

# Market Integration and Dynamic Relationship between Emerging and Developing Economies: Evidence from Selected Market

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## ABSTRACT

This paper re-examines the evidence for cointegration between international stock prices. It applies Johansen's maximum likelihood (ML) cointegration method Var and impulse response stock price of Nigeria, the United Kingdom, Morocco, South Africa, Tunisia and the United States, with monthly data covering the period of 01/02/2004-01/07/2016. It finds at most one cointegrating vector from the developed market to emerging market. The results show that no bivariate cointegration exists between the Nigeria and any of the stock markets being studied, and the multivariate cointegration confirms the result. The findings on dynamic return linkages is that there is no significant returns linkages among the markets, with the exception to UK. Indeed FTSE100 is the most exogenous. Therefore, all markets are not exposed to the same set of risk factors and the risk premia on each factor varies among all markets. The non-existence of a cointegrating relationship between the Nigerian market and the considered stock markets implies that these markets offer potential for pairwise portfolio diversification for a Nigerian portfolio manager .

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## 1. Introduction

The globalization of equity markets is bringing increased attention to stock markets throughout the world. Both investors and academic scholars have examined the implications of investing in international equity markets. Most studies have examined interrelationships among the world stock markets either using solely annual or daily data. The development of stock market is a function of so many factors such as the attitude of the investors, government regulations on new investment strategies, trend in the industries and integration of the economic and financial markets. African stock market reforms are the centre of economics liberalization policies that have been embraced in the late eighties. This process of stock market reforms continued with an effective regulation framework positioned at improving market efficiency, transparency, curbing unfair practices (asymmetric information) and achieving international standard in stock market.

Recent developments in the theory of cointegration by Engle and Granger (1987) provide new methods of testing international equity market linkages. Cointegration among a set of variables implies that even if they are nonstationary, they never drift far apart. In contrast, lack of cointegration suggests that such variables have no long-run link. We use this methodology to study how the different stock markets around the world are related. Engle and Granger (1987) have also shown that if two variables are cointegrated, then the variables follow a well specified error-correction model, where by 'well specified' it is meant that coefficient estimates, as well as the standard errors for the coefficients of the estimated equation(s) are consistent. The error-correction equation gives us a means of testing the dynamic interaction of national stock price movements. In this paper, we study the

linkages among stock prices in major world stock exchanges such as Nigeria, the United Kingdom, Morocco, South Africa, Tunisia and the United States, using daily closing data from 01/02/2004-01/07/2016. Finally, we investigate the impact of stock price movements in one market on another. The remainder of the paper is organized as follows. Section 2 briefly discusses the statistical meaning of cointegration and error-correction model. Section 3 presents the data and methodology. In section 4 the results are presented and discussed. Section 5 provides a summary and concluding remarks.

## 2. Theoretical Framework

### 2.1. Stock prices and cointegration

Cointegrating vectors can be thought of as representing constraints that an economic system imposes on the movement of the variables in the system in the long-run. Consequently, the more cointegrating vectors there are, the 'more stable' the system. (Dickey et al., 1994.) If stock prices are cointegrated, prices in different markets cannot move 'too far' away from each other. In contrast, a lack of cointegration suggests that stock markets have no long-run link and stock prices in different markets can diverge without bound. By stock market integration one understands that stocks in all markets are exposed to the same set of risk factors and the risk premia on each factor are the same in all markets. The interesting question is whether comovements of stock prices and cointegration reflect the integration of stock markets. One would expect stock prices to be cointegrated if stock markets are integrated. Engsted and Lund (1997) showed that stock prices will be cointegrated if the underlying fundamentals determining stock prices (i.e. dividends) are cointegrated. It is of course possible that stock prices are cointegrated for some

other reason not having to do with stock market integration (Kasa, 1992).

## 2.2. Empirical Review

Stock market is integration if all markets are exposed to the same set of risk factors and the risk premia on each factor are the same in all markets. The interesting question is whether comovements of stock prices and cointegration reflect the integration of stock markets. Expectedly stock prices would be cointegrated if stock markets are integrated. Drawing from Engsted and Lund (1997), Ahlgren and Antell (2002) showed that stock prices will be cointegrated if the underlying fundamentals determining stock prices (i.e. dividends) are cointegrated.

Furthermore, if markets are more integrated we would expect to see their indices display common trends (Dickson 2000). Since stock market indices are non stationary, testing for cointegration should be a necessary procedure. However, several authors have come up with different results on the convergence of the different stock markets. Using data from quarterly, share price indices and the recursive common stochastic trend analysis Rangvid (2001) investigated the degree of convergence among three European countries from 1960-1999. His results showed that after 1982, the UK, French and German markets have shown an increased convergence. Pascual (2002) also contended that a long-run co-movement is evident in the UK, French and German stock markets and argued that the recursive approach proposed by Rangvid (2001) may provide misleading results. He suggested an alternative measure of increasing stock market integration of estimating the time-path followed by the coefficient of the error correction term. His test results do not show evidence of changes in the degree of financial integration for the UK, French and German stock markets.

