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Co integration, Dynamic Linkage and Portfolio Diversification from Selected Stock Market in Africa.

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Abstract: *The recent trends in globalization, financial liberalization and financial innovation have raised questions with regard to the dynamic linkages and integration of selected African stock markets. This study examines the cointegration, dynamic linkage and portfolio diversification in African stock market over the period of 01/02/2004-01/07/2016. Using Johansen cointegration, Vector autoregressive (VAR) and Multivariate GARCH approach. Sixselected equity markets are used to form four portfolios in line with portfolio theory. The result show that no bivariate cointegration exists between the Nigeria and any of the stockmarkets being studied, and the multivariate cointegration confirms the result. Even though we control for the influence of FTSE100 and NYSE, Nigeria Allshare index still has no cointergration with the other market. The findings on dynamic return linkages is that there isno significant returns linkages among the markets, with the exception to UK. Indeed FTSE100 is the most exogenous. Findings regarding volatility are that the volatility in all the markets is inherently asymmetric and there is presence of high volatility in the Nigerian market from 2015 to date. 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 finding of this study have important implications for policymakers. 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*

Keywords: *cointegration, dynamic linkage, portfolio diversification, vector autoresgression, GARCH.*

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I. Introduction

Economic liberalization and globalization have increased the pace of development in the stock market, which has undergone a series of change during the last decade in Africa. Existing literatures documents that stock market plays a crucial role in the economic development of a country by activating investments and maintaining it properly for providing long-term source of finance. 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.

The growing literature on financial integration in the world's stock markets has become an active topic in academic research with considerable relevance for investors in an era of economic liberation. Events such as the stock market crash in 1987, Asian financial crisis, technological meltdown of 2000 and sub prime crisis 2007 also make this an important issue for financial policy makers since market co-movements can result in contagion as investors incorporate into their trading decisions price changes in other markets in an attempt to form a complete information set, so that errors in one market may be transmitted elsewhere (Fernandez-Serrano and Sosvilla-Rivero, 2001).

Another point of interest to researchers has been that of arbitraging and international diversification. According to Efficient Market Hypothesis, if stock markets are efficient, their stock prices should not be cointegrated, because then, arbitrage profits can be obtained (Granger, 1986; Baillie and Bollerslev, 1986). Cointegration in the stock markets is also an important factor with regards to international diversification of investment.

Phylaktis and Ravazolo (2005) have conducted studies into cointegration amongst stock markets. These authors have mostly used cointegration analysis to infer on the level of integration between stock markets. The underlying assumption in this method is that the existence of a single common stochastic trend amongst a group in stock markets implies high long-run correlations and integration amongst the markets. Cointegration amongst stock markets provides information on the underlying structural endowments common to the two markets and provides inferences on the long and short run dynamic causalities. Again conclusions about cointegration do not lend themselves necessarily to market efficiency or integration as noted by Dwyer and Wallace (1992) and Lence and Falk (2005). Therefore, understating the interaction between international stock market could have a significant impact on the formulation and implementation of major market policies targeting stock malpractices in Nigeria. It could also guide investors in the possible gain from the international portfolio diversification, given the dynamics of stock market integration, dynamic linkage and volatility in Africa.

Controlling for the possible influence of NYSE-US prices and FTSE-UK on the selected African stock market, this study seek to uncover (i) The long run relationship among the selected stock indexes in Sub-Saharan African countries, with a view to analysing its implication on portfolio diversification.(ii) The dynamic linkage of stock market in Sub-Saharan Africa.(iii) Volatility transmission between the African and developed market (US and UK).

The rest of this article will be organized as follows; section 2, presents survey of the literature. Section 3, will discuss the methodology employed in the study, while section 4, analyses the empirical results. Finally, section 5, contains conclusions and recommendations

II. Literature Review

There is a growing literature on the cointegration of international stock markets with a focus on developed stock market such as European stock, American stock, Asian stock but fewer discussions have been done in Sub-Sahara Africa. Notable cointegration literatures in likes of Fraser and Oyefeso (2005), Pascual (2003), Rangvid (2001), Dickson (2000), Chan et al (1997), posited that if two stock markets are efficient in the long run, then their stock prices cannot be cointegrated. Similarly, the same conclusion was obtained in the recent works of Masih and Masih (2004), Syriopoulus (2004),Phylaktisa and Ravazzolo (2005). In other words, if two markets are cointegrated, then possible arbitrage profits can be explored.

At the forefront of studies on the cointegration theory, are Engle and Granger (1987) as well as Johansen (1988, 1991, 1995) whose approach was mainly based on residual testing, and on likelihood tests respectively. The Johansen’s approach is based on the relationship between the rank of a matrix and its characteristic roots. The rank of the matrix is equivalent to the number of characteristic roots in the underlying vector autoregressive (VAR) model, and this will in turn yield the number of cointegrating vectors in the system of equations.

The presence of cointegration means there is a common force which brings the markets together in the long term. A test of cointegration can also be said to be a test of the extent of the level of arbitrage in the long term (Masih and Masih 2004). Since these markets are interdependent and highly integrated, they will act as if they are constituents of one integrated market. Hence, the possibility of gaining abnormal profits in these markets through diversifying investment portfolios is indeed limited. Cointegration test results have important implications for diversification through international investing. Chan et al (1997), contribution to cointegration is well documented. The scholar posits, diversifying into international stock markets cannot be effective if those markets have co-movements. That is to say, if two stock markets are cointegrated, for example, the South Africa and Nigeria stock markets. If stock prices in South Africa declined rapidly over a long period of time it will simultaneously followed by a decline in Nigeria stock market. The logical implication is that diversification would not be effective because the systematic risk cannot be diversified away. Thus, it is not in the best interest of investors who want diversified portfolios to invest in cointegrated markets.

2.1 Empirical Review

Existing empirical literature can be broadly classified into three parts according to the issues that the literature seeks to address. The first part focuses on long run comovement of stock marketindices using cointegration or principal component analyses. The existence of long-run relationshipsamong stock markets implies that although they may diverge in the short-run, they will be highlycorrelated in the long run. This will in turn mean that long term diversification in them will beunlikely to yield significant benefits in terms of risk reduction (Allen and McDonald, 1995). Thesecond part of the literature focuses on the linkages of financial markets in terms of returns – socalled ‘first moment’ and the third part focuses on volatility linkages – also called ‘second moment’linkages. Whilst most studies analysing returns (first-moment) linkages utilise the VectorAutoregressive model, studies on volatility transmission use volatility models, especially theGARCH family of models.

