International Review of Business Research Papers
Vol. 8. No.5. July 2012. Pp. 176 – 190

An Investigation into the Volatility and Stock Returns Efficiency in African Stock Exchange Markets

Njimanted Godfrey Forgha*

This study presents empirical evidence of the efficiency and volatility of stock returns in five stock markets in Africa namely, Cameroon, Nigeria, South Africa, Egypt and Kenya. Although the markets have proven to be inefficient based on Generalized Autoregressive Conditional Heteroskedasticity Mean (GARCH-M), Augmented Dekey Fuller (ADF) and the Variance Ratio tests, there are still supporting evidences to justify that, there are profit opportunities in these markets. Therefore, in as much as stock market is a medium for secondary securities, it is an agent of economic development.

Keywords: *Volatility, Efficiency,* Stock Exchange Markets and Existing Securities
Field of Study: Quantitative Methods/Monetary Economics

1. Introduction

By definition, stock exchange markets are markets where the buying and selling of second hand stocks, shares and securities are carried out. They are essentially secondary markets in that only existing securities as opposed to new issues could be traded on. They however, have very strong connection with the primary markets in that they facilitate and provide the assurance for primary holders of shares, stocks and securities to re-sell them later when need arises.

The stock returns efficiency and volatility have generated heated debates and interests among economists, stock market analysts, government regulatory and policy makers. This interests and debates stem in part from the implication for market efficiency, stock market bubbling, market crash and recession in some sectors of the economy (Nyong, 2005). As such, stock market returns efficiency, and volatility of stock needs to be investigated continuously to guarantee stationarity in them. This is also done to assess the nature of the risk-return relationship and for market participants to evaluate assets pricing, dividends behaviour and risks management of quoted companies in the sock exchange markets. These are carried out to achieve the expected roles stock exchange markets transmit in an economy to achieve economic growth.

On the basis of the above, there are currently twenty nine stock exchange markets in Africa, representing thirty three nations' capital markets. Of the twenty nine stock exchange markets in Africa, twenty one are members of the African Securities Exchanges Association (ASEA). With the Egyptian Exchange (EGX) founded in 1883 as the oldest stock exchange in Africa, many more stock exchange have emerged and today we have two well established regional stock exchange markets. These are the Bourse Regionale des Valeurs Mobilieres (BRVM), located in Abidjan, Cote d'Ivore and the Bourse Regionale des Valeurs Mobilieres d'Afrique Centrale (BVMAC), located in Libreville, Gabon Centrale.

*Njimanted Godfrey Forgha (Ph.D) Department of Economics and Management, University of Buea . Email: unicalub@yahoo.com

The BRVM serves, the Benin, Burkina Faso, Guiea Bissau, Cote d'Ivoire, Mali, Niger, Senegal and Togo, while the BVMAC serves, the Central African Repiblic, Tchad, Congo, Equatorial Guinea and Gabon. Table 1 below provides the list of stock exchange markets in Africa, their location and number of listed companies.

A critical examination of the trend of stock returns in the African stock exchange markets reveal that they are consistently bubbling. It is for this reason that studies such as Fama and French (1988), Lo (1991), Lee (1996), Rodriquez (2002), Nagayasa (2003), Fambon (2004), Harris (2004), Habibullah (2006), Hinaunye (2007), Roymond (2008) and Wachtell (2009) provide, reasonable conclusion concerning volatility of stock prices, dividends, stock turn over on the one hand and stock returns and market efficiency on the other hand. Many regulations have arisen in the past due to the proposition that too high volatility in stock returns adversely affect investors since they are risk averse. Increase volatility of returns implies that investors are worse-off unless expected returns rise.

Based on the methodology presented below, five stock exchange markets have been selected for study. These include: the Nigerian Stock Exchange, Douala Stock Exchange, Johannesburg Stock Exchange, the Nairobi Stock Exchange and the Egyptian Stock Exchange. These markets represent under random sampling the West African Exchange, the Central African Exchange, the Southern African Exchange, the East African Exchange and the Northern African Exchange markets. This procedure is different in the choice of the market as it is the case with previous studies where these markets are studied on regional bases or selected with high degrees of biasness. Based on the random method of random selection of a stock market in each of the zones in African, generalization is likely to yield consistent results. The random work hypothesis which are observed in previous studies as signs of stock market inefficiency are in this work considered as part of the risk of investment with the justification that where there is high returns, these is an expected high risk.

