http://journals.uonbi.ac.ke/index.php/adfj
ISSN 2522-3186

Leverage Effect and Market Efficiency in selected African Stock Markets

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Abstract
This study aimed at estimating African stock markets' efficiency, using Augmented Dickey Fuller as well as investigating their leverage effects, applying the EGARCH model. Monthly All Share Indices of five selected African stock markets from 1st January, 2018 to 31st December, 2022 form the data deployed. Findings showed that all but the Casablanca Stock Exchange manifested leverage effect while all the countries' markets were weak form efficient. However, an aggregate (African) estimation of leverage effect manifested volatility clustering and asymmetry while was also in weak form of efficiency. These findings show that African stock markets lagged behind in term of maturity and capacity for competing with stock markets in developed economies.

Keywords: *Leverage, Efficiency, Volatility, Market Returns*

Introduction

In the management of every quoted company, the financing decision goes a long way in determining the company's value in the Stock Market. The decision to source funds externally has implications on the stock and health of a firm. Leverage effect theory explains that when a stock's price falls, there is a decline in the equity value but debt remains the same, causing such an organization to become riskier as well as prone to negative shocks, as a result of an increase in gearing ratio (Black, 1976). This can be explained in two broad aspects. One relates to volatility with expected returns, where expected returns tend to rise as volatility increases, thereby causing the stock price to plunge. The second explanation relates to financial leverage (level of indebtedness of corporate firms). If financial leverage increases, there is a decline in stock price, resulting in increased fluctuation of return (Aydemir, Gallmeyer & Hollifield, 2008).

Fama (1970) explains that a market can be termed efficient when share prices display in full, complete information concerning a specific stock quoted in a stock market. This is the condition where investors cannot make abnormal returns, be it through monitoring of historical price changes as done by fundamental and/or technical analysts. What differentiate the market efficiency as categorized by Fama are mainly the nature and extent of information reflected in the market for investors' strategy development. In line with Fama's (1970) seminal paper, several works carried out on efficient market hypothesis have provided evidence of its realities. However, it was Fama (1970) that laid the theoretical foundation for capital market

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efficiency, including methodologies of which efficient market hypothesis are tested. For this reason, in order to test the efficiency of a stock market using different lags, autocorrelation coefficient is tested to see how statistically significant they are (Mun, Sundaram & Yin, 2008).

For leverage effect and market efficiency, the use of information is an underlying factor. While in leverage effect information concerning the rise and fall of stock price affect such stock's volatility, with respect to market efficiency, the tendency for stock market prices to be predictable relying on information about the stocks is expected to be at zero percent. These two phenomena are necessary for any stock market to develop, attract investment and in the long-run boost the economy. However, the stock market remains a source of capital for firms in many developing countries, most of which are in Africa. More so, stock markets have been critical to the growth of emerging economies, serving as a pivot for sourcing of new funding and cheap information (Mun, et al. 2008). This makes it necessary for a good understanding of stock markets' behaviour in terms of response to information and corresponding leverage effect as well as how efficient they are.

Several empirical studies have been carried out to support or refute leverage effect in several countries (Christie, 1982; Black, 1976; Schwert, 1989). While leverage effect was confirmed (Ait-Sahalia, Fan & Li, 2013) in some European market and refuted (Caner & Onder, 2005) in others, not much has been done on African markets. The few works available, (Olowe, 1999; Smith, Jefferies & Ryoo, 2002; Osei, 2002) were conducted using the Nigerian Stock Exchange (NSE) employing the Generalized Autoregressive Conditional Heterscedasticity (GARCH). According to Nelson (1991) the use of GARCH by many researchers as a model for testing leverage effect shows meaningless result because of the negativity in volatility which GARCH cannot accommodate. Mun et.al. (2008), buttressed the restrictive nature of GARCH because of its non-negativity constraints. Furthermore, some empirical studies were conducted to validate the Efficient Market Hypothesis (EMH) but mainly in developed countries with established financial market (Lo & Mackinlay, 1988; Fama & French, 1988). Empirical literature on emerging African markets is few largely due to non-availability of data. Also, the few ones available relied on the GARCH model (Mecagni & Sourial, 1999; Olowe, 1999; Smith et.al. 2002; Osei, 2002). While acknowledging that only a few researches have been conducted to determine market efficiency in Africa, there is the issue of variations in conclusions. For this reason, the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) model was introduced by Nelson (1991) to overcome this problem.