Fraser and Oyefeso (2005) examine long run convergence between US, UK and seven major European stock markets over 1974 to 2001, employing the Johansen cointegration test, their results showed that over the period that the degree (short-term) of association between markets has on average been greater between the UK and European markets than between US and the remaining markets in the sample. Corhay et al (1993) investigated price indices of five major European stock markets (France, Germany, Italy, the Netherlands and UK), making use of bi-weekly observations from 1975 to 1991, and empirical evidence showed common stochastic trends among the markets. Chan et al (1997) extends the previous researches on integration of international stock markets by including eighteen nations and covering a 32 year period from 1961 to 1992, the markets are analysed both individually and collectively in regions to test for the weak-form market efficiency, they tested for cross-country market efficiency making use of monthly price indices and Johansen's (1988 and 1991) cointegration tests on the eighteen stock markets, in most cases there is no significant cointegration for the full sample in the 1960s', 1970s' and 1980s'. However before the stock market crashed in 1988, there has been an increase in the significant cointegration vectors for the big four European community countries; Germany, France, Spain and Italy. However their empirical result provides that countries with common economic ties (e.g. European Community Countries) may not cointegrate. That is, the common economic and geographic ties do not necessarily lead national stock markets to follow the same stochastic trend. Their results also refuted the argument that international stock markets do not become more integrated

following some turbulence in the markets such as the October 1987 stock market crash.

Yang et al (2003) investigated the impact of the Economic and Monetary Union (EMU) on stock market linkages, allowing for inference on international market integration from three different perspectives; contemporaneous, the short run and long run. They employed the Johansen and Julius 1990 and Johansen 1991- Trace test on daily closing prices of ten European Monetary Union countries including the UK and US from 1996 to 2001, their findings shows that European stock markets as a whole are more integrated in the long run after the EMU was implemented. Dickson 2000 examined the macroeconomic variables driving the common stochastic trends of the US, UK, German and French stock markets, using cointegration analysis on monthly stock prices and macroeconomic variables (industrial production, interest rate and exchange rates) from 1980 to 1995, there does not appear to be a major increase in the degree of integration in Europe despite the potential for much real integration as monetary union proceeds. His results shows an equilibrium relationship between German stock index and the UK real interest rate, the US stock index also has a long run effect on the German real interest rate. He concluded that interest rate is an important source of stock market variability.

Masih and Masih (2004) assess the dynamic linkages of the stock prices of France, Germany, Netherlands, Italy and the UK for 14years the from 1979 to 1994 in terms of what effect the October 1987 crash had on its transmission. They employed the use of unit root tests and Johansen cointegration test on three sample periods; January 1978-September 1987, November 1987- June 1994 and January 1979 – June 1994. They found the presence of unit roots in the samples and both the max-eigen value and the Trace statistic indicate the existence of at most a single cointegrating vector in each of the models over the pre and post crash samples, this signify four common stochastic trends among the set of stock price indexes. The evidence of cointegration among these markets implies that each national stock price series contains information on the common stochastic trends which binds all the markets together; the predictability of one country's stock prices can be enhanced significantly by utilising information on the other country's stock prices. They concluded that the evidence of cointegration in their findings is consistent with a violation of the market efficiency hypothesis, this should however be evaluated with due caution since predictability implies nothing about market inefficiency (Richards 1995); a market is inefficient only by using the predictability one could earn risk-adjusted excess returns.

Using an error correction vector autoregressive model on the daily stock index closing prices in the six markets from 1997 to 2003, Syriopoulos (2004) examined the presence of short and long run linkages among major emerging central European stock markets as well as developed markets; Poland, Czech Republic, Hungary, Slovakia, Germany and the USA. Their empirical findings support the presence of one cointegration vector, indicating a stationary long run relationship. Based on their findings, both domestic and external factors affect stock market behaviour leading to long run equilibrium but the individual central European markets tend to display stronger linkages with their mature counterparts rather than neighbours.

The same findings was observed by Dickson (2000) and Yang et al (2003). They also argued that the cointegrating relationship among the major European stock markets especially after the 1987 stock crash may be driven partly by the long run relationships of macroeconomic fundamentals among these countries.

using the Johansen and Juselius (1992) cointegration approach and Granger Causality test and monthly stock returns, Piesse and Hearn (2002) found that Botswana, Namibia and South Southern African equity markets are cointegrated. Surprisingly, the finding suggests the Granger causality between the Namibian and South African stock market. The study attributed this to the presence of common regional factors that tend to affect Namibia more than South Africa which then spills over to the more open South Africa equity market. On the other hand, Collin and Biekpe (2003) analysed the extent of integration of African stock markets with a view to assessing their vulnerability to Asian stock market crisis of 1997 using the adjusted Pearson's correlation coefficient of Forbes and Rigobon (2002). They found that with an exception of Egypt and South Africa, the African stock markets are not vulnerable to contagion. The concluded that there is limited evidence of causal relationship among African stock markets except for regional blocks, which they attributed to trade and economic links rather than investors' behaviour (Collins and Biekpe, 2003). The nature of volatility within and across African stock markets has also been examined. For instance, time-varying asymmetric moving average threshold GARCH (asymmetric-MA-TGARCH) model and daily stock indices for South Africa, Nigeria and Kenya for the period 1985-1998. Ogum (2002) documents evidence that both conditional mean and conditional variance respond asymmetrically to past innovations. However, in the case of conditional mean, the asymmetry is reverse i.e. good news has greater impact on return than bad news of the same magnitude. Similarly, Piesse and Hearn (2002) use the exponential GARCH model of Nelson (1991) with weekly data for the period 1997-2000 to establish evidence of bidirectional transmission of asymmetric volatility among some of the sub-Saharan equity markets. However, their overall finding was that due to lack of liquidity and limited domestic participation most of the sub-Saharan equity markets were not integrated.