The fundamental role of stock market is to provide adequate guarantee to share holders for the existence of market for their second hand securities. Adequate knowledge about the volatility, performance and efficiency of stock returns remains vital and essential information to investors. These will guide not only investment decisions but also planning for economic growth and development. Given that Africa harbours up to twenty nine stock markets, and its growth and development remains questionable, it means the confidence they are expected to instil in investors to invest is still not commensurable. Therefore, in this work, the following questions are to be answered among others. They include: To what extent have stock returns volatility, dividend yields and exchange rates influence investment decisions in these markets? What is the nature of the stock returns efficiency in these markets? Can the increased volatility and stock returns efficiency be determined by interest rate, dividend yield, and exchange rate? These among others are questions which are expected to be answered in this work.

Thus, this work has been divided into five sections. Haven covered section one, section two reviews literature and theories which provide insight into the understanding of our subject in question. Section three designed the methodological framework for the study. While section four reviews the situation in the various stock markets, it also presents and discusses our empirical findings. Section five draws the work to logical conclusion through summary of major findings and policy remarks.

2. Literature Review and Theoretical Framework

In most advanced countries of the world, capital and financial markets have played pivotal roles in their economic development. Rouseau and Silla (1990), Wachtel (1998), Clark (1998), Weber (1905), Greenwood (1990), Levine (1996), Harris (1997), Obstfeld (1994), Ergungor (2006) and Cuyvers (2006) among others obtained quantitative evidence to justify the proposition that financial and capital markets positively influence the growth of American economy. Similar studies have been carried out in Japan, Australia, Belgium, Berlin, Budapest, Denmark, Finland, Luxembourg, Moscow, New York, Ottawa, Poland and Wellington with mixed conclusions. While some studies have focused solely on capital markets, others have dwelled on financial market role on economic growth and development. For example, Gabriel (2002) observes that the most important indicator of inefficiency which strongly translates to poor economic performance is the inadequate number of investors in the capital markets. Examining the efficiency in the Romanian capital market, he maintains that the high level of uncertainty in the financial and capital markets discourages potential investors into these markets.

The interaction between stock returns and market performance is strongly related to the efficient market hypothesis put in place by Fama (1965). Haven provide the most popular explanation of the dynamics of equity returns; the efficiency market hypothesis (EMH) harbours useful information on how current stock return is already contained in the most recent previous stock data. Thus, attempts by stock brokers, chartists and fundamentalists to develop trading functions to consistently beat the market are exercised in futility (Yong, 2005). One of the implications of the EMH is that equity prices or returns in less developed countries would eventually exhibit long range dependence due to the shallowness and narrowness of their markets arising from institutional arrangement and immature regulatory (Nagayasa, 2003).

For market performance, the stability of stock returns ought to be a major concern. This of course is linked to the efficiency of the market. In Austria, Spain, Italy and Japan, Cheung and Lai (1995) established empirically strong evidence of market inefficiency in their stock returns. In a similar manner, McKenzie (2001) in Australian stock market returns from 1876-1996, Barkoulas et al (2000) based on weekly stock data, Sadique and Silvapulle (2001) for Korea, New Zealand, Singapore and Malaysia and Nelson (2009) for Ghana, concluded that in terms of stock returns and market performance, these markets are inefficient.

Contrary to the above studies, Mills (1993) using UK monthly stock returns for thirty four years (1965-1990), Cheung and Lai (1995) based on Morgan and Stanley Capital International indices for eighteen industrial countries for twenty two years (1970-1992), Resende and Teixeira (2002) based on Brazilian Ibovespa Stock Market Index and Nyong (2005) based on stock returns in three emerging markets: Nigeria, South Africa and Brazil reject the random walk hypothesis designed to explain markets efficiency.

The study by Alam et al (1999), used Lo (1991) and Mackinlay variance ratio test on monthly, quarterly and yearly stock process from 1970-1996 to demonstrate that random walk hypothesis cannot be rejected. The review of studies by Habibullah (2006) reveal that while some studies indicate that stock markets are efficient but sometimes unpredictable, others reject the random walk hypothesis, insisting that the markets are

volatile, inefficient and predictable. Lo (1991) in Nyong (2005) emphasises the difficulties of assessing market efficiency and proposed ideally that stock market efficiency should be tested in the context of equilibrium asset pricing model that defines normal asset returns. The general consensus is that if stock markets are inefficient, it means profitable opportunities exist to reap above normal returns and vice versa.