Literature Review

Leverage Effect

Leverage Effect was mentioned for the first time in Black's (1976) work; where it was explained that when a firm's value drops, its stock experiences a resultant negative return, causing such a stock's leverage to increase. The resultant increase in stock return volatility from an upward change in financial leverage is known as Leverage Effect (Ait-Sahalia, Fan & Li, 2013). The increase in gearing ratio certainly implies an increase in the stock's volatility. Leverage can be linked to a singular economic explanation of this concept, propounded by Christie (1982) and Black (1976): when prices of asset drop, firms tend to be more leveraged because their debt value increases compared to the equity of the firm. For this reason, their stock gets riskier and volatility is increased. Though this may be a hypothesis, the interpretation is common in the documentation that the words "leverage effect" have been accepted for explaining the statistics under discussion.

Also documented is the general asymmetry of the effect (Ait-Sahalia, *et al*. 2013). The overall view is that leverage effect means that a negative return attracts greater ratio of debt-to-equity as a result of a decline in market value of the company causing an increase in its volatility. Volatility responds to greater changes such as the market value, while some statistical researches (Christie, 1982 and Black, 1976) revealed a high volatility in response to changes that are small. Notwithstanding, Black (1976) did not say anything concerning how volatility responds to positive returns. Even though positive returns lead to slight increases, they also lead to increased volatility (Cizek, Hardle & Weron, 2005). Ait-Sahalia, et al. (2013) maintain that leverage effect is the propensity for assets' volatility to respond negatively to assets' return. Ordinarily, increasing asset prices is usually followed by volatility reduction, while a reduction in asset prices leads to an increase in volatility.

Leverage Effect and Stock Market Return

Studies on stock market's response to information, the use of such information as well as the subsequent degree of changes in stock return are necessary for understanding capital market behaviour. Volatility estimates the rate of changes of the equity's current price, compared to its past mean values (Uyaebo, Atoi & Usman., 2015). This volatility, when caused by a firm's increase in leverage is termed "Leverage Effect". However, Ait-Sahalia *et al*. (2013) are of the view that this magnitude (entire market) of the effect appears too voluminous to be responsible primarily for the financial leverage increase. Also, Figlewski and Wang

(2000) postulate that there is apparently no effect on volatility if there is change in leverage as a result of change of debt value or shares' price. Making it doubtful to conclude that volatility has anything to do with financial leverage. Notwithstanding, Black's (1976) explanation points to the fact that, it is actually a decline in a company's stock value that can induce a negative return, resulting in a rise of its leverage and subsequent increase in financial leverage. In this situation, equity owners view the company to be getting riskier in terms of cash flow, so the volatility gets even higher (Ajayi & Nageri, 2016). Therefore, Leverage Effect entails the negative relationship between volatility and stock return – there is a rise in stock volatility when stock prices decline. This implies that Leverage Effect can be given two different interpretations. One correlates volatility with expected returns, where expected returns tend to rise as volatility increases, thereby, causes the stock price to plunge. Another explanation relies on financial leverage. If financial leverage increases, there is a decline in stock price, resulting in increased stock return volatility (Aydemir *et al*., 2008).

Volatility

Volatility is an estimation of variation in the distribution of a return. Measured by estimating the conditional variance's square root based on available information about the future (Schwert, 1990). Usually, when financial data are plotted, there tend to be clusters of large and small changes. The above trend manifested for the first time in Mandelbrot (1963) and Fama (1965) works and reiterated by Schwert (1989) and Chou (1988). What volatility clustering means is that future volatility is triggered by present day's volatility shocks. Notwithstanding, observation has shown that equal negative and positive shocks do not result in equal volatility. The negative shocks manifest greater volatility than the positive shocks. It implies that negative and positive returns have asymmetric effects on volatility. These were discoveries made first in the work of Black (1976).

Leverage effect proposes that fluctuations in the prices of stock respond negatively to volatility changes. Ait-Sahalia *et al*. (2013) reflected the inverse relation between equity returns and volatility. There is the same asymmetrical reaction of volatility to bad news and good news in the work of He, Li & Wang (2016). Majority of Financial experts are of the opinion that volatility is mean reverting in nature. A good example is Engle and Patton (2001) description of volatility's mean reversion nature which declared that there is a known normalcy level at which volatility is expected to come to a rest. Prolonged forecast of volatility would eventually come to a rest at a normal level but would not be influenced by current information.

Market Efficiency

Empirical researches on efficient market hypothesis are numerous, from which assertions were reached that the prices of stock in the market are expected to reflect the underlying assets' intrinsic value. Fama (1970), explained that the reflection of all available information in the prices of stock in a given market is a condition to declare it efficient. It implies that investors do not have the opportunities to make abnormal gains arising from the study of previous years' price movements and economic fundamentals except by chance. If there is efficiency in the commodity and asset markets, there will be a resultant efficiency in the allocation of resources by the economic agents. More so, in emerging markets, efficiency is of great importance. This is so because efficiency is a reflection of liquidity in such a market. It also indicates that there are no institutional restrictions and the information provided in the markets is enhanced.