2.2 Evidence of cointegration in advanced market

Stock market is integrated 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 quaterly, 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.

2.3 Evidence of cointegration In Sub-Saharaan African market

There have been arguments on the few existing empirical studies on African stock markets. One common finding has been that the African equity markets are generally segregated from each other and from the world equity markets, which is an indication that they are mostly influenced by domestic factors. Lamba and Otchere (2001) report that South Africa and Namibia, are linked to each other and also influenced by the US and UK equity markets. This study analysed the linkages among African stock markets and with the global market using VAR and impulse response. Furthermore, the authors documented that Ghanaian, Namibian and SA markets were linked to the resource-based stock markets like Australia and Canada influences.

However, 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 attracted a lot of attention 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.

2.4 Evidence of volatility and dynamic causal linkage in the world market.

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.

III. 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 are sourced from investing.com and 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:

$$y_t = (lnP_t - lnP_{t-1}) \times 100$$

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 $H_o: \beta = 0$ (i.e β has a unit root), and the alternative hypothesis is $H_1: \beta < 0$. All the variables should be integrated at first order difference I(1) so as to avoid spurious result.

3.3 Cointegration

This study adopts a dynamic vector autoregressive regression (VAR) which explores cointegration. The essence is to capture the causal dynamicsbetween 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:

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

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

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

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

If the coefficient matrix Π has reduced rank$r < n$, then there exist $n \times r$ matrices of α and β 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 β is a cointegrating vector. It can be shown that, for a given r, the maximum likelihood estimator of β define the combination of y_{t-1} that yield the r largest canonical correlations of Δy 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

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

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 Π matrix in equation 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 cointegrationanalysis will be used to examine the long run relationship between the Nigeria stock markets and eachof the stock markets under study. We follow the principle that unsystematic risk is a decreasingfunction of the number of assets included in a portfolio (Howells and Bain, 2005), possibleportfolios will be chosen and tested for long run relations using multivariate cointegration. Thechoice 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 marketdynamics, transmission and propagation mechanism driving these markets. A model that clearlyshows how returns and volatility are transmitted from one market to another in a recognisedfashion, 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 systemwithout putting any prior restrictions on the structure of the relationships. Because it does not haveany structural restrictions, the VAR system can enable the estimation of reduced form of correctlyspecified equations whose actual economic structure may be unknown. This is an important featurein 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 (6×1) vector of equity market prices return in log form α is the deterministic component comprised of a constant,A_s are the parameters to be estimated, ε_t are the 6×1random errors is uncorrelated with all the y_s..

The VAR analysis is a useful tool to test for and examine spillovers and linkages between stockmarkets. However, the fact that there are so many coefficients raises problems regardinginterpretation. Of particular concern here is that the signs coefficients of some of the laggedvariables may change across lags. Together with the interconnectivity of the equations, this couldmake it difficult to see how a given change in a variable would impact on the future values of thevariables in the VAR system (Brooks, 2002). Furthermore, the VAR estimates do not allow usto determine very much about the transmission of shocks across the system or the period of timethat it takes these shocks to work through the system. Thus, the VAR model is normally extendedwith block exogeneity, impulse responses and variance decompositions functions in order toalleviate these problems.

3.5 Analysis of volatility and volatility Linkages

In recent empirical studies, the univariate GARCH model has been extended to the multivariate GARCH (MGARCH) case, with the recognition that MGARCH models are potentially useful developments regarding the parameterization of conditional cross-moments.Karolyi (1995) employed a similar model to examine the international transmission of stock returns between the United States and Canada.

The following MGARCH model is developed to examine the joint processes relating themonthly rates of return for four African markets plus US and UK from 01/02/2004 to 01/07/2016. The vectorautoregressive stochastic process of assets returns is give in equation…..Assets of the following country $i(r_{iit})$ are specified as a function of their own innovations (ε_{it}) and the past own return $\left(r_{ijt-1}\right)$, for all $j = 1, \dots \dots 6$ and $i = j$ as well as the lagged returns of the countries (r_{ijt-1}) for all $i = 1, \dots, 6$ and $i \neq j$ as follow;

$$r_{iit} = \mu_{0i} + \sum_{j=1}^{6} \mu_{ij} r_{ijt-1} + \varepsilon_t \qquad (8)$$

Where $i = 1$ for ftse100,$i = 2$ for Morocco, $i = 3$ for Nigeria, $i = 4$ for New York Stock Exchange, $i = 5$ for South Africa, $i = 6$ for Tunisia; μ_{0i} is the intercept for country i; μ_{ij} (for all $i = 1, \dots, 6$ and $j = 1, \dots, 6$) indicates the conditional mean of the stock return, which represents the influence from own past returns of country i (ie. own-mean spillovers) when $i = j$ and the influence from the past returns of country j towards country i (i.e. cross-mean spillovers from country j to i) when $i \neq j$; and $\varepsilon_{it}$is own innovations (shocks) to country i.

The conditional variance-covariance matrix (H_t) has six dimensions with the diagonal and non-diagonal elements representing the variance and the covariance term, respectively. In matrix notation, (H_i) can be written a :

$$H_t = \begin{pmatrix} h_{11t} h_{12t} h_{13t} h_{14t} h_{15t} h_{16t} \\ h_{21t} h_{22t} h_{23t} \; h_{24t} h_{25t} \; h_{26t} \\ h_{31t} \; h_{32t} h_{33t} h_{34t} h_{35t} h_{36t} \\ h_{41t} h_{42t} h_{43t} h_{44t} h_{45t} h_{46t} \\ h_{51t} \; h_{52t} h_{53t} h_{54t} h_{55t} h_{56t} \\ h_{61t} h_{62t} h_{63t} h_{64t} h_{65t} h_{66t} \end{pmatrix} \qquad (10)$$

Where h_{iit} is the conditional variance at time i and h_{ijt} denotes the conditional covariance between the stock returns of country i and country j (where $i \neq j$) at time t.