Recent research by Ndikumana (2009) found strong presence of inefficiency and volatility of asset returns in six countries. Ndikumana regressed using stock returns on two periods, Lagged Stock Returns, Current and Lagged dividend yield, current and lagged growth rate of output and interest rate based on vector autoregressive (VAR) methodology. His findings reveal that inefficiency in stock returns increases in low frequency data compared to high frequency data.

Different approaches have been adopted to investigate the efficiency and volatility of stock returns in different markets. Most of these studies have adopted the capital asset pricing model, among which are the works of Markowitz (1964), Nasri and Harb (2005), Agbetsiata (2003), Makina (2006), Donald and Allen (2000).

While arrays of research have used the multi-factor or integrated capital asset pricing model (ICAPM) developed by Merton (1973) or arbitrage pricing theory (APT) developed by Ross (1976), there is the general consensus that the appropriate approach to examine the efficient and the volatility of stock returns is the Autoregressive Conditional Heteroskedasticity (ARCH) developed by Engel (1982). The ARCH approach and its various modifications have been shown to provide a good fit to many financial return time series (Seguim 1993; Poon and Taylor 1992; Bessembinder 1993; Engel and Bollersler 1986; Lo and Mackinlay 1988 and Najand and Yung 1991). This is because changes in the variability of returns over time are expected to impact on the risk or profit of an investment (Nyong, 2005).

Based on the limitations embodied in the ARCH, studies have also adopted the Generalised Autoregressive Conditional Heteroskedasticity (GARCH). Using the GARCH Engel et al (1995) observed that the coefficient of relative risk aversion is approximately 3.0 in the US stock market using monthly data for over thirty five years. According to Engel et al., Capital Pricing Model (CAPM) might have performed better in the French and Fama estimation if the betas were conditioned on contemporaneous information (Nyong, 2005).

3. Analytical Methodology

3.1 Scope and Selection Procedure

Of the 29 stock exchange markets in Africa as presented on table 1 below, five were randomly selected representing the Central, Western, Eastern, Northern and Southern African exchange markets. The period chosen for this study is 2001 to 2010 using quarterly data. Therefore, the sample size for this work is 30, that is n = 30. This period is chosen based on the availability of data especially in the Douala stock market where only two companies are quoted.

Table 1. Stock Exchange Markets in Africa

Exchange	Location	Founded	Listed companies	Link
BRVM	Abidjan	1998	39	BRVM
Bourse d'Alger	Algiers	1997	7	SGBV
Botswana stock exchange	Gaborone	1989	44	BSE
Douala stock exchange	Douala	2001	2	DSX
Bolsa de valores de Cabo Verde	Mindelo	-	-	BVC
Egyptian exchange	Cairo	1883	378	EGX
Ghana stock exchange	Accra	1990	28	GSE
Nairobi stock exchange	Nairobi	1954	48	NSE
Libyan stock exchange	Tripoli	2007	7	LSM
Malawi stock exchange	Blantyre	1995	8	MSE
The stock exchange of Mauritius	Port Louis	1988	40	SEM
Casablanca stock exchange	Casablanca	1929	81	CASA SE
Bolsa de Valores de Mocambique	Maputo	1999	-	BVM
Namibia stock exchange	Windhock	1992	NSX	NSX
Abuja securities and commodities exchange	Abuja	2001	-	ASCE
Nigeria stock exchange	Lagos	1960	223	NSE
Rwanda over the counter exchange	Kigali	2008	2	n/a
AltX-JSE 2003	Johannesburg	2003	51	ALTX
JSE 2009	Johannesburg	1989	400	BESA
JSE Limited	Johannesburg	1887	471	JSE
The South Africa Future Exchange	Johannesburg	1990	-	SAFEX
Khartoum stock exchange	Khartoum	-	-	KSE
Swaziland stock exchange	Mbabane	1990	10	SSX
Dar es Salaam stock exchange	Dar es Salaam	1998	11	DSE
BVM de Tunis	Tunis	1969	56	BVMT
Uganda securities exchange	Kampala	1997	14	USE
ACE of Zambia	Lusaka	-	-	ZAMACE
Zimbabwe stock exchange	Harare	1993	81	ZSE

Sources: African Financial Bill 2009, African Development Indicators, 2006. ASEA Website

Given the objectives of this study, the obtained results are based on the following econometric techniques. To examine the volatility of stock returns in the five different markets, the Autoregressive Conditional Heteroskedasticity (ARCH) is employed. The beauty of the ARCH process is that it allows the conditional variance of returns to change over time as a function of past squared errors. By imposing an autoregressive structure on the conditional variance, it allows the volatility of shocks to persist over time. It is this persistence of volatility of stocks to persist over time that explains the clustering, non-normality and instabilities observed in empirical asset return distributions.