### 3. Data and Methodology

#### 3.1. Data

This study uses monthly time series covering 01/02/2014 to 01/07/2016. Highly capitalized equity market from Nigeria Allshare index, South African index 40, Morocco (MAS), New York Stock Exchange, Financial time stock exchange (UK) Tunisia (TUN) are employed. All these variables have been employed in related studies (see Allen and McDonald, 1995; Lamba and Otchere 2001; Ogum 2002; Collin and Biekpe 2003 ). Another reason why these studies utilise such a proxy is that it is normally level non-stationary, unlike return series which are level stationary. As mentioned earlier, level non-stationarity of series is one of the preconditions for the series to be applicable for cointegration analysis. On the other hand, studies that seek to establish whether return linkages exist between stock markets use stock market returns as their proxies. Since return series are not readily available, they are computed from market indices series as follows:

$$y_t = (\ln P_t - \ln P_{t-1}) \times 100$$

Where  $y_t$  is current continuous compounded returns,  $P_t$  is the current month stock price index and  $P_{t-1}$  is the previous month stock market index.

#### 3.2. Unit root Test

In time series analysis, before running the cointegration test the variables must be tested for stationarity. For this purpose, we use the conventional ADF tests, the Phillips-Perron test following Phillips and Perron (1988). Therefore, before applying this test, we determine the order of integration of all variables using unit root tests by testing for null hypothesis  $H_0: \beta = 0$  (i.e  $\beta$  has a unit root), and the alternative hypothesis is  $H_1: \beta < 0$ . The objective is to ensure that the variables are not I(1) so as to avoid spurious results.

#### 3.3. Cointegration

This study adopts a dynamic vector autoregressive regression (VAR) which explores cointegration. The essence is to capture the causal dynamics between stock market returns, and at the same time to observe the long run dynamics. For instance, given a VAR with possible long run cointegration amongst a set of variables.

Therefore, we start with the Johansen co-integration equation which starts with the vector auto regression (VAR) of order  $p$  is given by:

$$y_t = \mu + A_1 y_{t-1} + \dots + A_p y_{t-1} + \varepsilon_t \quad (1)$$

Where  $y_t$  is a  $(n \times 1)$  vector of stock market prices in log form that are integrated at order one- commonly denoted  $I(1)$ ,  $n=6$ ,  $A_p$  are the parameters to be estimated,  $\varepsilon_t$  are the random errors. This (VAR) can be re-written as;

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-1} + \varepsilon_t \quad (2)$$

Where,  $\Pi = \sum_{i=1}^p A_i - 1$  and  $\alpha_i = -\sum_{j=i+1}^p A_j$  (3)

If the coefficient matrix  $\Pi$  has reduced rank  $r < n$ , then there exist  $n \times r$  matrices of  $\alpha$  and  $\beta$  each with rank  $r$  such that

$$\Pi = \alpha \beta' \quad (4)$$

Where  $r$  is the number of co-integrating relationship, the element is  $\alpha$  is known as the adjustment parameters in the vector error correction model and each column of  $\beta$  is a cointegrating vector. It can be shown that, for a given  $r$ , the maximum likelihood estimator of  $\beta$  define the combination of  $y_{t-1}$  that yield the  $r$  largest canonical correlations of  $\Delta y$  with  $y_{t-1}$  after correcting for lagged differences and deterministic variables when present. The two different likelihood ratio test of significance of these canonical correlations are the trace test and maximum eigenvalue test, shown in equation 5 and 6 respectively below

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \quad (5)$$

and

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (6)$$

Here, T is the sample size and  $\hat{\lambda}_i$  is the  $i^{th}$  ordered eigenvalue from the  $\Pi$  matrix in eqt 3 or largest canonical correlation. The trace tests the null hypothesis that the number of  $r$  co-integrating vector against the alternative hypothesis of  $n$  co-integrating vector where  $n$  is the number of endogenous variables. The maximum eigenvalue tests the

null hypothesis that there are  $r$  cointegrating vectors against an alternative of  $r + 1$  (see Brooks 2002).

In this study, cointegration analysis will be carried out in two stages. Firstly, bivariate cointegration analysis will be used to examine the long run relationship between the Nigeria stock markets and each of the stock markets under study. We follow the principle that unsystematic risk is a decreasing function of the number of assets included in a portfolio (Howells and Bain, 2005), possible portfolios will be chosen and tested for long run relations using multivariate cointegration. The choice of these portfolios will primarily be based on the importance of the stock markets under consideration from a Nigerian investor's perspective.

### 3.4. Examining returns Linkages

In order to understand the returns and volatility comovement, it is important to analyse the market dynamics, transmission and propagation mechanism driving these markets. A model that clearly shows how returns and volatility are transmitted from one market to another in a recognised fashion, as well as ensuring that multilateral interactions are simultaneously analysed, is necessary. The Vector Autoregressive (VAR) model would be among one of the most appropriate models. Developed by Sims (1980), the VAR model can estimate a dynamic simultaneous equation system without putting any prior restrictions on the structure of the relationships. Because it does not have any structural restrictions, the VAR system can enable the estimation of reduced form of correctly specified equations whose actual economic structure may be unknown. This is an important feature in empirical analysis of data since structural models are normally misspecified.

