharan region and three stock markets in the Northern region. Presently, there are 29 stock exchanges as a representation of 38 countries' capital market. This reflects an image of willingness to develop and ultimately bridge the gap between Africa and the rest of the world. To a large extent, the motive (political) behind the creation of the stock exchange in Africa was in efforts of national resources mobilization, "notably as part of privatization programmes which concerns an important sector of public enterprises, besides attracting foreign investors"[2].

Reasons for the rapid development of Africa stock markets have been an interesting issue in recent times. As the second most populous continent with lots of natural resources, African stocks are ticked of their future economic potentials in Africa's economy. Quite a number of studies and research have been conducted on the scope and rate of African stock market development viz –a viz the quantum of investment the region attracts. Other researchers also focused on testing the efficient Market Hypothesis (EMH) on African stock market [3][4]. Although most of them assign weak – form market efficiency of the major developed and emerging stock markets of Latin America, Europe and Asia have been focus of prior studies [5][6],the weak – form hypothesis has received little attention from researchers in Africa'[7].

The state of African stock market in totality brings forth questions about how the market holds in terms of the gap in their functional and operational efficiencies. As arguments established by some studies on African stock exchanges, a contentious case of informational inefficiency could be one besetting issue for the continent's stock markets whereas question arising from flow of liquidity is another. These clearly spell out the difference between stock markets in Africa and those in the develop countries. It is however noteworthy that the disparity between the various renowned and developed stock markets and that of Africa signifies a challenge for the financial base of the continent. Attempts to up its efforts to reach the standards of such stock market could be seen as a case of clear – cut emulation of the western markets which is of positive effects to the African stock markets.

Fact and figures gathered in early 2013 have it that by region, North and Latin American bourses obtained the largest share of 43.2 percent of the total global stock market capitalization whereas Asia – Pacific followed with 30.6 percent. Europe, Africa and the Middle East had a total of 26.14 percent [8]. On the whole, Africa stock markets cannot boast of a very significant share of the world market capitalization but 'many African markets offered dramatic returns to investors over time' [9]. And since 1995, there has been at least one African stock exchange on the world top ten best performing stock markets. This is seen as a reflection of the efforts on the advancement of the stock exchanges in the African region; may as well be a motivation for both local and foreign investors to consider investing in African stocks.

The emergence of African stock markets has raised concerns about the integration of African stock as a financial hub with the power of attracting international investors to Africa. Researchers have found out that regionalization as a means of consolidating African stocks is the right opportunity to promote the "financial globalization of Africa' [10]. It is heart – lifting to discover that most African stock markets are considering regionalization as a viable option. With the Bourse Regionale des Valeurs Mobilieres SA (BRVM) being a leading example, the West, East and Southern African Exchanges are gearing their efforts towards regionalization.

Recent advances in graphical models and the logic of causation have given rise to new ways in which scientists analyze cause – effect relationships. Granger causality modeling has received considerable attention and use in many areas of research. Since the concept of Granger (non) causality was introduced by [11], it has become a popular concept in econometrics and many other fields of human endeavors.

In line with most literatures in econometrics, one variable is said to Granger cause the other if it helps to make a more accurate prediction of the other variable than had we only used the past of the latter as predictor. Granger causality between two variables cannot be interpreted as a real causal relationship but merely shows than one variable can help the other one better.

The aim of this study is to show the existence of a hit – and – run behavior in the interaction between SP and SR across 5 selected countries. By replicating previous studies that deal with the interaction between stock return and stock price indices, using a more sensible time selection setting, the study is able to demonstrate that one has to exercise great caution in using the Granger approach because stock return and stock price indices are dynamic and their fluctuation are robust and vigorous, especially during period of uncertainty. Pooling lengthy periods does not capture the hit – and – run causational behavior and hence, may lead to useless conclusion with no real application.

Given two-time series variable X_t and Y_t, X_t is said to granger cause Y_t if Y_t can be better predicted using the histories of both X_t and Y_t than it can by using the histories of Y_t alone. In this research, we model selected countries stock market price using Pairwise Granger causality analysis as proposed by [11].

In the wake of initial studies on the performance of African stock markets, this research sets to look at the general relationship and linkage of the selected African country's stock market price from July 2010 to July 2015. The study may serve as a guide for both local and foreign investors who have intention of investing in the African stock markets.

2. Literature Review

Many researchers in the field of Time Series Econometrics have Granger causality procedure to study the casual interaction that exists among stock market price of the selected African countries. Moreover, several intelligent articles have surface in literature on the use of Granger test to analyze time series data since introduction by Granger (1969).