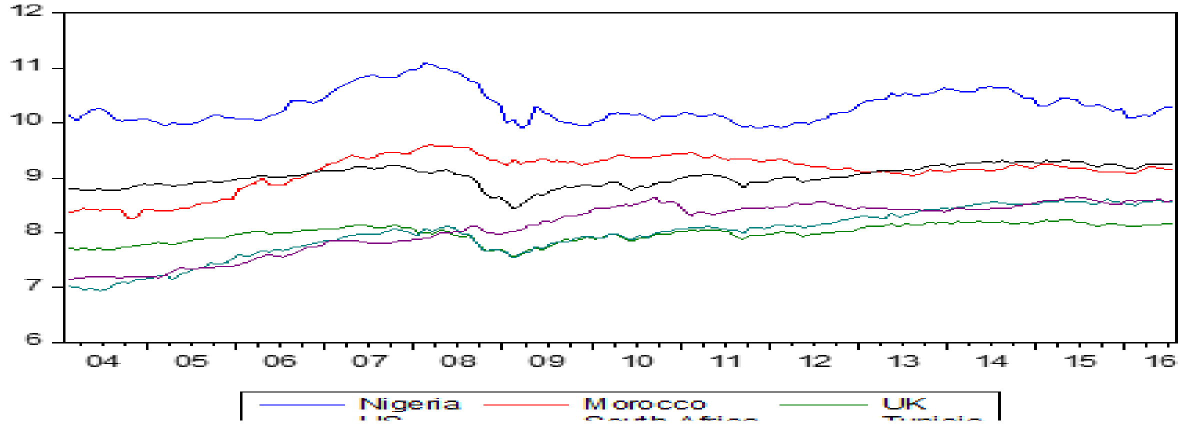
In this study we employ a diagonal VECH model (Bollerslev, Engle and Wooldridge, 1988) to better understand the conditional variance and covariance matrix because this model is more flexible when H_t contains more than two variables (see Scherrer and Ribarits, 2007). This model is based on the assumption that the conditional variance depends on squares lagged residuals and the conditional covariance depends on the cross-lagged residuals and lagged covariance of the series (Harris and Sollis, 2003). The diagonal VECH model can be written as follows:

$$vech(H_t) = C + Avech(\varepsilon_{t-1}\varepsilon_{t-1}^{'}) + Bvech(H_{t-1}) \qquad (11)$$

Where A and B are $\frac{1}{2}\mathrm{N}(\mathrm{N}+1) \times \frac{1}{2}\mathrm{N}(\mathrm{N}+1)$ parameter matrices and C or (M) is a $\frac{1}{2}\mathrm{N}(\mathrm{N}+1) \times 1$ vector of constants. The diagonal elements of matrix A $(a_{11}, a_{22}, a_{33}, a_{44}, a_{55}, a_{66})$ measures the influences from past squared innovations on the current volatility (i.e own-volatility shocks) while non-diagonal elements (a_{ij} where $i \neq j$)determine the cross product effects of the lagged innovations on the current covolatility (see Karunanayake, Valadkhani and O'Brien, 2009). Similarly, the diagonal elements of matrix B $(b_{11}, b_{22}, b_{33}, b_{44}, b_{55}, b_{66})$determine the influences from past squared volatilities on the current volatility (i.e own-volatility spillovers) and non-diagonal elements (b_{ij} where $i \neq j$) measure the cross product effects of the lagged current covolatility.

IV. Empirical Results

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



Source: from eview9

4.1 Descriptive statistic

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	6.642 281	111.5798	0
SA40	0.010283	0.038205	0.120966	-0.161438	0.047179	-0.345107	3.936512	8.402681	0
TUN	0.009647	4.548484	0.095492	-0.142611	0.037259	-0.414253	4.887909	26.38927	0

Source: calculated using eview9

Table 1above 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 around0.309% thanthe (US) NYSE,which is the world's largest stock market, has unconditional mean returns of about 0.0303% and itsreturns fluctuate between -14.4% to 9.09% and -21.7% to 10.7% respectively. A common observation is that the Africanmarkets 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 anindication that volatility is much higher in African stock markets than in developed stockmarkets, which is well in line with most theoretical and empirical underpinnings.

Interestingly, contrary to the common findings that the unconditional standard deviation forAfrican markets tends to be higher than in developed markets, indicating the existence of morerisk in the former markets (see Tastan, 2005), the picture seems to be mixed in our case. Asevident from the Table 1Nigeria, has the highest unconditional standarddeviation 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 ofmost of the stock markets under consideration are negatively skewed except for the Moroccan stock markets. All the stock markets under consideration have distributions withpositive excess kurtosis and show evidence of fat tails. A distribution with a kurtosis value of morethan 3 is described as leptokurtic relative to normal (Bala and Premaratne, 2003 and Hosking,2006). This impliesthat 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 beseen from the Table 1,the JB indicates that the hypothesis of normality is rejected for all returnseries. This non-normality is also evident from the fatter tails of the kurtosis and negative andpositive skewness. This is contrast to the market efficiency hypothesis.

4.2 Correlation matrix for returns

Table 2: Correlation matrix for returns

	LNIG	LMASI	LFTSEUK	LNYSE.US	LSA40	LTUN
LNIG	1					
LMASI	0.411003	1				
LFTSEUK	0.470812	0.368275	1			
NYSE-US	0.564687	0.247635	0.960703	1		
LSA40	0.348181	0.638622	0.835132	0.75049	1	
LTUN	0.049527	0.707946	0.548803	0.397465	0.880982	1

Source: calculated from eview9

Table 2 shows the pairwise correlation matrix and there is evidence of contemporaneouscorrelation 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 andSA40 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

Table 3: **unit root test**

	1(0)		1(1)		
Variable	ADF	PP	ADF	PP	Order of integration
Inftse	-2.2664	-1.9054	-4.5931*	-11.7079*	1 (1)
In magi	-2.4006	-2.3228	-7.79181*	-11. 0678*	1 (1)
LnNIG	-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 eview9

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 β has a unit root), and the alternative hypothesis is $H_1\colon \beta < 0$ 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 stationary at 1% significance level (integrated of order one 1(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

Table 4

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

Note: p-value in ( )
Source: calculated using eview9

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 Nigerianmarket and any of the world stock markets being studied.