Our study will express the VAR model as follows:

$$y_t = \alpha + \sum_{s=1}^m A_s y_{t-s} + \varepsilon_t \quad (7)$$

Where  $y_t$  is a  $(6 \times 1)$  vector of equity market prices return in log form  $\alpha$  is the deterministic component comprised of a constant,  $A_s$  are the parameters to be estimated,  $\varepsilon_t$  are the  $7 \times 1$  random errors is uncorrelated with all the  $y_s$ .

The VAR analysis is a useful tool to test for and examine spillovers and linkages between stock markets. However, the fact that there are so many coefficients raises problems regarding interpretation. Of particular concern here is that the signs coefficients of some of the lagged variables may change across lags. Together with the interconnectivity of the equations, this could make it difficult to see how a given change in a variable would impact on the future values of the variables in the VAR system (Brooks, 2002). Furthermore, the VAR estimates do not allow us to determine very much about the transmission of shocks across the system or the period of time that it takes these shocks to work through the system. Thus, the VAR model is normally extended with

block exogeneity, impulse responses and variance decompositions functions in order to alleviate these problems.

## 4. Empirical Results

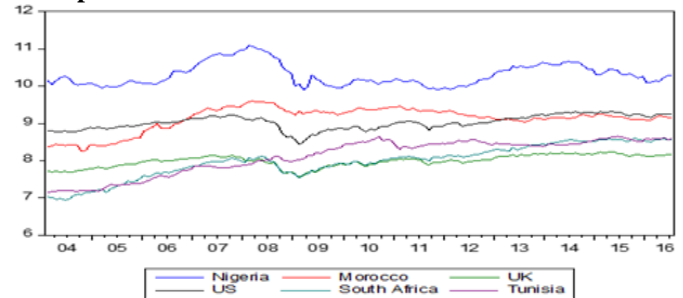


Figure 1. Evolution of selected stock market index based on local currency.

Source: from review9

Table 1 above provides the summary statistics, namely, sample means, maximums, minimums, medians, standard deviations, skewness, kurtosis and the Jarque-Bera tests with their p-values for the return series. Four proxies of sub-Saharan African market (NIG Allshare, Tunindex, Morr.Allshare-MASI, South Africa 40), and two control variables (Ftse 100-UK, NYSE-US) over the period of 02/01/2004-07/01/016. Whilst it is clear that all the statistics show the characteristics common with most financial data, for instance non normality in the form of fat tails, there are a number of noticeable differences, especially between control variables (developed market) and African market. Firstly, returns in African stock markets are larger than those of their developed counterparts. More specifically, the South African stock markets (SA40) has the largest unconditional average monthly stock market return of around 1.02%. The returns for SA40 fluctuate between the minimum of -16.14% and a maximum of 12.09%. The Nigerian All-share index recorded the least returns of around 0.1021%, the minimum and maximum are -36.58% and 32.4% respectively. Among the African markets, Tunindex has the second highest average returns and MASI the third with unconditional average returns of 0.964% and 0.5272% respectively.

Of the developed stock markets (UK) FTSE100 has the higher unconditional average returns of around 0.309% than the (US) NYSE, which is the world's largest stock market, has unconditional mean returns of about 0.0303% and its returns fluctuate between -14.4% to 9.09% and -21.7% to 10.7% respectively. A common observation is that the African markets have more extreme values (i.e. the difference between the maximum and the minimum) for the monthly returns compared to the developed stock markets. This could be an indication that volatility is much higher in African stock markets than in developed stock markets, which is well in line with most theoretical and empirical underpinnings.

Table1. Summary statistics of monthly returns for six selected market.

	Mean	Median	Maximum	Minimum	Std.dev.	Skewness	Kurtosis	J-B	Prob.
FTSEUK	0.003091	0.009367	0.090936	-0.144118	0.038205	-0.80768	4.548484	31.08633	0
MASI	0.003091	0.009367	0.183381	-0.169717	0.046147	0.159545	5.433184	37.38783	0
NIG	0.001021	0.090936	0.324064	-0.365883	0.076107	-0.50636	7.949172	158.436	0
NYSEUS	0.003033	0.144118	0.107842	-0.217377	0.044654	-1.084541	6.642281	111.5798	0
SA40	0.010283	0.038205	0.120966	-0.161438	0.047179	-0.345107	3.936512	8.402681	0
TUN	0.009647	4548484	0.095492	-0.142611	0.037259	-0.414253	4.887909	26.38927	0

Source: calculated using review9

Table 2. Correlation matrix for returns.