The difference in the market efficiency categorization is typically in the types of information provided for investment decisions. In this study, attention is given to the weak-form of the efficient market hypothesis. This is because a test for the Semi-strong and Strong form can only be necessary when a market has passed the weak-form, (Wong & Kwong, 1984). EMH proposes that when the historical price movements of securities are reflected in their current prices, then there is weak-form market efficiency. According to McInish and Puglisi (1982), the random fluctuation of stock price is an adequate condition for weak-form efficiency. Therefore, a market is weak-form efficient when prices of stock toe random walk. Since capital markets are efficient in the weak-form, investors cannot rely on historical price movements to make abnormal gain. Thus, stock returns are unpredictable, so technical analysts' effort to study patterns of past price movements is futile.

Leverage Effect and Market Efficiency

The knowledge that there are opportunities to make profits from stock assumed to be overvalued or undervalued is a stimulating factor for investors to deal on stock and this is the reason for prices' movement (Ajayi & Nageri, 2016) and Ayramor, Goyal & Chordi (2006). This reliance on information stimulates the buying behavior of investors and consequently the price changes, the degree of volatility of such a market and its efficiency over time. Hentschel (1995) is of the opinion that investors are likely to pay a reduced price for equities with higher volatility, since this implies a higher risk where return is also threatened. The volatility of a stock Market has generated some innovative theories, which is supported by sufficient empirical evidence, to explain what leads to speculative markets fluctuation in prices. This opposes the

model for standard efficient markets in the explanation of prices of asset by laying emphasis on the vital responsibility played by psychology or popular opinion in volatility (Shiller, 1990). This model of popular opinion is an empirical evaluation of price fluctuations resulting from the ability of the investors to rely on their psychological belief rather than make sound judgment in the light of available information. However, this model is not an outright neglect of the Fama (1970) postulation, rather it proposes that investors' disposition is necessary for the determination of price as well as the volatility the market and the EMH may not provide the full explanation.

Empirical Literature Review

Several research works have attempted to measure leverage effect in stock markets. Different statistical tools were deployed for this purpose and the results thereof showed variety of findings.

Yeh and Lee (2000) investigated how investors respond to unexpected returns and information transmission in the stock markets of greater China area using data from May 22, 1992 to August 27, 1996 and the TGARCH model. It was found that there is asymmetric volatility in Taiwan and Hong Kong stock market, while reverse is the case in the Shanghai and Shenzhen markets. Lee, Chen and Rui (2001) evaluated time series features of China Stock returns from January, 1992 to December, 1997 by employing the Variance Ratio Test, GARCH, GARCH-M and EGARCH. It was observed that random walk hypothesis was absent with strong evidence of time-varying volatility, leverage effect and volatility persistence.

Jayasuriya (2002) tested the impact liberalization of stock market has on stock return volatility. Fifteen emerging stock markets including Nigeria were considered from December 1984 to March 2000 using asymmetric GARCH model. The result showed that positive changes in prices were followed by similar changes. According to the result, the Nigerian Stock Exchange manifested business cycle behaviour than volatility clustering behaviour. Okpara and Nwezeaku (2009) collected data between 1996 and 2005 of forty-one randomly selected firms from Nigerian Stock Exchange to estimate the effect of the idiosyncratic risk and beta risk on returns applying EGARCH model. The study concludes that less volatility persistence and showed the NSE to manifest asymmetric volatility.

Ibiwoye and Dallah (2010) evaluated daily returns of twenty-six (26) insurance firms in the Nigerian Stock Exchange for volatility between 15th December, 2000 and 9th June, 2008. After using ARCH (1), GARCH

(1, 1) TARCH (1, 1) and EGARCH (1, 1), it was revealed that EGARCH is the most suitable model for volatility estimation of returns as it performs better than other models when used for volatility forecasting. Olweny and Omondi (2011) in an effort to determine what effect macroeconomic factors have on volatility in the Kenya stock market return used EGARCH and TGARCH models. Macroeconomics variables monthly data were considered from January 2001 and December 2010. The result showed the returns to be symmetric and volatility in the Kenya stock market is affected by all macroeconomics variables considered.