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 beselected 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 marketscould be added. Thus, the following hypothetical portfolios; W,X,Y,Z were considered formultivariate 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

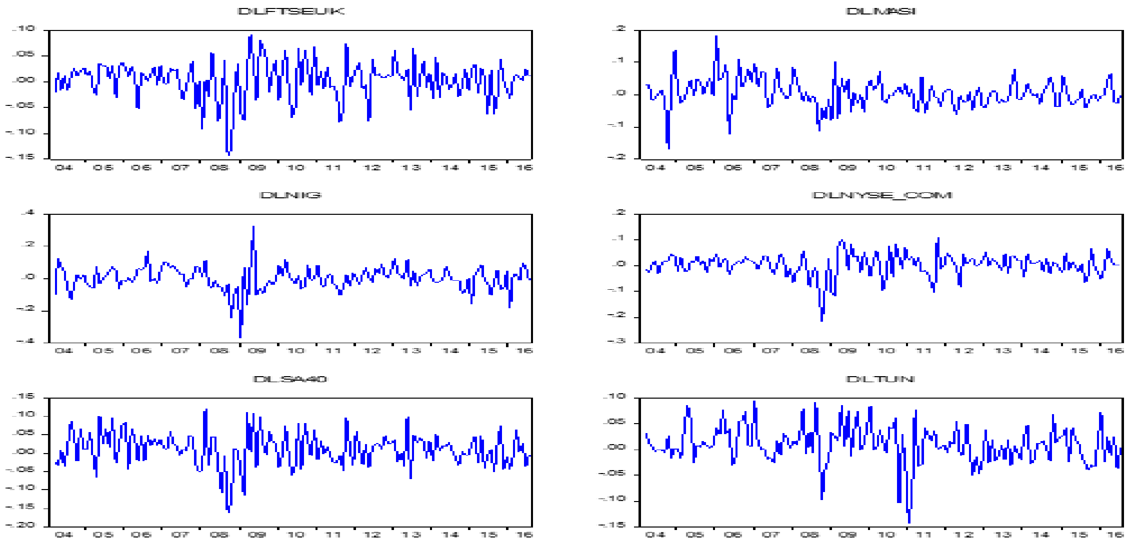
Table 5: Multivariate Johansen cointegration results for the 4 portfolios

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

In spirit with the bivariate cointegration in section 4.4, we maintained the VAR lag length at (1) using the akaike information criteria. As shown in Table 5there 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, sincewe were unable to establish a long-run comovement, we thus proceed to examine the dynamic return linkage.

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



Source: author's computation

4.6Result 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

Table 6: block Exogeneity

Excluded	NIG chi-sq	NYSE Chi-sq	SA40 Chi-sq	NIG df	NYSE df	SA40 df	NIG Prob	NYSE Prob	SA40 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

The block exogeneity test results are reported in Table 6. None of the markets individually influence the Nigerian market returns. But collectively all the have influence at the Nigeria at 10% level at 10.4612 chi-sq.None of the stock markets influence its returns except Moroccan market influence SA40 and NYSE at 5% and 10% respectively. This result is in line with, amongst othersHassan and Naka (1996) and Masih and Masih (2001).

4.5.1 Variance Decomposition

Lutkepohl (2007) explained that variance decomposition indicates the amount of information each variable contributes to the other variables in the auto regression. It seeks to address the question with regard to the proportion/percentage of the movements in the stock market returns that are due to its 'own' innovations, against those that are due to shocks to other stock markets. Therefore the variance decomposition for Nigerian stock market return is shown Table 7. The table shows a 10 period forecast of the contribution of the variables to the Nigeria stock market return.There are certain common features that seem to be evident.

Firstly,the Ftse100 is the most exogenous in that its innovations tend to explain the variations in returns of all markets better than other innovations explain its returns. Secondly, in the first period Nigeria All share index account for 94.27% of its change. In the second period, ftse100 accounts for about 9.6%, MASI accounts for 1.86% while NYSE and SA40 were the least contribution by 0.065% and 0.56% respectively. From the third period it is surprising that all the equity market maintained a consistent influence on the Nigerian market up until the last period. Generally, the contribution of all equity returns are relatively low to the Nigeria equity market.