	LING	LMASI	LFTSEUK	LNyse.US	LSA40	LTUN
LNIG	1					
LMA SI	0.411003	1				
LFTSEUK	0.470812	0.368275	1			
NYSE-US	0.564687	0.247635	0.960703	1		
LSA 40	0.348181	0.638622	0.835132	0.75049	1	
LTUN	0.049527	0.777946	0.548803	0.397465	0.880982	1

Source: calculated from view9

Interestingly, contrary to the common findings that the unconditional standard deviation for African markets tends to be higher than in developed markets, indicating the existence of more risk in the former markets (see Tastan, 2005), the picture seems to be mixed in our case. As evident from the Table 1 Nigeria, has the highest unconditional standard deviation of around 7.5%, whilst Tunisia has the lowest of about 0.37% compared to the advanced market. This could be due to the fact that there has been a lot of political issues and investors are risk averse. Returns of most of the stock markets under consideration are negatively skewed except for the Moroccan stock markets. All the stock markets under consideration have distributions with positive excess kurtosis and show evidence of fat tails. A distribution with a kurtosis value of more than 3 is described as leptokurtic relative to normal (Bala and Premaratne, 2003 and Hosking, 2006). This implies that the distribution of stock returns in all the stock markets tends to contain extreme values.

Lastly, the Jarque-Bera (JB) statistic tests whether the series are normally distributed. As can be seen from the Table 1, the JB indicates that the hypothesis of normality is rejected for all return series. This non-normality is also evident from the fatter tails of the kurtosis and negative and positive skewness. This is contrast to the market efficiency hypothesis.

#### 4.2. Correlation matrix for returns

Table 2 shows the pairwise correlation matrix and there is evidence of contemporaneous correlation among the markets. Correlation between all the markets is positive, which tends to indicate that there is a common trend/factor that is driving the markets in the same direction. However, this is adverse for international diversification since one condition for international diversification is that correlation between returns should be negative to ensure that some

markets will go up if some go down (see Narayan and Smyth, 2005). Also, the other condition for international portfolio diversification (i.e. correlation among stock markets should be low) is mixed. Evident from Table 2, there are weak correlation between most of the stock markets returns (except for the case of the UK with the US stock markets, the UK with the SA40 stock markets and the US and SA40 markets). None of the market has a strong influence in the Nigeria market because the market are less than 50% except for US. However, the correlation matrix cannot provide any empirical answer since correlation does not imply causality (Gujarati, 2005). Furthermore, correlation merely provides insight into short run market linkages, but fails to account for long term arbitrage activities in stock markets (Narayan and Smyth, 2005). Therefore we need to infer this from other empirical tests.

#### 4.3. Unit root test

All that data are transformed into the natural log form. To determine the order of integration of the variables, the ADF (augmented Dickey-Fuller) test complemented with the PP (Philips-Perron) test in which the null hypothesis is  $H_0 = \beta = 0$  (i.e  $\beta$  has a unit root), and the alternative hypothesis is  $H_1: \beta < 0$  are implemented. The results for both the level and differenced variables are presented in Table 3

The stationarity tests were performed first in levels and then in first difference to establish the presence of unit roots and the order of integration in all the variables. The results of the ADF and PP stationarity tests for each variable show that both tests fail to reject the presence of unit root for NIG, MASI, FTSE100, NYSE, SA40, and TUN data series in level, indicating that these variables are non-stationary in levels. The first difference results show that these variables are

Table 3. Unit root test.

Variable	I(0)		I(1)		Order of integration
	ADF	PP	ADF	PP	
Inftse	-2.2664	-1.9054	-4.5931*	-11.7079*	1(1)
In magi	-2.4006	-2.3228	-7.79181*	-11.0678*	1(1)
Ln NIG	-1.6034	-10.6529	-10.6529*	-10.7107*	1(1)
In NYSE	-2.2776	-1.7452	-4.9507*	-10.1978*	1(1)
In S40	-1.7853	-1.7581	-12.0802*	-13.0859*	1(1)
In Tun	-2.2334	-2.0972	-10.7397*	-10.8241*	1(1)

Note: all variable are in the natural log form

\*level of significant at 1%

Source: calculated using view9

Table 4.

Var.lag	Deterministic ass.test statistic	NIG-UK 3	NIG-MASI 3	NIG-NYSE 3	NIG-SA40 3	NIG-TUN 3
1 Trace		15.339 (0.0528)	9.614 (0.3115)	11.681 (0.1725)	10.386 (0.252)	7.9166 (0.474)
1 Max		9.5464 (0.2434)	5.8303 (0.6351)	8.787 (0.3087)	8.737 (0.3087)	5.4739 (0.6812)

Note: p-value in ( )

Source: calculated using view9

stationary at 1% significance level (integrated of order one I(1)). As mentioned in the preceding sections, a linear combination of I (1) series could be I (0) if the series are cointegrated. We thus proceed to test for cointegration of the index series.

#### 4.4. Results of Bivariate cointegration test

The bivariate cointegration analysis was carried out with a view to tracing whether there is a pairwise long-run relationship between the Nigerian market and each of the markets under study. This was done by first specifying a VAR with Nigerian index and each of the indices and then testing for cointegration. In this study the information criteria approach was used. We use lag 1 as our maximum lag length as it is our considered view that the stock market would have reacted to information from other markets since stock market are considered one of the most informationally efficient markets.

The result of the cointegration test, based on Johansen approach to cointegration, are presented in Table 4. There is no evidence of pairwise cointegration between the Nigerian market and any of the world stock markets being studied. These results are indeed in contrast with the recent finance literature argument that due to increased globalisation, technological development and financial liberalisation, financial markets are expected to move together (Isakov and Perignon, 2000; Bala and Premaratne, 2004; Forbes and Chinn, 2004; Bonfiglioli and Favero, 2005). Our results are also in contrast with those of Allen and McDonald (1995) who established that Australia has a long run cointegrating relationship with some of the world's major equity markets.