Unfortunately, the ARCH approach has a number of weaknesses prominent of which is the dependence of conditional variance on past values of itself and independent variables. This limitation led to the development by Bollersler (1986) the Generalized

Autoregressive Conditional Heteroskedasticity (GARCH) also employed in this study, which permits for a more flexible structure in the sense that it allows all lags to exert influence on the conditional variance including the past value of conditional variance itself and in addition to lagged values of the squared errors. In GARCH as in ARCH, the covariance of asset returns with the market returns are expected to vary over time because the portfolio weights change over time, and the covariance matrix of individuals is time-variance. Also, the GARCH is employed in this study because it has enjoyed considerable successes in forecasting conditional variance of asset returns since it statistically reduces the distance between the stock market portfolio and the mean-variance efficient frontier (Engle, 1995). Furthermore, the (GACH-M) that is in mean methodology is used in this study to investigate the effects of risks and other fundamental financial variables on stock return generating process. This is supported by the use of Augmented Dickey Fuller (ADF) and the variance ratio test.

The ADF model is presented as:

$\Delta Y_t = a_1 + a_1 Y_{t-1} + \sum_{t-1}^{n} b_j \Delta Y_{t-j} + e_t$ …. (3.1) where;

Y_t is the variable being tested for unit root, j is the lag length to ensure that any autocorrelation in ΔY_t is absorbed and the error term e_t is white noise distribution. The appropriate lag length is determined by the Akaike and Schwarz information criteria. The testable hypothesis is H_o: $a_1 = 1$; that is the series is non stationary, hence random walk: H_1: $a_1<1$, that is the series is stationary and hence the market is inefficient. In this case, the t-statistics is greater than the critical value as such we reject the null hypothesis (H_o) that the market is efficient and accept the alternative (H_1) that the market is inefficient (Nyong 2005).

Based on the variance ratio test, if the returns are purely random walk, the variance of its n-differences grows proportionally with difference n. The model is given by:

$$VA(n) = \frac{1}{n}\left\{\left[\sigma^2 \frac{n}{\sigma^2}\right](1)\right\} = 1 \text{.....3.2)}$$

The standardized modified overlapping variance ratio's statistic is given as $Z^*(n) = \left[\frac{VR^*(n)-1}{v}\right] ron(0,1)$ where $\sigma^2(n)$ is the unbiased estimator of the variance of the nth difference of stock return (SR), $\sigma^2(1)$ is the variance of the first difference of return (SR_1) $V = \frac{2(2n-1)(n-1)}{3Nn}$.

$VR^*(n) = \frac{1}{n}\left[\frac{\sigma^2(n)}{\sigma^2}(1)\right]$, N = Sample size.

A variance ratio VR(n) <1, indicates the presence of negative serial correlation, which is consistent with mean-reverting behaviour, hence with market inefficiency. However, if VR(n)>1, it means the presence of positive serial correlation or an explosive function is the series. This is in agreement with random walk behaviour or unit root hypothesis. The finding that VR(n)>1 suggests that the market is efficient. Since it is not clear whether the random walk for the returns may be due to heteroskedasticity or autocorrelation, we have used the heteroskedasticity consistent variance ratio test statistic Z^*(n) to reject the random walk hypothesis with the conclusion that the only reason for rejecting the random walk hypothesis is the presence of autocorrelation.

3.2 Model Specification and Justification of Inclusion of Variables in the Model

Many theories have provided insight in the understanding of dividend behaviour of quoted companies in the stock market. The stock returns, stock volatility and stock predictability are also explained by some of these theories. The capital asset pricing theories provide links that explained the relationship between risk-return, exchange rate and dividend yield as a proxy for information innovations. Market interest rate, dividend yield, industrial production and exchange rate variables are important fundamentals of financial variables for changing investment decisions. A risk adverse investor who chooses between two or more different portfolios given the same distribution of future wealth, the investor has actually chosen a portfolio that gives him better hedge against unfavourable shifts in dividend yields, interest rate, exchange rate and industrial production. The implication of such portfolio selection behaviour is that in equilibrium, all things being equal, security prices and return will differ according to the sensitivities of these variables. From the above, the important financial variables namely dividend yield (DY) and exchange rate (EXCHR) are specified thus:

$$SR_t = a_o + a_1 SR_{t-1} + a_2 DY_{t-1} + a_3 EXCHR_t + a_4 \sigma_t^2 + \sum t \quad \ldots (3.3)$$

$$\sigma_t^2 = b_0 + b_1 e_{t-1} + b_2 \sigma_{t-1}^2 + b_3 EXCHR_t + b_4 DY_t \quad \ldots\ldots\ldots\ldots (3.4)$$

Where, $e_{t-1} NN(0, \sigma_t^2)$, SR_t = Percentage change in total return index. DY = dividend yield in percentage, EXCHR = exchange rate (local currency / US dollar), σ_t^2 = variance of returns or volatility. The rest are parameters to be estimated.

The GARCH-M enables us to study whether investors in our selected markets are rewarded for their exposure to a certain level of stock price volatility. The application of the GARCH to test the CAPM is an improvement in the specification of asset pricing model since it allows measurement of the conditional variance of returns as the measure of risk. The volatility measure defined by the conditional variance in GARCH model is an expectation formulation. Thus, if asset return was unexpectedly large in either the upward or downward direction, the trader will increase the estimate of the variance for the next period.

Therefore, the GARCH model is consistent with the volatility clustering in financial returns data where large changes in returns are accompanied with further large changes (Nyong, 2005). A Leptokurtic distribution which explains that the stock market is likely to be affected by big surprises conditioned on the availability of information at any time is said to have occurred. Hence, there is the likelihood that GARCH model provides an attractive representation of daily, monthly, quarterly and yearly stock return. It also captures successfully, the temporal dependence of volatility. On the bases of the above, the GARCH-M approach overcomes the Ordinary Least Squares (OLS) restrictive assumptions of linearity, independence of constant variance, and the risk measure normally employed in unconditional distribution of return. GARCH-M is the Engel et al (1987) extension of the ordinary GARCH model. Bollersrev et al (1988) observed that GARCH-M approach provides a close parsimonious approximation to the form of heteroskedasticity, which are usually encountered with non stationary economic time series data. Thus, the GARCH (p,q) – M model is specified as:

$$SR_t = C_0 + C_1 SR_{t-1} + C_2 X_{t-1} + C_3 h_t^2 + \sum t, \sum_t / I_{t-1}\, nD(o, h_t^2) \ldots (3.5)$$

Where SR_t is the rate of returns at time t, X_{t-1} is a column vector of lagged explanatory financial variables that have been hypothesized to influence stock returns, I_{t-1} is the information available at the beginning of time t, D is the generalized error distribution indicating the conditional density function, C_1 is the autocorrelation coefficient reflecting the effect of non-synchronous trading in the assets constituted from the market index. The coefficient of the conditional variance (h_t^2) that is C_3 is expected to be positive. The application of equation (3.5) to test the capital asset pricing models (CAPM) is an improvement in the specification of asset pricing models for reason explained above.

The volatility measure defined by the conditional variance in GARCH model is an expectation formulation. That is:

$$h_t^2 = E_o + \sum_{i=1}^{q} \lambda \sum\nolimits_{t-1}^{2} + \sum_{i-1}^{p} \phi_i h_{t-1}^2 + EW_{t-1} \quad \text{..... (3.6)}$$

W_{t-1} is a column vector of other variables hypothesized to influence volatility of returns. Equation 3.5 and 3.6 are behavioural equations affecting the tendency of traders to determine the period's variances by formulating long run weighted average E_o, the forecasted variance for the last period (the GARCH) and the volatility observed in previous period (i.e. the ARCH term).

The sum of the estimated parameter λ and ø (λ + ø) shows the extent to which volatility stocks persist over time. If λ + ø are close to one, it means the process is integrated in variance for all horizons. This process is referred to as integrated GARCH or IGARCH. If ø > λ, it means large market surprisingly generates relatively small revision in future volatility (Nelson, 1991). We expect the value for λ +ø (volatility persistence) to fall if accounting for information explains the presence of GARCH in the data. This study has adopted a multiple estimation approach (MEA) unlike in previous studies where a unit estimation approach is adopted with inconclusive results.