Although, flurries of articles have been written on the topic, regrettably, the comparison is usually done among smaller groups of variables. This study tends to contribute to the theoretical and empirical literature on the topic and examines the Pairwise Granger causality analysis of selected Country's market price in Africa. We also offer some theoretical economic underpinnings of the related variables involved in the study. It particularly aims at probing into the pool of literatures available on African stocks in relation to the established objectives of the study. And as such this literature will be segmented into various parts;

2.1. Brief History of the Development and Trend of African Stock Markets

Following information on the history and development of African Stock Markets, it is difficult to overlook the fact that African Stock Markets have shown a collective sign of rapid maturity and development over time. Started with just 8 stock exchanges in the whole of Africa prior to 1987, the number of stock exchanged burgeoned to 29 by the year 2012 representing 38 nations' capital markets [12][13]. With Seyshelles Stock Markets established in 2012 and 1883 respectively, it would be erroneous expression to conclude that African Stock Exchanges has not seen substantial development overtime. Below is the list of various African Stock Markets and their dates of establishment.

Economy	Exchange	Location	Founded
West African Regional Stock Exchange	Bourse Regionale des Valeurs Mobilieres*	Abidjan (Cote d' Ivoire)	1998
Algeria	Algiers Stock Exchange	Algiers	1997
Botswana	Botswana Exchange*	Gaborone	1989
Cameroon	Doula Stock Exchange*	Douala	2001
Egypt	Egyptian Exchange*	Cairo, Alexandria	1883
Cape Verde	Bolsa de Volaores de Cabo Verde*	Mindelo	2005
Ghana	Ghana Stock Exchange*	Accra	1990
Kenya	Nairobi Stock Exchange*	Nairobi	1954
Libya	Libyan Stock Exchange*	Tripoli	2007
Malawi	Malawi Stock Exchange*	Blantyre	1995
Mauritius	Stock Exchange of Mauritius*	Port Louis	1988
Morocco	Casablanca Stock Exchange*	Casablanca	1929
Mozambique	Bolsa de Valores de Mozambique*	Maputo	1999
Namibia	Namibia Stock Exchange*	Windhoek	1992
Nigeria	Abuja Securities and Commodities Exchange	Abuja	1998
	Nigerian Stock Exchange*	Lagos	1960
Rwanda	Rwanda Stock Exchange	Kigali	2008
Seychelles	Seychelles Stock Exchange*	Victoria	2012
South Africa	Johannesburg Stock Exchange*	Johannesburg	1887
Sudan	Khartoum Stock Exchange*	Khartoum	1994
Swaziland	Swaziland Stock Exchange	Mbabane	1990
Tanzania	Dares Salaam Stock Exchange	Dares Salaam	1998
Tunisia	Bourse des Valeur Mobilieres de Tunis *	Tunis	1969
Uganda	Uganda Securities Exchange*	Kampala	1997
Zambia	Agricultural Commodities Exchange of Zambia	Lusaka	2007
	Lusaka Stock Exchange*	Lusaka	1994
Zimbabwe	Zimbabwe Stock Exchange*	Harare	1993

Table 1: List of African Stock Exchanges (*) members of African Securities Exchanges Association, ASEA
Source: Wikipedia, http://enwikipedia.org/wik/list_of_African_stock_exchanges

It is important to note that there has been a decline in the number of stock markets openings although it reached its peak in the 1990s. Reference [14] simply categories African Stock Markets into four groups based on their stages of development:

1. South Africa which is larger, more developed in terms of regulatory framework and more advanced in terms of technical infrastructure than its counterparts;
2. Medium – sized new market which have been established for a long time (e.g. Egypt, Nigeria and Morocco)
3. Small – sized new market which have grown rapidly (e.g. Ghana, Mauritius and Botswana);
4. Small – sized markets that are still at an early stage of development (e.g. Swaziland, Zambia and Malawi).

The above categorization by [14] provides an insight to the extent of growth of the various African stock markets but on the other hand, some of the stock markets have currently transcended their categories into another given the time and stock activities that have taken place with time. It is often documented that the apparent substantial increase in stock markets in Africa can be attributed to the extensive financial sector reforms undertaken by a number of African countries [15]. These financial reforms provide a platform for revamping the liberalization of their financial sectors, privatization of state – owned enterprises, the improvement of the investment climate, introduction of a more robust regulatory framework and improvements in the basic infrastructure for capital market operations.

However, as [1] put it, 'the rapid development of stock markets in Africa does not mean that even the most advanced African stock markets are mature'. Maturity here denotes market capitalization in close comparison to market capitalization of other developed stock markets. It is relevant to note that albeit African stock markets have increased in number over the past years, it is still considered to be small "by world standards and of limited local interest' [16]. The South African stock exchange is seen to control a lion's share of the total market capitalization of African stock markets. The Johannesburg Securities Exchange (JSE) in South Africa has about 90 percent of the combine market capitalization of the entire continent [1]. This is followed by other giant African stock exchange such as Nigeria, Egypt and Zimbabwe. This is not to disregard the fact that other African stock markets have been performing superbly on the world table. For instance, in 2004 the Ghana Stock Exchange was honored as the best stock market with the performance of 144 per cent end of year return in USD terms compared with 30 percent return by Morgan Stanley Capital International Global Index [17].