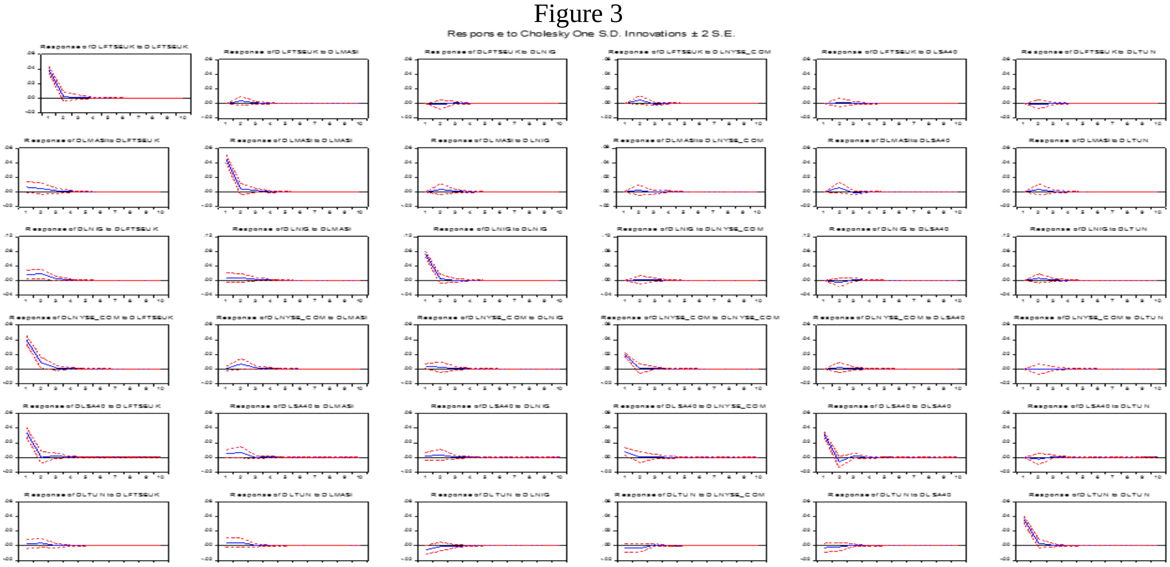
Table: 7

PERIOD	S.E	LFTSEUK	LMASI	LNIG	LNYSE	LSA40
1	0.074137	4.556335	1.172724	94.27094	0	0
2	0.077224	9.69182	1.86202	87.25142	0.065155	0.569673
3	0.077495	10.00031	2.014616	86.64105	0.11992	0.637274
4	0.077513	10.00921	2.014616	86.60665	0.119929	0.636987
5	0.077514	10.01037	2.040991	89.60381	0.120323	0.637187
6	0.077515	10.01051	2.041149	86.6035	0.120328	0.637185
7	0.077515	10.01052	2.041156	86.60348	0.120334	0.637186
8	0.077515	10.01052	2.041157	86.60347	0.120334	0.637186
9	0.077515	10.01052	2.041157	86.60347	0.120334	0.637186
10	0.077515	10.01052	2.041157	86.60347	0.120334	0.637186

Source: extract from eview9

4.5.2 Impulse Reponse

Figure 3

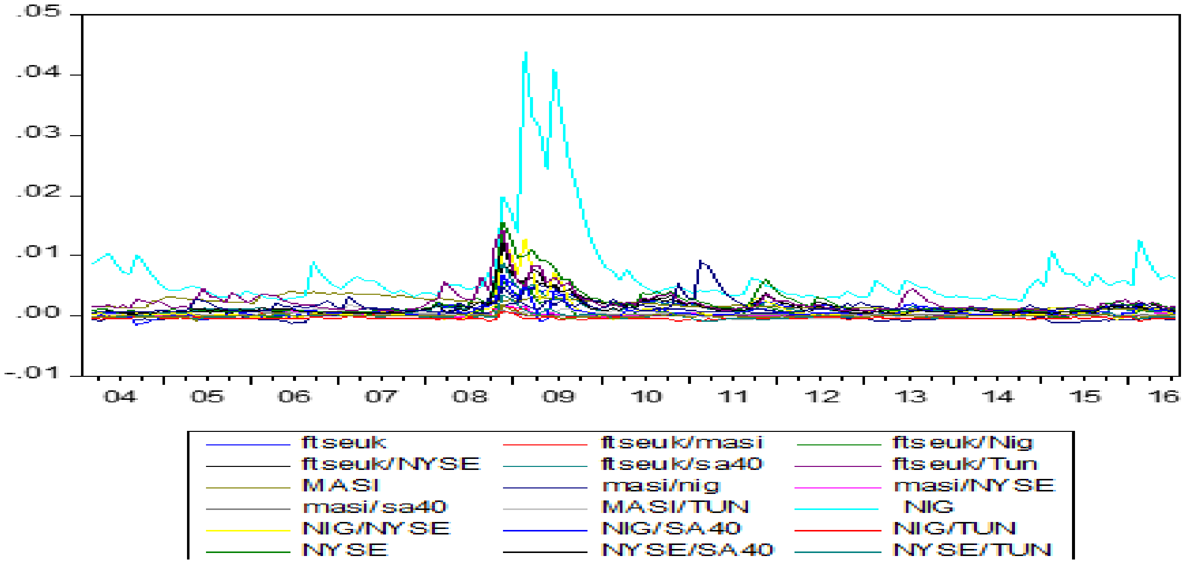


Source: extract from eview9

The impulse response function was estimated using the Cholesky approach and the results arereported in Figure 3. The orthogonalisation followed is in line with the approach used forvariance 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 owninnovations is the low. 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 inthe 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.

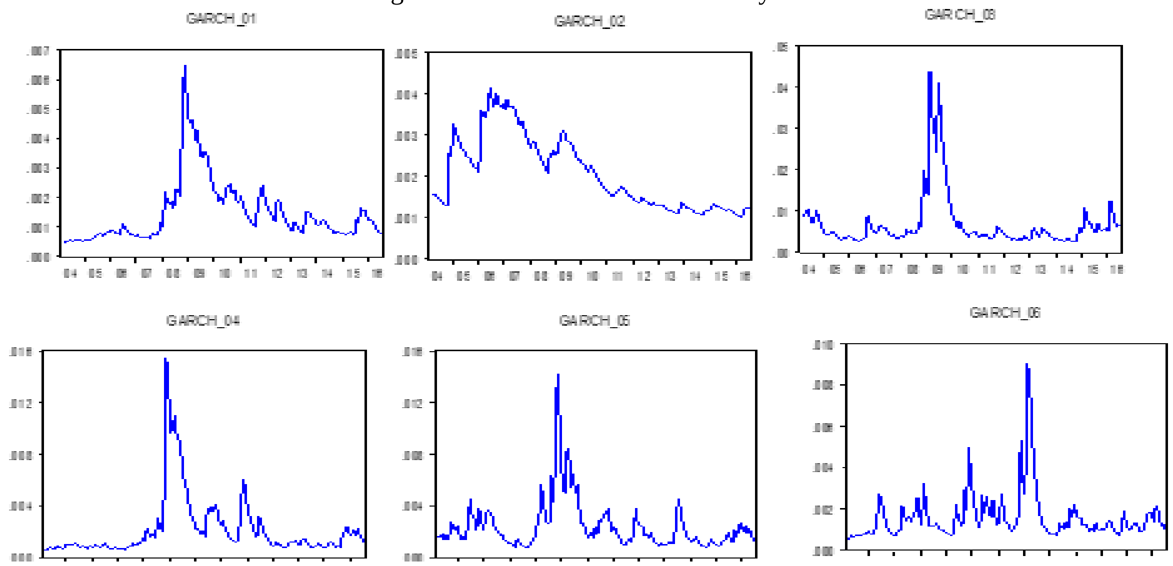
4.6 Result of Volatility and Volatility Transmission

Figure 4: Trend in Volatility



Source: eview9

Figure 5: individual trend in volatility



Note: figure 4 and 5 are the same

Source: author's computation

We start by showing graphical plots of volatility in the stock markets.As is evident from Figure 5, all the stock markets show evidence of volatility. Generally volatility for all the stock markets exhibit similar features within the time frame especially within the financial crisis that originated the US. However, Tunisia (GARCH 6) shows a different pattern prior to the financial crisis evident from the high volatility. This could be attributed to the series of political unrest. Volatility for the rest of the equity markets seem to have significantly decreased since 2001, but Nigerian (GRACH 3) volatility starts to increase from 2015. This is attributed to decrease in the oil prices at the world market.