Kambadza and Chinzara (2012) measured the relationship between stock returns and volatility in eight African stock market (Ghana, Mauritius, Nigeria, Egypt Namibia, Morocco, South Africa and Kenya) between January 31, 2000 and July 28, 2010. Three GARCH models were used for the estimation of the markets. It showed that there were partial returns and volatility interactions among the markets. Al- Hasan and Gupta (2013) studied the impact of leverage on EPS. Seven listed firms were selected from each four industries in Bangladesh stock market form January 2005 to December, 2009. The study findings show that there is significant relationship between leverage and EPS. Therefore, effective management of leverage can maximize shareholders' returns.

Volatility clustering was tested for its existence in the Nigerian Stock Exchange by Osazevbaru (2014). Share prices of listed firms from 1995 to 2009 were estimated using Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models. The NSE was discovered to manifests volatility clustering. However, trading of wider range securities was suggested to engender increased market depth and consequently reduce volatility. Long, Tsui and Zhang (2014) investigated leverage effect on the mainland Chinese stock market with monthly data from January, 2000 to December, 2013. The result indicated that there is significant leverage effect in the markets during the period. Coffie (2015) studied volatility asymmetric with GARCH models for Ghana (from January, 1996 to December, 2013) and Nigeria (January, 1995 to December, 2013) stock market returns.

Samuels and Yacout (1981) reached the conclusion that weak-form efficient market cannot be rejected after testing with 21 listed companies in the Nigerian stock market between 1977 and 1979. Dickinson and Muragu (1994) also tested with thirty (30) listed stocks in Kenya stock market and found that most of these stocks price movement were random and conform to conditions for weak-form EMH. Also, Olowe (1999)

after using the monthly returns of fifty-nine (59) listed stocks on the Nigerian Stock Exchange to check for Random walk concludes that the market is efficient in weak-form. Smith, Jeffersis and Ryoo (2002), using multiple variance-ratio, tested for random walk hypothesis in the Stock Markets of South Africa, Kenya, Botswana, Morocco, Egypt, Nigeria, Zimbabwe, and Mauritius. Aside the JSE (South Africa), the listed stock markets did not pass weak-form efficiency test.

Using partial-auto correlation test, Magnusson and Wydick (2002) applied monthly returns from 1989 to 1998 to examine the capital markets of Nigeria, Botswana, Zimbabwe, Cote d'Ivoire, Kenya, Ghana, South Africa and Mauritius. It was found that Ghana as well as Zimbabwe were the only markets not weak-form efficient. In Jeffersis and Smith (2005) latter work, GARCH model was used to estimate serial-dependence using weekly indices for the exact set of stock market between 1990 and 2001. Only the JSE showed weak-form market efficiency based on the outcome. Mun et al (2008) estimated leverage effect and market efficiency using the Malaysian stock market and its efficiency using weekly Kuala Lumpur Composite Index (KLCI) from 9 January 2004 to 8 Jun 2007. EGARCH and the Augmented Dickey-Fuller (ADF) were developed, respectively. Results show that the EGARCH model did not confirm the existence of the leverage effect but the KLCI possess a unit root with no trend but with drift which indicates that KLCI is efficient in the weak form. Okpara (2011) evaluated data from the Nigerian Stock Exchange between January, 1984 and December, 2006 for random walk using the GARCH model. The outcome of study showed the Nigerian Stock Exchange to follows a random walk which indicated it to be weak form efficient.

Afego (2012) tested the weak-form efficiency of the Nigerian Stock Exchange (NSE) by using data of monthly index returns ranging from 1984 to 2009. The non-parametric runs test results revealed the NSE to display elements of predictability which implies that chartists can earn abnormal gains by monitoring market trends. Gimba (2012) investigated the Nigerian Stock Exchange for efficient market hypothesis using both daily and weekly indices of five (5) of oldest banks in Nigeria from January 2007 to December, 2009 for the daily indices and June, 2005 to December, 2009 for weekly. The result revealed the presence of autocorrelation in the series, implying that the Nigerian capital market is not weak-form efficient. Using data of Analysis of all-price-index (API) of listed firms in the Nigerian Stock Exchange between January 2000 and December 2012, Nwidobie (2014) tested the random walk in Nigeria with the Augmented Dickey-Fuller (ADF) test. The result shows that movement of price in the NSE does not follow random walk as proposed by Fama (1965). It all implied that there is no efficiency in resources allocation. Obayagbona and

Igbinosa (2014) used Nigerian Stock Exchange (NSE) data of daily stock prices and returns from January 2006 to December 2011 to test for weak-form efficiency in the Nigerian emerging market. The three tests of randomness were used to check for autocorrelation. The result revealed that both returns and stock prices showed significant dependence, implying that the market is not weak-form efficient during the period.