2.2. Stock Market and Economic Growth

There is an increasing realization by researchers of the correlation between stock market and economic development of countries. As records have it, there are currently quite a number of literatures outlining the significance correlation between stock market development and economic growth of countries. The linkages obtained it significance from the observation gathered from the

activities of stock market on a developed economy. As [10] explains, 'the linkage is explained by the role of a well – functioning stock market system in lowering the costs of mobilizing financial resources and in ensuring that these resources are allocated efficiently in the sense of being channeled to their highly valued use'. Evidence in the Eastern Asia countries during the 70s and 80s has it that there was a rapid growth in their macroeconomic indicators as stock market capitalization soured in the East Asian Countries. In the same period, some Latin American countries experienced a slow – down in economic growth as expected, their stock markets responded negatively. In other study, [18] showed the relationship between the stock price and the economic growth in their study of KSE – 100 index. The data used ranged from 1971 to 2006. In conclusion, they established a direct and relevant correlation between the stock price and economic growth.

2.3. Risks of African Stock Markets

Investments risks are present everywhere even where the markets are most developed and efficient. Likewise, investments in African stock markets as emerging markets are stringed with a couple of risks, as noted, a function of stock market is to provide a function means of risk diversification. "However, there are risk factors that are beyond the control of these markets, which largely stem from instabilities in the economic system as well as political system' [10]. The following represent the risks researchers perceive of African stock markets based on evidence;

2.3.1. Macroeconomic and Political Instability

Investment is a forward – looking activity based on investors' expectations regarding future returns and the confidence that they can place on these return [19]. These expectations from investors are contoured by specific factors such as the microeconomic and political wellness of the country in which they invest. Africa has been plagued with political instability and fluctuations in the macroeconomic indicators. Although issues are getting calmer by the day, some rational investors are still skeptical about investing in African stocks. There have been a considerable number of literatures that study the relationship and effect of macroeconomic and political instability on stock market [20]. Stock market volatility due to political instability has been established in studies such as [21][22]; etc. till date, there has not been an agreement on the exact relationship between macroeconomic stability and stock market development. But what is generally known is that investors are attracted to countries with convincing microeconomic indicators and this affects Africa's ability to pull international investors. This however if gradually changing

2.3.2. Currency Fluctuation

Endemic to most African states is the high volatility in currency exchange. As researched by [10], it is evident that currency depreciation has had quite a negative effect on the performance of African stock markets. Reference [23] found a bivariate causality on whether currency depreciation informed lower stock prices or whether declining stock prices led to depreciating currencies during the Asian crisis of 1997. In most research works on currency fluctuations, there seen to be a form of significant relationship between currency fluctuation and stock market prices.

3. Data and Method

The method used in the collection of data is the transcription method. Such data is called secondary data because the data has been used for the purpose of its collection before other demands for it. The research methodology consists of two phases.

3.1. Granger Causality

Granger causality test involve the estimation of two regression which is commonly expressed as follows:

$SPt = \sum_{i=1}^{n} \alpha_i SR_{t-1} + \sum_{j=1}^{n} \beta j SP_{t-1} + w_{1t}$ - - (1)

$SRt = \sum_{i=1}^{m} \theta_i SR_{t-1} + \sum_{j=1}^{m} \delta j SP_{t-1} + w_{2t}$ - - (2)

Where it is assumed that the disturbance $\hat{U}_{1t}$ and $\hat{U}_{2t}$ are uncorrelated. Equation (1) postulate that current SP is related to past values of SP as well as of past SR. similarly, equation (2) postulate that SR is related to past values of SR as well as of past Sp. The null hypothesis for equation (1) is that there is no causation from SP to SR, thus the coefficient on the Lagged SP are not significant, $\sum \beta j = 0$. Four possible conclusions that can be addressed from such analysis include (1) unidirectional causality from SP to Sr is present; (2) unidirectional causality from SR to SP is present; (3) bilateral causality, i.e. SP and SR granger cause each other and (4) SP and SR are independent to each other.

There are two points that are worth noting when employing the granger approach. Firstly, stationary data is required for equation (1) and (2), and so studies (e.g.[24][25]) commonly test whether SP and SR both have a unit root using the conventional Augmented Dickey – Fuller (ADF) test. In fact, all studies reviewed above found that unit root exist in SP and SR, and so their first difference are used in the analysis.

Secondly, in addition to the need for testing the stationary property of the data, the Granger methodology is somewhat sensitive to the lag length used in equation (1) and equation (2). Some prior research employed the [26] final prediction error (FPE) criterion to search for the optimum lag length that produces the causality. In a financial world where information flow in near perfect, the time lag would be fairly short as investors react almost immediately to fluctuation in the market. In fact, most of the studies employ a 1 – day – lag in their models. It is ironical that while a 1 – day lag suggested by [23] and [27], the results are reported on a several years basis. We emphasize that the causality between the two variable need to be seen from a shorter duration perspective in order for sensible implication to be derived.