We therefore establish three possible implications to the aforementioned. The first one is that the Nigerian equity market is not integrated with the world equity markets considered in this study. The second implication flows from the first and it regards the possibility of gaining from international diversification. The non-existence of a cointegrating relationship between the Nigerian and the considered stock markets implies that these markets offer potential for pairwise portfolio diversification for a Nigerian portfolio manager. The third implication is in the spirit of efficient market hypothesis (EMH) for international equity markets. This is because the existence of cointegration implies that causality must at least run from one direction (see Allen and McDonald, 1995 and Aziakpono, 2006). In this regard, if two stock markets indices move together in the long-run they will be violating the weak form efficiency as this would indicate that one stock market index can be predicted by the aid of the other stock market index. Stock prices from two distinct efficient equity markets cannot be cointegrated (Chang, Nieth and Wei, 2006).

Therefore, the non-existence of cointegrating relationships between the Nigeria and the world equity markets considered in this study implies that none of the markets help predict the long run path of the Nigeria equity

market price index. However, a note of caution should be sounded when interpreting the implication of cointegration for the EMH. As Masih and Masih (2001) note, non-existence of cointegrating relationship only invalidates the concept of existence of a long-run equilibrium tending relationship, but does not invalidate any short-run relationships which may arise due to profit-seeking opportunities in transaction. Thus, it is possible that the Nigerian index may be predicted by at least one of the world stock market indices in the short run.

#### 4.5. Result of Multivariate cointegration

One of the shortcomings in previous section is based on an assumption that the Nigerian investor will only hold bivariate portfolios. This is not realistic as international investors normally consider wide portfolios in making investment decisions. The portfolio theory of investment postulates that unsystematic risk exponentially decreases as the portfolio becomes wide (Howells and Bain, 2005). Thus, a typical equity internationally diversified portfolio should comprise stocks from more than two stock markets. One way of handling this is assuming that the Nigerian market does not have bivariate cointegration with any of the world equity markets being considered, a portfolio containing all the markets will be worthwhile. To illustrate this point we follow Allen and McDonald (1995) approach. This approach involves forming portfolios that could be selected by a Nigerian portfolio manager. From the perspective of Nigerian investors, a prior portfolio would comprised of the biggest stock markets and then other smaller markets could be added. Thus, the following hypothetical portfolios; W, X, Y, Z were considered for multivariate cointegration using the Johansen (1988) and Johansen and Juselius (1990) techniques.

Portfolio W: with ftse100, NYSE, MASI, SA40, TUN

Portfolio X: with SA40, MASI, TUN

Portfolio Y: with NYSE, SA40, MASI, TUN

Portfolio Z: with UK, SA40, MASI, TUN

The bivariate cointegration in section 4.4, we maintain the VAR lag length at (1) using the akaike information criteria. As shown in Table 5 there is evidence of no cointegrating vectors for the (4) portfolios under consideration. This is despite the fact that all markets are randomly included in these four portfolios respectively. Our bivariate result is robust with the result of multivariate cointegration. However our findings are in contrast with (Kasa, 1992; Allen and McDonald, 1995; Hassan and Naka, 1996) who found that developed stock markets share a common long-term trend. But the result is conformity with the notable cointegration literatures in likes of Fraser and Oyefeso (2005), Pascual (2003), Rangvid (2001), Dickson (2000), Chan et al (1997), who posit that if two stock markets are efficient in the long run, then their stock prices cannot be cointegrated. Therefore, since we were unable to establish a long-run comovement, we thus proceed to examine the dynamic return linkage.

**Table 5. Multivariate Johansen cointegration results for the 4 portfolios.**

Ho	Portfolio w	Portfolio x	Portfolio y	Portfolio z
Estimation assumption	3	3	3	3
Lag length(AIC)	1	1	1	1
1=0: Trace	86.351 (0.859)	36.954 (0.3497)	61.726 (0.1862)	61.818 (0.1873)
max	26.877 (0.6416)	18.715 (0.4368)	22.146 (0.5963)	22.584 (0.5429)

Note: p-value in ( )