4.7 Volatility and Volatility Linkages

Based on the result presented in Table 8, all the estimated parameters of the multivariate GARCH are highly significant at 5 and 10 percent of level for the sample period respectively. Therefore the null hypothesis of constant covariance is rejected. This result means that the conditional variance and covariance change over time. The sumof the lagged conditional covariance and coefficients of the ARCH term are close to one which implies that the conditional covariance is highly persistent. Hence, if a future forecast of the variance is conducted, it will likely show large negative or positive return and will lead to a forecast of the variance to be high for a long time. Also, the values of the of the GARCH term range from 0.186075 to 0.903195 while the values of ARCH term range from 0.015041 to 0.338702 for the sample period respectively which when summed will be very close to one meaning that the volatility clusters and the second moment of the indices can be represent by multivariate GARCH model. This result implies the volatility of the indices tend to move together. The constant term is low signifying that the long-term average weighted value of conditional variance has small effect on the today's conditional variance.

Table 8: parameter Estimate for the diagonal VECH(1,1)

parameter	*coefficient*	*coefficient*	*coefficient*	*coefficien*	*coefficient*	*coefficient*
M	0.0000264	0.0000706	0.0000706	0.0000371	0.0000288	0.000167
	(1.0987)	(-0.0818)	(1.5779)	(1.3057)	(1.0876)	(1.8458)
M		1.42E-08	1.64E-06	08.64E-07	6.69E-07	-3.88E-06
		(0.0258)	(0.0517)	(0.0518)	(0.0523)	(0.0517)
M			0.000189	9.92E-05	7.70E-05	-0.000446
			(1.5148)	(1.8926)	(1.3016)	(2.398)
M				5.21E-05	4.04E-05	-0.000234
				(1.4308)	(1.1837)	(2.2995)
M					3.14E-05	-0.000182
					(-1.5053)	(0.8184)
M						0.001054
						(2.8326)
A	0.141167	0.015041	0.0150136	0.175779	0.198655	0.082797
	(3.4562)	(0.3366)	(2.8127)	(3.2512)	(3.9316)	(0.8334)
A		0.055052	0.111177	0.051590	0.026803	0.154022
		(2.7992)	(2.4361)	(1.1242)	(0.4630)	(0.9585)
A			0.231019	0.205295	0.161263	0.123167
			(2.6304)	(3.0195)	(2.1796)	(0.8564)
A				0.241158	0.244020	0.221123
				(2.9608)	(3.5225)	(1.8197)
A					0.338702	0.208022
					(3.5202)	(1.6813)
A						0.269676
						(1.3012)
B	0.862581	0.903195	0.837692	0.830214	0.799310	0.400631
	(26.0662)	(51.6429)	(24.6597)	(23.3226)	(22.9860)	(1.8658)
B		0.945722	0.877134	0.869305	0.836945	0.419494
		(68.9385)	(28.6749)	(34.3911)	(27.7002)	(1.895)
B			0.813521	0.806257	0.776246	0.389071
			(14.7974)	(20.5054)	(19.4160)	(1.8424)
B				0.799062	0.769317	0.385593
				(17.4807)	(20.5699)	(1.8646)
B					0.740679	0.371244
					(17.3981)	(1.8493)
B						0.186075
						(0.9437)

Note: z-statistics in ( )
Source: eview9 extract

4.8 Diagnostic test and stability test

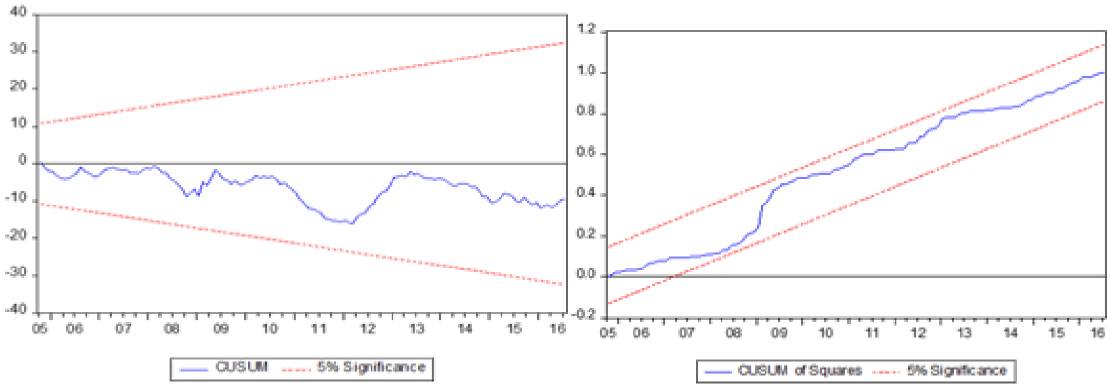
Table 9: Diagnostic test on selected market

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

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 Orthogonization method. Both the Q-statistics and the adjusted Qstatistics 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 inTable 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.

Figure 6: CUSUM and CUSUMQ for the coefficient stability of ECM for the selected market returns



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.

4.9 Discussion of findings

The results from the bivariate cointegration 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. Surprisingly, the multivariate cointegration confirmed this results which is 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 in 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.

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 implicationflows 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 marketsimplies that these markets offer potential for pairwise portfolio diversification for a Nigerian portfoliomanager.The third implication is in the spirit of efficient market hypothesis (EMH) for internationalequity markets. This is because the existence of cointegration implies that causality must at leastrun from one direction (see Allen and McDonald, 1995 and Aziakpono, 2006). In this regard, iftwo stock markets indices move together in the long-run they will be violating the weak formefficiency as this would indicate that one stock market index can be predicted by the aid of theother stock market index. Stock prices from two distinct efficient equity markets cannot be cointegrated (Chang,Nieth and Wei, 2006).