This study considers the stock returns and stock price indices from 5th July 2010 to 3rd July 2015 (5 days per week), which were retrieved from https://www.msci.com/end-of-day-data-search. Although, around 1305 samples for each country were included in the analysis. several data mining steps were undertaken to improve the quality of the data. This include removing data on public holidays *which MSCI fills with previous working day). Further, the value of the local currency per USD was used to avoid the rounding up error. This is especially pertinent for countries with large denomination.

3.2. Phase of the Methodology

Since using non- stationary macroeconomic variables in times series analysis causes superiority problems in regression [28] as a first phase of the analysis, it was tested whether stock prices and stock return are integrated of order zero, I (0), that is whether SPt and SRt are stationary. This was achieved by performing Augmented Dickey – Fuller (ADF) Test. The second phase of this analysis focuses on the search for the optimum lag length, which produces the causality before applying Granger causality test.

3.3. Augmented Dickey – Fuller Test (Unit Root Test)

Before employing the Granger causality test, the unit and model selection criteria are necessary to test to select dmax and k, respectively. The study employs the Augmented Dickey – Fuller (ADF) regression proposed by [29] to test if time series variables are stationary. The Dickey – Fuller unit root test assumes the error terms are uncorrelated. In higher – order models and models where the error terms may be correlated, the ADF test is more appropriate [30]. The ADF test is based on the regression [31].

The ADF test is on the following two functions:

$\Delta y_t = \alpha_o + \gamma y_{t-1} + \alpha_2 + \sum \beta i\, \Delta y_{t-I} + \varepsilon_t$ - - (3)

$\Delta y_t = \alpha_o + \gamma y_{t-1} + \sum \beta i\, \Delta y_{t-I} + \varepsilon_t$ - - (4)

Where ε_t is a white noise with zero mean and constant variance; Under the null hypothesis that the unit root exists ($\gamma = 1$ or not stationary), the convectional computed t statistic is known as the τ statistic. If the variable still has a unit root when testing (3) and (4), then the regression have to be differentiated once. As the first difference ADF regression is stationary, the series variable is called to be integrated of order 1, or I (1), and dmax = 1 means all variables are stationary when they are I (1).

The most general method of selecting optimal lagged length k are the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SBC). Their rationales are similar: running the VAR with a different length, and then choosing a lagged length, which makes the VAR have higher explanatory power than other lagged lengths. In other words, the smaller the AIC and SBC, the better the model; However, [1] reminded that these criterions are not appropriate all the time because it is not possible to find the best model with many data sets. In a time series study, monthly or seasonal data a commonly used, but this study will use daily data sets. If the lagged length is too long, many will be skeptical about the empirical results because it may not valid that one variable from many years ago influence another variable this year. Therefore, this study will select a shorter lagged length, such as 1 or 2.

3.4. Co – integrating Regressions and Granger Representation Theorem

Here we are primarily concerned with testing for co-integration in a system of k = 2, I(1) variables, in which case there is at most r =1 co – integrating relationship.

If a set of variable are co-integrated, then there exist a valid correction representation of the data, and vice – versa.

If y and x are both I(1) and have a long run relationship, there must be some force which pulls the equilibrium error back to zero. Reference [32] recommend a two – step procedure for co-integration analysis.

1. Estimate the lung – run (equilibrium) equation:

$Y_t = \delta_o + \delta_1 X_t + U_t$ - - (5)

The OLS residuals from (5) are a measure of disequilibrium:

$\hat{U}_t = Y_t - \delta_o - \delta_1 X_t$

A test of co-integration is a test of whether $\hat{U}t$ is stationary. This is determined by ADF test on the residuals, with the [33] critical values adjusted for the number of variables (which Mackinnon denotes as n).

If co-integration holds, the OLS estimator of (5) is said to be super – consistent. Implications: as T → infinity (i) there is no need to include I (0) variables in the co-integrating equation.

Note: The t-ratios from equation (5) are not interpretable, as it is a long – run equation, and therefore will have serial correlation (due to mis-specified dynamics) as well as omitted variable problems, and as such the distribution of the t – ratio is not known.

The traditional diagnostic test from (5) are unimportant as the only important question is the stationarity or otherwise of the residuals.

2. Second step: Estimate the Error Corrected Model

$\Delta Y_t = \varphi o + \sum_{j=1} \varphi_j \Delta Y_{t-j} + \sum_{h=o} \theta_h \Delta X_{t-h} + \alpha \hat{u}_{t-1} + \varepsilon_t$ - (6)

By OLS as this equation has only I(0) variables, standard hypothesis testing using rations and diagnostic testing of the error term is appropriate. The adjustment coefficient α must be negative.

Special case:

$\Delta Y_t = \varphi o + \varphi_1 \Delta Y_{t-1} + \theta_1 \Delta X_{t-1} + \alpha(Y_{t-1} - \delta o - \delta_1 X_{t-1}) + \varepsilon_t$ - (7)

ECM describes how y and x behave in the short run consistent with a long run co – integration relationship.