3.3 Methods of Data Collection and Sources of Data

The randomly selected representative of African zonal markets reveals the cross-section of stock market efficiency and stock return volatility in Africa. This requires substantial information between 2001 and 2010, which is our period of study. Based on intensive library study, the data for this work has actually been obtained from numerous sources among which are: Financial Bills various issues, International Finance Corporation IFC, Emerging Stock Market Fact Book, various issues, Washington, D.C., BEAC, NIS, World Bank various issues and African Development Indicators; various series.

4. Presentation and Discussion of Empirical Findings

This section commences with the presentation and discussion of results obtained from the descriptive statistics on the nature of the parameters of our model for the different countries. There are as presented on Table 2 below.

Table 2. Descriptive Statistics on Financial Data

Country	Cameroon	Nigeria	South Africa	Egypt	Kenya
Variable **mean**					
SR	10.333	22.400	27.00	34.600	14.201
DY	13.222	45.200	33.6	9.009	3.842
EXCHR	8.778	14.000	6.038	7.204	3.606
Variance					
SR	15.77	98.4439	13.518	5.840	34.588
DY	6.0914	8.4380	9.7361	10.691	1.5811
EXCHR	1.6583	7.9372			
Skewness					
SR	5.2691	-2.3942	-0.0461	-0.4661	-0.0431
DY	-0.431	1.2143	-0.0146	-0.448	-0.0112
EXCHR	4.531	-3.9641	-0.294	-0.4631	-0.0062
Kurtosis					
SR	4.384	11.7236	12.348	3.9386	3.753
DY	2.9386	2.559	1.7236	2.559	2.0179
EXCHR	1.7535	2.0171	0.7654	0.4982	0.228
JB	10.7153	30.3968	10.7654	0.4982	15.8922
P-Value	0.0725	0.820	0.6988	0.7796	0.6568
n	30	30	30	30	30

JB = Jarque – Bera for SR.
Source: Selected by author from descriptive statistics table of the calculated results.

From Table 2 we observe that the returns in all the five markets are negative except with the case of Cameroon stock market which is positive. The result also reveals that the mean of stock returns in Egypt is the largest and the lowest in Cameroon. The negative skewness in the above markets explains that the returns in distribution of the stocks traded on these markets have higher probability of earning negative returns. This is in agreement with the law of diminishing returns in large firm. Except Cameroon, which has only two companies quoted in the stock exchange, the next small market size is the Kenyan stock exchange with 48 quoted companies. The value of Kurtosis in each market exhibits normal distribution since they exceed 3 in the case of SR. (3 is the critical value).

Furthermore, the stock returns in the five countries (markets) exhibit varying amount of excess Kurtosis with South Africa stock returns having the largest amount of excess returns. Important descriptive statistical information associated with our result is that, the volatility in stock return is dictated more in Nigeria, SR variance is 98.44 followed by Kenya with SR variance equal to 34.59. Less volatility is observed in the Egyptian's market. This is supported by the value of Jarque-Bera in the five different markets.

Table 3. MacKinlay and Lo Variance Ratio Test

N	n	Cameroon	Nigeria	South Africa	Egypt	Kenya
30	2	0.456	0.998	0.692	0.786	0.989
30	4	0.377	0.946	0.511	0.543	0.743
30	6	0.249	0.625	0.499	0.453	0.564
30	8	0.126	0.591	0.204	0.400	0.258
30	15	0.094	0.306	0.119	0.056	0.146
30	20	0.062	0.221	0.047	0.002	0.016

Source: Extracted by author from quantitative results

In Table 3 above, we employed the MacKinlay and Lo variance ratio test to investigate into the efficiency of the stock returns in the five markets. The Mackinlay and Lo (1988,

1989) methodology provides statistical test of significance for the asymptotic normal estimate of variance, which is robust to hereroskedasticity and non-normal disturbances. From our results, the variance ratio estimates are less than unity for all SR and the ratios decrease with increasing n. The implication is that all the markets are inefficient.