However, the non-existence of cointegrating relationships between the Nigeria and the world equity markets considered in this study implies that none of themarkets help predict the long run path of the Nigeria equity market price index. However, a note ofcaution 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-runrelationships 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 theshort run.

Our results from the MV-GARCH are in contrast with the findings of Piesse and Hearn (2002) that 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.

V. 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 selected stock from February 1, 2004 to July 1, 2016 using VAR-MV-GARCH approach. Four 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 thestock markets. Here the VAR framework, along with the block exogeneity, impulse response andvariance decomposition functions, were estimated. Results from the VAR framework establishedthat 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 MV-GARCH was use in analysing volatility in each of the stock markets, the result shows conditional variance and covariance change over time. Although all the market show related characteristics between 2007-2009 but they differ from 2010. This has been attributed to their individual risk. The sumof the lagged conditional covariance and coefficients of the ARCH term for the individual market is close to one which implies that the conditional covariance is highly persistent.

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.

References

[1]. Ahlgren,N and Antell,J.(2002) Testing for cointegration between international stock prices. Applied Financial Economics, 2002, 12, 851-861

[2]. Allen, D. E. and McDonald, G., (1995). The long-run gains from international equity diversification: Australian evidence from cointegration tests. Applied Financial Economics. 5, 33-42.

[3]. Appiah-Kusi, J. and G. Pescetto (1998) "Volatility and volatility spill-overs in emerging markets:the case of African stock markets". Ekonomia 2(2), 171-185.

[4]. Arshanapalli, B., Doukas, J. and Lang, L., (1995). Pre- and Post- October 1987 stock market linkages between US and Asian markets. Pacific-Basin Finance Journal. 3, 57-73.

[5]. Baillie,R.,and Bollerslev,T,(1989),Common Stochastic Trends in a System of Exchange

[6]. Rates,' Journal of Finance**,** Vol. 44: 167- 181.

[7]. Bekaert, G., and Harvey, C.R.,(1995), Time-varying world market integration. Journal of Finance .50,403–444.

[8]. Bollerslev, T.(1986), Generalised Autoregressive Conditional Heteroskedasticity, Journal of Econometrics, Vol. 31, pp. 307-27.

[9]. Bollerslev, T., Engle, R. F. and Wooldridge, J. M. (1988). A Capital asset pricing model with time-varying covariances. Journal of Political Economy 96(1):

[10]. 116-131.

[11]. Brooks,C (2010). Introductory Econometrics for Finance. 2nd ed. The Edinburgh Building, Cambridge CB 8RU, UK: Cambridge University press.

[12]. Chan, K.C., B.E. Gup and Pan,M.S (1992), An Empirical Analysis of Stock Prices in Major Asian Markets and the United States, Financial Review, Vol. 27, pp. 289-307.

[13]. Chan,K.C., Gup,B.E., and Pan,M.(1997) International stock market efficiency and integration: A study of eighteen nations. Journal of Business Finance & Accounting,24(6),0306-686X

[14]. Chang, T., Nieh, C. and Wei, C., (2006). Analysis of long-run benefits from international equity diversification between Taiwan and its major European trading partners: An empirical note. Applied Economics. 38, 2277–2283.

[15]. Chen, J.,Buckland, R., and Williams, J.,(2011), Regulatory changes, market integration and spillover effects in the ChineseA, B and HongKong equity markets, Pacific-Basin Finance Journal.

[16]. Collins, D. and M. Abrahamson (2004), African equity markets and the power of financial integration. South African Journal of Economics 72(4), 658-683.

[17]. Collins, D. and N. Biekpe (2003), Contagion: a fear for African equity markets? Journal of Economics and Business 55, 285-297.

[18]. Corhay, A., A.T. Rad and J.P. Urbain (1993), Common Stochastic Trends in European Stock Markets, Economics Letters, Vol. 42, pp. 385–90.

[19]. Darrat, A. R. and Benkato, O. M., (2003), Interdependence and Volatility Spillovers under Market Liberalization: The Case of Istanbul Stock Exchange. Journal of BusinessFinance and Accounting. 30(7), 1089-1114

[20]. Dickey, David, A., and Wayne, A., Fuller (1979), Distribution of the Estimators for Autoregressive Time Series With a Unit Root, Journal of the American Statistical Assoc., 74, 427-431.

[21]. Dickinson,D (2000), Stock market integration and macroeconomic fundamentals: an empirical analysis, 1980- 95. Applied Financial Economics, 2000, 10, 261- 276

[22]. Dwyer, G.P., and M.S Wallace (1992), Cointegration and market efficiency. Journal of International Money and Finance 11(4), 318-327.Econometrica. 59(2), 347-370.

[23]. Engle, R.F. and Granger, C.W.J., (1987), Co-integration and error correction: representation, estimation and testing. Econometrica 55 (2), 251–276.

[24]. Eview Manual., (2009). Help system. [Online]. Available: www.eviews.com.

[25]. Frnandez-Serrano, J.L. and Sosvilla-Rivero, S. (2001), Modelling Evolving Long-run Relationships: The Linkages between Stock Markets in Asia, Japan and the World Economy, 13, 145–60.

[26]. Forbes, J. and Rigobon, R., (2002), No contagion, only interdependence: Measuring stock market comovements. Journal of Finance. 57, 2223-2261.

[27]. Forbes, J. K. and Chinn M. D., (2004). A decomposition of global linkages in financial markets over time. The Review of Economics and Statistics. 86(3), 705-722.

[28]. Fraser,P and Oyefeso,O . (2005). UK and European Stock Market Integration. Business Finance & Accounting. 32(1) & (2), 0306-686X

[29]. Glezakos, M., Merika, A. and Kaligosfiris, H., (2007), Interdependence of major world stock exchanges: how is the athens stock exchange affected? International researchJournal of Finance and Economics. 7, 24-39.