Note: the formula used in calculating the 5 selected countries stock market rate of returns is given below"

$S_r = 100 \text{ x } \log\left(\frac{S_t - S_0}{S_o}\right)$ - - - - - - (8)

Where: S_r is the rate of returns

S_t is the price at time t
S_o is the initial stock price

4. Data Analysis and Results

4.1. The Data and their Time Series Properties for the stock Price

The sample is made of five African stock markets, which satisfy the definition of 'emerging market' (Nigeria, Ghana, Morocco and Tunisia); the data in these countries is well reported and readily available. These five countries represent the largest stock markets. The data consist of daily closing prices for the selected countries from July 2010 to July 2015. The data from Nigeria, Ghana, Kenya, Morocco and Tunisia is the Morgan Staley Capital international (MSCI) Index, computed based on market performance in global emerging markets.

All the data are reported in US dollars. Calculating the stock market price in US dollars to eliminates location inflation and thus makes the result more comparable. It also eliminate exchange rate risk and other trading cost associated with investing in developing economies, which may be over looked when using local currency stock price. Daily data is used to circumvent the problem of non-synchronous trading, so common in emerging markets. Below represents each of the stock market series in their natural logarithm form.

4.2. Daily Stock Prices

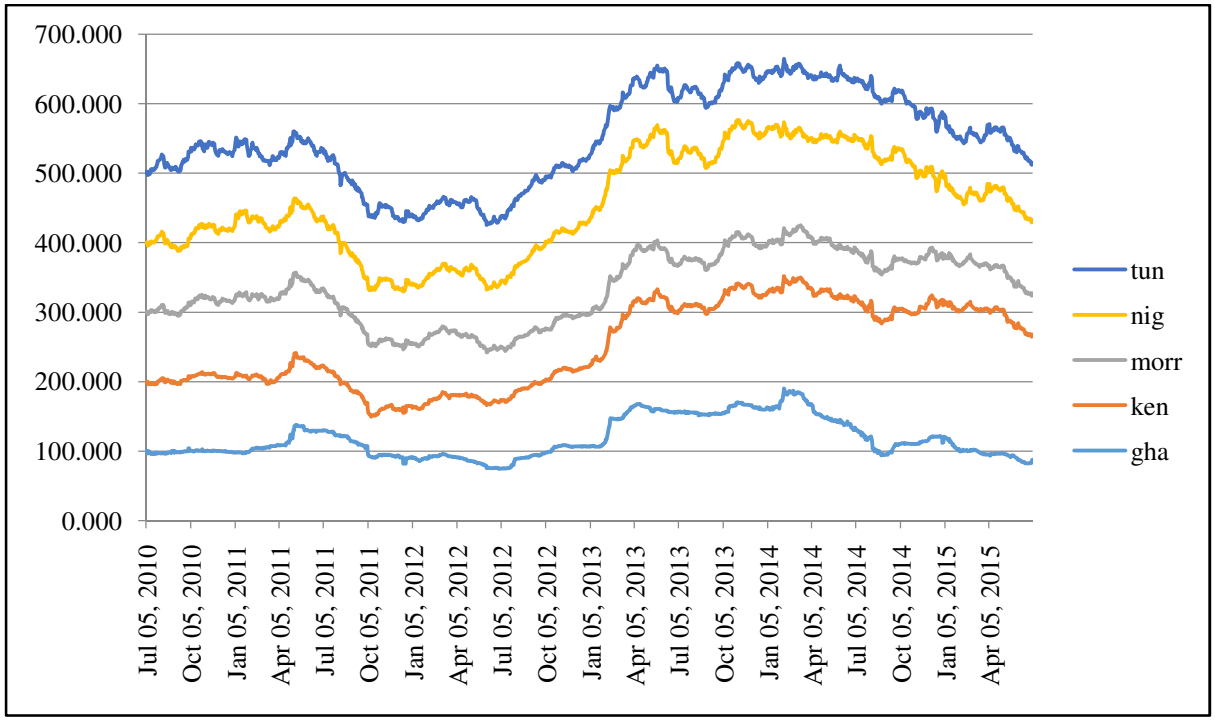

Figure 1: Time Plot of Selected Emerging Stock prices in Africa

Figure 1 shows the stock price of each of the selected countries which shows the trend at which the stock market price moves.

Countries/Statistic	Ghana	Kenya	Morocco	Nigeria	Tunisia
Mean	117.3099	134.0480	83.07659	121.2023	93.84815
Std. Dev.	28.54508	43.89481	17.39861	27.53661	9.400156
Skewness	0.673693	0.181242	0.696882	0.280374	0.995602
Kurtosis	2.184454	1.618202	2.050676	1.561390	3.743265
Jarque-Bera	134.8806	110.9663	154.6315	129.6320	245.6303
Observations	1305	1305	1305	1305	1305

Table 2: Summary Statistics of Stock Market Price: July 2010 to July 2015

4.3. Descriptive Statistics of the Selected 5 African Countries Stock Market Price

The descriptive statistics describe the basic feature of out indices. As shown in Table 2, the mean shows the average daily stock market piece index. It can be seen that Kenya has the highest average daily stock market price of 134.0480, followed by Ghana and Morocco has the lowest average daily stock price of 83.07659. Therefore Kenya make relative attractive rates that an international portfolio holder may want to consider.