Table 4. Augmented Dickey-Fuller Unit Root Test

Country	Cameroon	Nigeria	South Africa	Egypt	Kenya
Variable SR					
t-value	-3.8572	-8.7516	-3.8572	-3.924	-5.2719
p-value	0.006	0.000	0.0047	0.052	0.001
Optimal lag	4	2	5	4	2
DY					
t-value	-4.496	-1.347	-1.791	-2.467	-7.631
p-value	-0.005	0.6743	0.5933	0.3196	0.004
Optimal lag	4	3	6	4	9
EXCHR					
t-value	-9.564	-3.396	-3.577	-3.659	-0.015
p-value	0.000	0.052	0.064	0.0251	0.973
Optimal lag	6	4	9	3	1

Source: Extracted by author from regression results

Table 4. is designed to test for the random walk hypothesis based on the Augmented Dickey-Fuller test at different lagg length. In all cases, the hypotheses of no random walk in the stock returns parameter for all the countries stock markets are rejected. As suggested by Nyong 2005 who obtained similar results in the study of three African emerging market, explained that the rejection of the random walk hypothesis in these markets are due to the existence of the autocorrelation, which is the justification that investors are not risk averse. This may be due to information asymmetric and the competence difficulty gap. However, based on our results on Table 2, and 3, the five markets exhibit inefficiencies at different degrees based on SR.

Presented in Table 4, are the parameter estimates of GARCH-M for the five countries. In each of the models, stock returns (expected risk) are specified as the function of its lagged stock returns, dividend yield and exchange rate as predictory variables. The results explain that about 84 percent of total variation of stock returns in Cameroon, 95 percent in Nigeria, 46 percent in South Africa, 45 percent in Egypt and 76 percent in Kenya are accounted for by the variables specified in our model.

Table 5. GARCH-M Estimated Parameters

Variable	Estimated coefficient	z-statistics	p-value
Cameroon			
Constant	**-1257.806**	**-2.8070**	**0.005**
SRC(-1)	**-0.10925**	**-0.2161**	**0.829**
DYC(-1)	**4.009**	**8.7592**	**0.000**
DYC(-2)	**0.33556**	**9.8886**	**0.000**
EXCHR(-1)	**0.20978**	**7.0040**	**0.000**
EXCHR(-2)	**0.012140**	**0.0488**	**0.9610**
$\sqrt{\sigma^2}$	**-7.639**	**-1.6458**	**0.059**
Constant	**18242.90**	**0.626013**	**0.5313**
ARCH(-1)	**-0.199158**	**-2.09152**	**0.0365**
GARCH(-1)	**0.534212**	**0.5488**	**0.0531**
Adj. R^2 = 0.8379	**Loglikelihood = -153.75**	**F-ratio = 20.8**	**000**
Nigeria			
Constant	**-277.665**	**-0.2211**	**0.825**
SRN(-1)	**-1.79489**	**-0.89227**	**0.372**
SRN(-2)	**3.79230**	**21.8616**	**0.000**
DYN(-2)	**0.33769**	**8.5507**	**0.000**
EXCHR(-1)	**-0.0450**	**-7.0556**	**0.055**
$\sqrt{\sigma^2}$	**-4.570**	**-2.0993**	**0.0367**
Constant	**29.0931**	**0.52719**	**0.5981**
ARCH(-1)	**0.4117**	**0.9238**	**0.5981**
GARCH(-1)	**0.42105**	**0.012008**	**0.990**
Adj. R^2 = 0.953	**Loglikelihood = -135.455**	**F-ratio = 62.01**	**0.001**
South Africa			
Constant	**56.4603**	**1.3496**	**0.1774**
SRSA(-1)	**-0.0033**	**-0.122**	**0.902**
DYSA(-1)	**0.237**	**1.6051**	**0.547**
EXCHRSA(-1)	**-1.4238**	**-0.6056**	**0.5434**
$\sqrt{\sigma^2}$	**4.649**	**2.3481**	**0.0533**
Constant	**92.641**	**23.143**	**0.6871**
ARCH(-1)	**0.25000**	**0.4019**	**0.667**
GARCH(-1)	**0.60071**	**0.45508**	**0.649**
Adj. R^2 = 0.4642	**Loglikelihood = -29.0853**	**F-ratio = 6.6**	**0.0001**
Egypt			
Constant	**35.431**	**2.713**	**0.006**
SRE(-1)	**-16.1843**	**-2.1722**	**0.029**
DYE(-1)	**1.00573**	**3.0966**	**0.007**
EXCHRE(-1)	**16.851**	**1.09657**	**0.2728**
$\sqrt{\sigma^2}$	**6.4391**	**3.0471**	**0.000**
Constant	**3.3110**	**1.0969**	**0.2727**
ARCH(-1)	**1.0642**	**0.8847**	**0.4871**
GARCH(-1)	**-0.4615**	**-0.9601**	**0.333**
Adj. R^2 = 0.448	**Loglikelihood = -53.057**	**F-ratio = 2.9**	**0.048**
Kenya			
Constant	**5.4634**	**3.2423**	**0.0012**
SRK(-1)	**-125.8901**	**2.658**	**0.0043**
DYK(-1)	**-11.1494**	**-4.1897**	**0.000**
EXCHRK(-1)	**0.6200**	**1.2565**	**0.2089**
$\sqrt{\sigma^2}$	**-2.540**	**-0.691**	**0.489**
Constant	**8.32E+11**	**0.8312**	**0.406**
ARCH(-1)	**1.28097**	**6.9178**	**0.3587**
GARCH(-1)	**-0.96887**	**-1.1889**	**0.034**
Adj. R^2 = 0.7607	**Loglikelihood = -457.287**	**F-ratio = 46**	**0.008**