[30]. Granger, C.W.J. (1986), Developments in the Study of Cointegrated Economic Variables, Oxford Bulletinof Economics and Statistics, 48, 213–28.

[31]. Green, W.H.,(2002),Econometric Analysis (5th Edition).New Jersey: Prentice Hall.

[32]. Gujarati, D. N.,(2005),Essential of Econometrics (4th Edition). New York: McGraw-Hill Inc.

[33]. Harris, R. and Sollis, R. 2003. Modelling and forecasting financial time series. New

[34]. York, Wiley.

[35]. Hosking, J.R.M., (2006), On the Characterization of Distribution by their L-moment. Journal of Statistics Planning and Inference, 136,193-198.

[36]. Johansen, S. (1991), Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, Econometrica, vol. 59, No.6, 1551-1580.

[37]. Johansen, S. (1988), Statistical Analysis of Cointegrating Vectors', Journal of Economic Dynamics and Control, vol. 12, pp. 231–54.

[38]. Johansen, S., (1995), Likelihood based inference in cointegrated vector autoregressive models. In: Advanced Texts in Econometrics. Oxford University Press.

[39]. Johansen, S., and K Juselius (1992), Testing structural hypothesis in a multivariate cointegration analysis of the PPP and the UIP for the UK. Journal of Econometrics 53 211-244.

[40]. Karolyi, G.A. (1995), A multivariate GARCH model of international transmissions of stock returns and volatility: the case of the United States and Canada, Journal of Business and Economic Statistics, 13(1), 11-25.
[41]. Kasa, K. (1992), Common stochastic trends in international stock markets. Journal of Monetary Economics 29 (1), 95-125.
[42]. Kearney, C. and Lucey, B. M.,(2004), International equity market integration: Theory, evidence and implications. International Review of Financial Analysis. 13, 571-583.
[43]. Kwiatkowski, D., Phillips, P. C. B., Schmid, T, P. and Shin, Y., (1992).Testing the null hypothesis of stationary against the alternative of a unit root. Journal of Econometrics. 54, 159-178.
[44]. Lamba, S. A. and Otchere, I.,(2001), An analysis of the linkages among African and world equity markets. The African Finance Journal. 3(2), 1-25.
[45]. Lence, S. and B. Falk (2005) Cointegration, market integration and market efficiency, Journal of International Money and Finance 24(6), 1, 873-890.
[46]. Lutkepohl, H, (2007), New Introduction to Multiple Time series Analysis, Springer, Germany.
[47]. Maddala, G. S. and Kim, I. M., (1998), Unit Roots, Cointegration and Structural Change. England. Cambridge University Press.
[48]. Mansourfar ,G.,Mohamad,S., and Hassan,T.,(2010), A review on international portfolio diversification: The Middle East and North African region.African Journal of Business Management. Vol.(19),pp.4167-4173.
[49]. Masih, R. and A.M.M. Masih (2001), Long and short term dynamic causal transmission amongst integrated stock market. Journal of International Money and Finance 20, 563-587.
[50]. Masih, Rumi, Mansur, A. and Masih, M. (2004), Common stochastic trends and the dynamic linkages driving European stock markets: evidence from pre- and post-october 1987 crash eras, The European Journal of Finance, 10: 1, 81 – 104
[51]. Morana, C. and Beltratti, A., (2006), Comovements in international stock markets. Working Paper. No 3/2006. International Centre for Economic Research.
[52]. Naryan, K. P. and Smyth, R., (2005). Cointegration of stock markets between New Zealand, Australia and the G7 economies: Searching for co-movement under structural change. Australian Economic Papers. 44(3), 231-247.
[53]. Nelson, D. B., (1991),Conditional Heteroskedasticity in Asset Returns: A New ApproachEconometrica. 59(2), 347-370.
[54]. Ogum,G.,(2002),An analysis of asymmetry in the conditional mean returns: Evidence from three Sub-Saharan Africa emerging equity markets. African Finance Journal. 4,78-82.
[55]. Pascaul, A. G. (2003),Assessing European Stock Market Cointegration. Economic letters, 78, 197 – 203.
[56]. Philip, P.C.B and Perron,P. (1988),Testing for a unit root in time series regression, Biometrika, 75, 2, 335-46
[57]. Phylaktis, K. and F, Ravazzolo (2005), Stock market linkages in emerging markets: implications for international diversification. Journal of International Financial markets Instrument and Money 15, 91-166.
[58]. Piesse, J. and B. Hearn (2002), Equity markets integration versus segmentation in three dominant markets of the Southern African Customs Union: cointegration and causality test. Applied Economics 14, 1711-1722.
[59]. Piesse, J. and B. Hearn (2005) Regional integration of equity markets in Southern Africa. South African Journal of Economics 73(1) 36-53
[60]. Piesse, J. and Hearn, B., (2005), Integration and the Asymmetric Transmission of Volatility: A Study of Equity Markets in Sub Saharan Africa. South African Journal of Economics.73(1), 36-53.
[61]. Rangvid, J. (2001), Increasing convergence among European stock markets? A recursive common stochastic trends analysis, Economic Letters 71, 383-389.
[62]. Richards A.J. (1995), Comovements in national stock market returns: Evidence of predictability, but not cointegration, Journal of Monetary Economics 36, 631 – 654.
[63]. Richards A.J. (1995), Movement in national stock market: Evidence of predictability, but not cointegration. Journal of Monetary Economics 36, 631-654.
[64]. Scherrer, W. and Ribarits, E. (2007). On the parameterization of multivariate GARCHmodels. Econometric Theory 23: 464-484.
[65]. Sims, C., (1980). Macroeconomics and reality. Econometrica. 48, 1-48.
[66]. Syriopoulos, T. (2004) International portfolio diversification to Central European stock markets, Applied Financial Economics, 14: 17, 1253 — 1268.
[67]. Wang Z & J Yang & D.A Bessler (2003), Financial crisis and African stock market Integration. Applied Economics Letters 10, 527-533
[68]. William, J. (2011). Empirical Methods in Finance. Lecture Notes. University of Aberdeen Business School.
[69]. Yag,J., Min, I and Li, Q.(2003), European Stock Market. Journal of Business Finance & Accounting. 30(9) & (10), 0306-686X

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