The Modern Portfolio theory suggests that variance or standard deviation of stock which shows volatility is a measure of risk. Thus, standard deviation is being used to gauge the level of risk in the various indices over the study period. Kenya's index is most volatile with standard deviation of 43.89481 while Tunisia has the least standard deviation of 9.400156. this study proves that investing Kenya is riskier among the African stock market considered, while Tunisia is less risky compare to others.
Skewness was used to show how symmetrical our distribution is. Since the values are generally close to zero (0), the distributions do not have problem of skewness. Kurtosis was used also to measure the various assets risk level by comparing the shape of the stock distribution of Gaussian distribution. Our result indicates that the distributions of all the 5 markets are positive and below 3 of the Gaussian distributions, meaning that they possess wider peak. They are Platykurtic and the possibility of extreme value is less than for a normal distribution. Similarly, the Jarque – bera statistic is used to test if our stock data have skewness and kurtosis that match that of the normal distribution.

4.4. Correlations of the Stock Price of the Selected 5 African Countries
Correlation of stock price shows how the various indices move in relation to one another. Table 3 below gives an insight into stock correlation of the selected indices over the study period.

	Ghana	Kenya	Morocco	Nigeria	Tunisia
Ghana	1				
Kenya	0.397013	1			
Morocco	-0.29871	-0.73286	1		
Nigeria	0.741702	0.61943	-0.56257	1	
Tunisia	-0.43201	-0.72952	0.757299	-0.60855	1

Table 3: Correlation of Stock market Price: July 2010 to July 2015
Source: SPSS output

It can be seen from table 3 that some of the correlation coefficients are negative while others are positive. The negative sign indicates that price of the concerned market have moved more in opposite direction. This is a good sign for diversification to take place. The common low positive correlation is also a good sign. Notably, the pairs of Morocco/Tunisia have the highest positive correlation coefficient of 0.757299

4.5. The Data and their Time Series Properties for the stock returns
The data initially consist of daily closing prices for the selected countries from July 2010 to July 2015, but in order to carry out the research we need to get the stock rate of returns for each of the stock price. By the help of R console Package the data were transformed. The data for Ghana, Kenya, Morocco, Nigeria and Tunisia is the Morgan Stanley Capital International (MSCI) Index, computed based on market performance in global emerging markets.
The reason for this is to avoid spurious problem, because stock price are non-stationary and the rate of return is stationary. So the natural logarithm trend of each of the 5 selected countries is presented below.

4.6. Daily Stock Returns

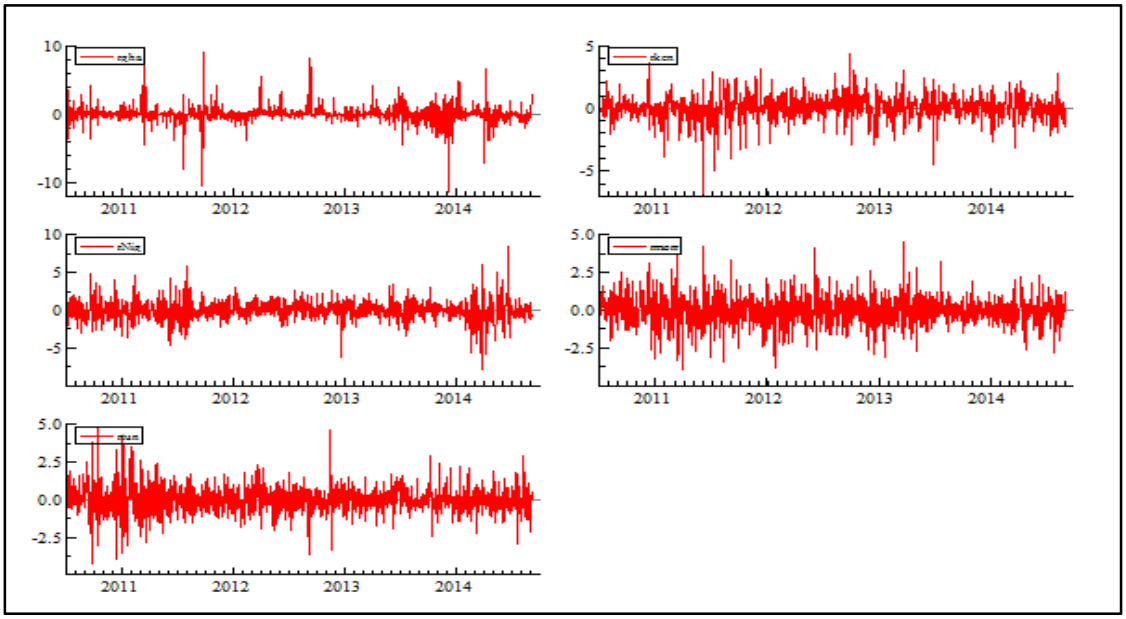

Figure 2: Time plot of Nigeria's Stock returns

The above figures 2are daily stock return of each of the selected emerging stock market in Africa.