Source: calculated using eview9

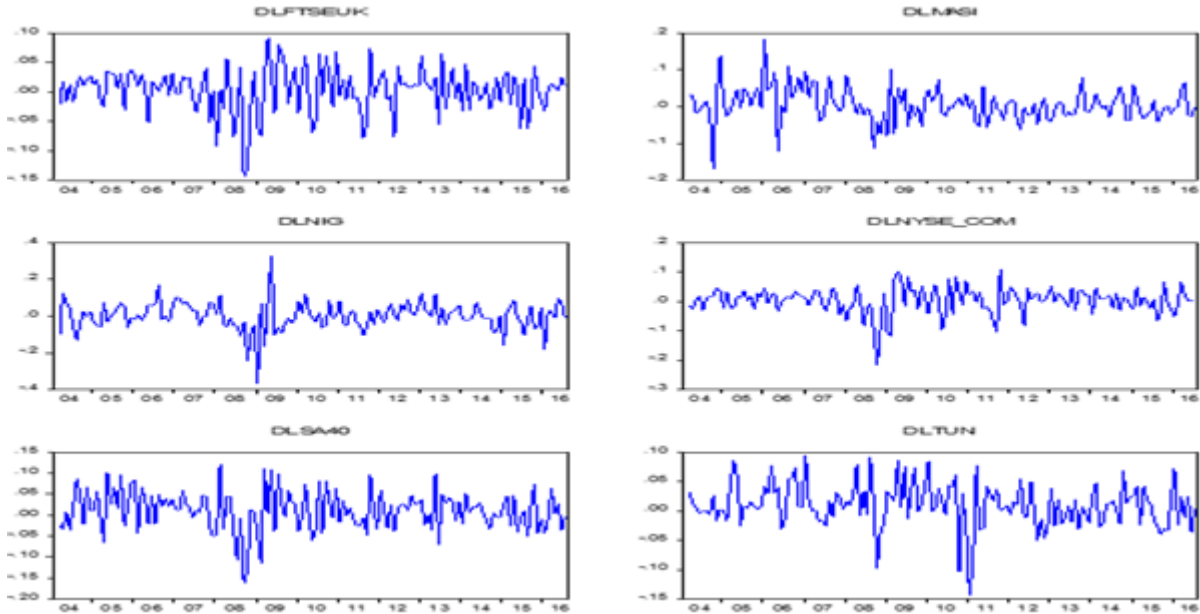


Figure 2. Graphical plots of monthly returns series from February 1, 2004 to July 1, 2016.

Source: author's computation

**4.6. Result of dynamic returns linkages**

In analysing returns linkages using a VAR, it is important to distinguish between the influences of own-returns and those of returns from other markets. Since we are concerned with determining which of the stock markets has the greatest impact on Nigerian returns, our discussion is mostly concerned with the influence of the other stock market returns on Nigerian returns, rather than how all the markets influence each other. Thus, we employ the extended VAR model with block exogeneity, impulse responses and variance decompositions.

**4.6.1. Block Exogeneity**

The block exogeneity test results are reported in Table 6. None of the markets individually influence the Nigerian market returns.

its returns except Moroccan market influence SA40 and NYSE at 5% and 10% respectively. This result is in line with, amongst others Hassan and Naka (1996) and Masih and Masih (2001).

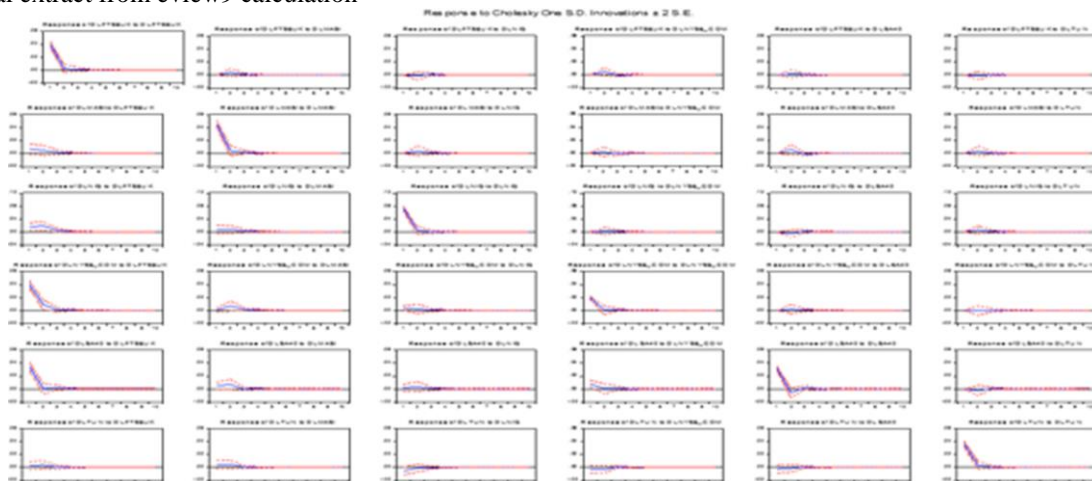
**4.5.2 Impulse Reponse**

The impulse response function was estimated using the Cholesky approach and the results are reported in Figure 3. The orthogonalisation followed is in line with the approach used for variance decomposition. Generally the response of Nigeria returns to both own and to foreign markets innovations is positive. As would be expected, the response of Nigeria returns to own innovations is the low.

Table 6

	NIG	NYSE	SA40	NIG	NYSE	SA40	NIG	NYSE	SA40
Excluded	Chl-sq	Chl-sq	Chl-sq	df	df	df	prob	prob	prob
FTSE UK	1.1066			1			0.2928		
MASI	1.0409	2.853	3.9508	1	1	1	0.3076	0.091	0.046
NYSE	0.4125			1			0.5207		
SA40	0.8437			1			0.3583		
TUN	0.9116			1			0.3397		
All	10.4612			5			0.0632		