Source: Computed by Author from Regression Results.

Going by the risk return relationship measured by conditional variance of return from the quarterly data, it was realised that the results for Cameroon, Nigeria and Kenya are negative, and significant. This explains that the higher the risks, the lower the returns and vice versa. This is the indication of risk aversion. This option is rejected in South Africa and Egypt meaning that within our period of study, a large proportion of stocks was in their doldrums.

Further investigation into the volatility of the stock returns based on the GARCH explains that except in Kenya. Within our period of study, volatility is not all that sensitive to its lagged values as it might be the case with new surprises in the market. In the Nigerian and Kenyan markets, the sum of ARCH and GARCH is much closed to unity meaning that volatility in these markets is persistent. While the information on previous stock returns has no role in explaining the observed volatility in the Cameroon market, dividend yield and exchange rate especially with non CEMAC countries do.

While in Egypt and Kenya, exchange rate has no significant role for the observed volatility in the stock returns, previous stock returns and dividend yield strongly explain the existing volatility in these markets. In Nigeria as it is the case with Egypt, previous year stock returns and dividend yield in the quoted companies have some role to play in the current stock market volatility. Given these robust values of the persistent stock in South Africa (0.850), Nigeria (0.832), Egypt (0.6037) and the low value in Cameroon (0.335) and Kenya (0.316), it is therefore, observed that persistency of stock in the selected markets are directly proportional to market size, measured by the number of companies quoted in the stock market and the value of the traded stocks. These findings are consistent with those of Nyong 2005, Engel and Gonzalez-Rivera (1991). This is because based on market capitalization index, South Africa top our selected sample with US$ 469.2 billion, Egypt US$ 69.8 billion, and Nigeria with US$ 41.68 billion. In all, the results explain that volatility of stock returns in the five markets are time variant or are not weakly stationary.

5. Policy Remarks

It has been established that inefficiency exists in various degrees in our selected markets. While that of Cameroon is traced from the fact that the economy is highly centralised, commercialization, guided privatization, and liberalization of the economy is strongly recommended. For the case of Nigeria, Egypt and South African markets, maximum market size needs to be determined. Instead of creating branches of the markets in all the regions within the country, competition need to be encouraged as such more markets need to be created. For Kenya, market efficiency has not been the target within our period of study. Instead, the authorities have embarked on market performance. We recommend simultaneously, policies such as price control (inflation control), in short social welfare pages that will reduce the level of poverty thereby enhancing market performance and efficiency through subscription for investment funds by the general public.

Due to large volatility in some of the markets, investors in these markets are likely to be worse-off. Therefore, it is recommended that under such conditions, expected returns must be raised. Strategies need to be designed toward reaping abnormal returns by exploiting information and actions that enhance inefficiency in stock markets. Firms and individuals should be encouraged to buy or sell securities outside their face values, as a means of encouraging business or economic activities in the economy in question.

6. Conclusion

This study has presented empirical evidence of the efficiency and volatility of stock returns in five stock markets in Africa namely, Cameroon, Nigeria, South Africa, Egypt and Kenya. Although the markets are inefficient, there are profit opportunities in these markets. Furthermore, the rejection of the random walk hypothesis does not imply the existence of market inefficiency especially in those markets where the agents are risk averse. Therefore, in as much as stock market encourages medium for the buying and selling of secondary securities, it should also be mirrored as agents of economic development. As such, while the issue of stock volatility is a major concern, volatility of stock returns should not be seen as constraints to investment decision but as one of the risk of investment. It is certain in business that where there is high risk of investment, there is also high returns.

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