Countries/Statistic	Ghana	Kenya	Morocco	Nigeria	Tunisia
Mean	-0.000182	0.000405	-0.000446	-5.03E05	-0.000186
Std. Dev.	0.012258	0.009802	0.009829	0.013089	0.009118
Skewness	-0.765735	-0.690600	0.025570	-0.116876	-0.018394
Kurtosis	23.90203	7.341554	4.732414	7.735358	6.447504
Jarque-Bera	23865.38	1127.787	163.2104	1221.319	645.8406
Observations	1304	1304	1304	1304	1304

Table 4: Summary Statistic of Stock Returns: July 2010 to July 2015
Source: SPSS Output

4.7. Stylized Facts of the Selected African Market Returns

The descriptive statistics describe the basic features of our indices. As shown in table 4, the mean shows the average daily stock market return of each index. It can be seen that Kenya has the highest average daily stock market returns of 0.000405, followed by Ghana and Morocco has the lowest average daily stock market return of -0.000446. Therefore Kenya make relative attractive rate that an international portfolio holder may want to consider.

The modern Portfolio theory suggests that the variance or standard deviation of stock which shows volatility is a measure of risk. Thus, standard deviation is being used to gauge the level of risk in the various indices over the study period. Nigeria's index is most volatile with standard deviation of 0.013089 while Tunisia has the least standard deviation of 0.009118. This study proves that investing in Nigeria is more risky among the African stock markets considered, while Tunisia is less risky compare to others.

Skewness was used to show how symmetrical our distribution is. Since the values are generally close to zero (0), the distributions do not have problem of skewness. Kurtosis was used also to measure the various assets risk level by comparing the shape of the stock distribution of Gaussian distribution. Our result indicates that the distributions of all the 5 markets are positive and above 3 of the Gaussian distributions, meaning that they possess thicker tails. They are leptokurtic, sharper and the possibility of extreme value is higher than for a normal distribution. Similarly, the Jarque – bera statistic is used to test if our stock data have skewness and kurtosis that match that of the normal distribution.

	Ghana	Kenya	Morocco	Nigeria	Tunisia
Ghana	1				
Kenya	-0.00417	1			
Morocco	0.029761	0.1066466	1		
Nigeria	-0.01467	0.180532	0.044073	1	
Tunisia	0.020217	0.04113	0.168679	-0.01179	1

Table 5: correlation of Stock Market returns: July 2010 to July 2015
Source: SPSS Output

It can be seen from table 5 that some of the correlation coefficients are negative while others are positive. The negative sign indicates that returns of the concerned market have moved more in opposite direction. This is a good sign for diversification to take place. The common low positive correlation is also a good sign. Notably, the pairs of Kenya/Nigeria have the highest positive correlation coefficient of 0.180532

4.8. Unit Root Tests

Traditionally, most economic variables are non – stationary; hence we test for the presence of unit roots using the Augmented Dickey – Fuller tests.

Reference [29] noted that the least square estimator of the VAR model in the Granger causality analysis is biased in the presence of unit root and this bias can be expected to reduce the accuracy of forecasts.

Country	Test Statistic (p-value)	Critical Value	Order of Integration
Ghana	-25.887	-3.413	I(1)
Kenya	-25.266	-3.413	I(1)
Morocco	-33.647	-3.413	I(1)
Nigeria	-27.711	-3.413	I(1)
Tunisia	-32.753	-3.413	I(1)

Table 6: Augmented Dickey – Fuller Test for the selected countries stock prices
Source: Eview 8.

From Table 6, each of the countries got stationary after the first difference, therefore we conclude for the above ADF test that the stock series of Ghana, Kenya, Morocco, Nigeria and Tunisia are not stationary at level difference.

Hence the series became stationary for stock returns at level difference Table 7 below presents the result of the ADF test.

Country	Test Statistic (p-value)	Critical Value	Order of Integration
Ghana	22.2705	-3.41327	I(0)
Kenya	25.9905	-3.41327	I(0)
Morocco	34.2981	-3.41327	I(0)
Nigeria	27.2721	-3.41327	I(0)
Tunisia	32.589	-3.41327	I(0)

Table 7: Augmented Dickey – Fuller test for the Selected Countries Stock Returns
Source: E-views version 8.