Source: partial extract from eview9 calculation



Source: extract from eview9

Table 7

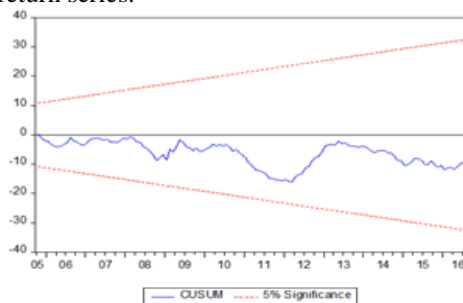
lags	q-start	prob	Adj q-start	Prob.	df
1	52.19	0.0396	52.54274	0.0369	36
2	95.933	0.0313	96.88108	0.0269	72
3	126.8	0.1044	128.3855	0.088	108
4	164.03	0.1212	166.6471	0.0952	144
5	192.37	0.2505	195.9722	0.1968	180
6	220.17	0.4084	224.9344	0.3242	215
7	271.02	0.1959	278.2887	0.1226	252
8	314.27	0.1377	323.9978	0.0709	288
9	335.7	0.3155	345.7979	0.1837	324
10	371.06	0.3324	384.7119	0.1774	360
11	405.36	0.3618	421.7377	0.179	396
12	439.59	0.3899	458.9717	0.1783	432

Source: calculated using eview9

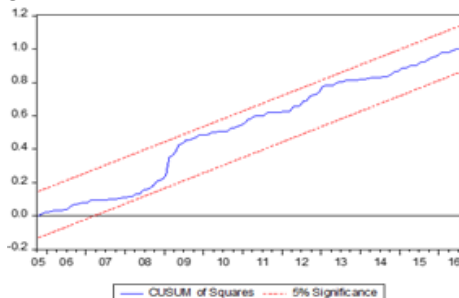
It quickly declines to zero within the third period after which it becomes insignificantly negative and finally dies off within the tenth period. With regard to response from cross innovation, the Nigeria returns seem to respond slowly and very insignificant. Response from the US innovations starts at zero in the first day, picks sharply and then sharply declines by the thereafter. Response of other stock markets to Nigeria innovations is insignificant. Overall, consistent to informational efficiency, the response of all stock market returns to both own is quick but slow on cross innovations i.e. it takes more than a month.

#### 4.8. Diagnostic test and stability test

Table 9 provides the estimated Portmanteau Box-Pierce/Ljung-Box Q-statistics and the adjusted Q-statistics for the system residuals using the Cholesky of covariance Orthogonalization method. Both the Q-statistics and the adjusted Q-statistics show that the null hypothesis of no autocorrelations cannot be rejected at the 10 per cent level for various lags of up to 12. Thus, one can conclude that there is no significant amount of serial correlation left in the system residuals as the bulk of the serial correlation have disappeared in the resulting system residuals in Table 9. This provides further support for the VECH model as it absorbs a great deal of inertia and ARCH and GARCH effects present in the original return series.



CUSUM



CUSUMSQ

Figure 6

Source: eview7 calculation

The cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests are applied to assess parameter stability (Pesaran and Pesaran, 1997). Fig 6 plot the results for CUSUM and CUSUMSQ tests. The results indicate the absence of any instability of the coefficients because the plot of the CUSUM and CUSUMSQ statistic fall inside the critical bands of the 5% confidence interval of parameter stability.

#### 5. Conclusion and Policy Implications

Controlling for the possible influence of advance stock market (UK and US) and, in the spirit of finance proposition that portfolio diversification is fruitful if more markets are added into the portfolio, this paper examines the cointegration, dynamic linkage and portfolio diversification in African stock from February 1, 2004 to July 1, 2016 using VAR-MV-GARCH approach. Five hypothetical portfolios from the perspective of Nigerian investors were formed and tested in a multivariate cointegration using the Johansen (1988, 1990) approaches the results show that there is no cointegration relationship between Nigeria and the selected African market with exception to UK where there is evidence of weak comovement. This result is robust with bi-variate cointegration analysis. Thus, the implication for these findings is that the Nigeria market is weakly integrated into the global equity markets and as such long term diversification is worthwhile for Nigeria portfolio managers. In general the result are in line with most studies on African market interactions.

The next step in our empirical analysis was to examine the extent of returns linkages among the stock markets. Here the VAR framework, along with the block exogeneity, impulse response and variance decomposition functions, were estimated. Results from the VAR framework established that there are no significant linkages of returns coming from the individual equity market. But collectively all the have influence at the Nigeria. Furthermore, the response of Nigeria to innovations from other markets was examined and responses to innovations from the UK was the fastest. It was also established that the UK has the dominant influence on Nigeria returns followed by Morocco and the other markets are not very important. However, own innovations were found to be more important than cross innovations.

The findings of this study have important implications for policymakers and investment strategies. Firstly, the fact that the Nigeria equity market is weakly integrated into the world stock markets considered implies that long term portfolio diversification may be worthwhile for Nigeria portfolio managers. Thus, investors can exploit this to



construct potentially risk-averting or profit maximising portfolios. Moreso, the fact that the Nigerian equity market is not well integrated into the world equity market should be of concern for policy makers. This is because more integration of world equity markets will ensure reduction of cost of capital (see Kearney and Lucey, 2004). Therefore, we advocate that more openness and more relaxation of any form of foreign currency control could be of importance to achieve this end and indeed encourage foreign direct investment. Secondly, the fact that volatility from other stock markets is quickly transmitted into the Nigeria stock market should be of concern for policy makers. This is because volatility affects financial stability. Volatility transmission from the world stock markets to the Nigeria market could be harmful during times of crises.

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