The test reveals that all the variables are non- stationary. They were made stationary after the level or first difference.
Ghana became stationary at the level difference, likewise Kenya, Morocco, Nigeria and Tunisia became stationary at the level difference. Reference [28] noted that regression results from the VAR models of the Granger causality test using non-stationary variable will be spurious. To avoid this, we will run the regression with the stationary variables after differencing.

4.9. Co-integration Test
In literature, Co-integration tests, e.g. [32], [33], [34] etc. are used to ascertain the presence of potential long run relationship between two variable. A major implication of Granger causality is that if two variable say, x and y, are co – integrated, then either X must Granger cause Y or vice – versa.

Country	Eigen value	Trace Statistic	0.05 Critical Value	Hypothesized No. of CE(s)
Ghana	0.180133	974.2870	69.81889	None*
Kenya	0.157354	716.4874	47.85613	At most 1*
Morocco	0.143361	494.2589	29.79707	At most 2*
Nigeria	0.125388	293.4080	15.49471	At most 3*
Tunisia	0.087960	119.5091	3.841466	At most 4*

Table 8: Co – integration Test for the Selected Countries stock returns

Trace test indicate 5 co - integration equations at 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
The test reveals that there are co – integration series in all the 5 countries considered in this research.

4.10. Pair wise Granger Causality Tests
We test for the absence of Granger causality by estimating the following VAR model

$$Y_t = a_o + a1Y_{t-1} + \ldots + a_pY_{t-p} + b_1X_{t-1} + \ldots + b_pX_{t-p} + U_t \quad - \quad - \quad (9)$$

$$X_t = C_o + C_1X_{t-1} + \ldots + C_pX_{t-p} + d_1X_{t-1} + \ldots + b_pY_{t-p} + V_t \quad - \quad - \quad (10)$$

Testing
Ho: $b_1 = b_2 = \ldots = b_p = 0$
Against
Ho: $b_1 \neq b_2 \neq \ldots \neq b_p \neq 0$
Is a test that X_t does not Granger cause Y_t
Similarly, testing
Ho: $d_1 = d_2 = \ldots = d_p = 0$
Ho: $d_1 \neq d_2 \neq \ldots \neq d_p \neq 0$
Is a test that Y_t does not Granger cause X_t?
In each case, a rejection of the null hypothesis implies there is Granger causality between the variables.
In testing for granger causality, two variables are usually analyzed together, while testing for their interaction. All the possible results of the analysis are four:

i. Unidirectional Granger causality from variable Y_t to variable X_t
ii. Unidirectional Granger causality from variable X_t to variable Y_t
iii. Bi – directional causality and
iv. No causality

Here, we present the main results obtained from the pairwise Granger – causality analysis done in the study. Ten pairs of variables (countries) were modeled as seen in table 9 below:
The five countries considered are represented as follows:

Pairwise Hypothesis	Obs.	f-statist	P-value	Decision	Type of causality
B→A	1300	0.78056	0.5637	DNR Ho	No causality
A→B	1300	1.09343	0.3621	DNR Ho	No causality
C→A	1300	0.91841	0.4680	DNR Ho	No causality
A→C	1300	1.20326	0.3053	DNR Ho	No causality
D→A	1300	1.63161	0.1486	DNR Ho	No causality
A→D	1300	0.18592	0.9680	DNR Ho	No causality
E→A	1300	0.78174	0.5628	DNR Ho	No causality
A→E	1300	0.16204	0.9769	DNR Ho	No causality
C→B	1300	2.17032	0.0551	DNR Ho	No causality
B→C	1300	0.05381	0.9982	DNR Ho	No causality
D→B	1300	5.38205	7.E-05	DNR Ho	No causality
B→D	1300	1.51518	0.1821	DNR Ho	No causality
E→B	1300	2.40023	0.0353	Reject Ho	Uni-directional causality
B→E	1300	1.50597	0.1615	DNR Ho	Uni-directional causality
D→C	1300	0.50597	0.7719	DNR Ho	No causality
C→D	1300	0.74095	0.5928	DNR Ho	No causality
E→C	1300	3.03901	0.0098	Reject Ho	Uni-directional causality
C→E	1300	0.46073	0.8056	DNR Ho	Uni-directional causality
E→D	1300	1.62928	0.1492	DNR Ho	No causality
D→E	1300	1.58922	0.1601	DNR Ho	No causality

Table 9: Result of Pairwise Granger causality Tests

Ghana – A, Kenya – B, Morocco – C, Nigeria – D, Tunisia – E, → = does not granger cause

5. Conclusions

From the research, the stock market price of each of the selected countries have relationship due to the result of the co-integration test that depicts we have five co – integration equations in the study, and the Augmented Dickey – Fuller (Unit root test) that is being performed for the stock market price of the selected countries as well enables the granger causality test to hold because each of the country's stock market price become stationary at different levels. However, as expected, given the granger causality test results, few linkages between the series was established and the following recommendation was made: The government of each countries should try and stabilize their currency value and Nigeria government should provide necessary amenities to promote the county's stock market and enhanced it return to attract stock investors to the country.

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