Though studies in Asian market test the various GARCH model, there was no effort made to assess the propriety of these models. An estimation of the significant effect risk has on expected return and the various other areas in which GARCH models are applied makes it important in the finance world. Such applications include but not limited to portfolio selection, asset pricing and risk management. For the above reasons, this research attempts to add to existing literature by assessing the behaviour of assets and return series in African stock markets and at the same time evaluate the adequacy of the EGARCH models. Furthermore, studies on Random Walk Hypothesis (RWH) have been carried out by several scholars to test the efficiency of stock market around the world. Usually, the test for RWH is to estimates the future stock returns based on its lagged values from which it can be adjudged whether the market is efficient or not, this study hence, examine the RWH as well as the Efficient Market Hypothesis for selected stock markets in Africa.

Methodology

This study adopts the *ex post facto* research design because it uses historical (existing) data of monthly Indices and uses the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) model to investigate the existence of leverage effect in five selected African Stock Markets: Nigerian Exchange Group Limited, Kenyan Stock Market, Casablanca Stock Exchange, Stock Exchange of Mauritius, and Johannesburg Stock Market purposively selected based on the market size (capitalization) and regional geographical location in the continent. . The EGARCH is adopted because of its fitness to surmount the non-negative constraints. The prices covering the sampled period from 1stJanuary, 2018 to 31st December, 2022 were deployed with the EGARCH as specified in model equation I in the estimation of leverage effect. The All-Share Indexes of the various markets are converted to returns to assess weak-form of market efficiency. Data for selected markets were analyzed for each market first to test the uniqueness of leverage effect and markets efficiency, followed by a general test for the five selected markets combined for the purpose of effective generalization. Leverage effect were being measured in the Africa Stock Markets using the software to run the EGARCH model. Also, the Augmented Dickey-Fuller (ADF) test was conducted using the Natural logarithms of African Stock Market monthly indices for the sampled

period for the purpose of identifying the presence or otherwise of Random Walk drifts and market efficiency.

Model Specification

Leverage Effect: As earlier mentioned, the EGARCH is used due to its ability to capture asymmetry, as it connects with volatility changes and stock return. Meanwhile, EGARCH (1, 1, and 1) is considered appropriate and hereby chosen.

$$\text{In}h_t^2 = w + \beta In\sigma_1^2 + \delta \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad \text{(I)}$$

Where h_t representsmarket risk.

w connotes the intercept of the variance.

β connotes the coefficient of the logged term of GARCH

$ln(\sigma_{t-1}^2)$ represents the logged GARCH term**.**

γ stands for the scale of the volatility asymmetry, it is also called gamme and is the leverage effect or helps to determine the leverage effect.

$\sigma_t$conditional standard deviation at *t*.

ε_t are the standardized residuals.

$\delta$is the parameter of the ARCH component model.

$\gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$**:** represents the standardized last period's shock

When γ is positive, it implies that there is no leverage effect. Conversely, should γ be negative, it is then confirmed that there is asymmetry. The presence of δ is mainly to accommodate the negative values to overcome the inherent constraint of financial time series.

***Weak form hypothesis*:** The weak form of Efficient Market Hypothesis model is given below

$$R_t = \alpha + \mu_t \quad \text{(II)}$$

The expression $R_t$is the result of subtracting two successive logarithmic of price indices

$$InP_t = \alpha + InP_{t-1} + \xi_t \quad \text{(III)}$$

The Augmented Dickey-Fuller test (ADF) test is employed to solve the problem of autocorrelation in ξ_t, equation III can be tested as shown below

$$\Delta P_t = \beta_2 T + \lambda P_{t-1} + \tau_i \Sigma \Delta \text{P}_{t-1} + \mu_t \quad \text{(IV)}$$

Where $\alpha$is a constant.

β the coefficient on a time trend.

p the lag order of the autoregressive process.

So T represents trend. For the performance of the ADF test, m(lag length) is chosen so as to free the error term, $\mu_t$from autocorrelation. The Akaike Information Criterion is used for the purpose of checking the level of significance of the lag length

Measurement of Variables: This study is conducted using secondary data, sourced from the official websites of the respective stock markets. The data is made up of monthly market indices in the various selected stock markets (represented with ASI). The data is restructured into a continuous time series of compounded percentage return, with the equation;

$$r_t = \log\left(\frac{ASI_t - ASI_{t-1}}{ASI_{t-1}}\right) \times 100 \quad \text{(V)}$$

Where ASI_t is the All-share index on t-th month and $ASI_{t-1}$is the All-share index of the month preceding the t-th month.

Findings and Discussions

Descriptive Statistics

For the purpose of robustness, residual based tests were used along with the traditional ARCH effect test to check for volatility as indicated in Table 1 and 2, respectively. The residual based tests show the presence of volatility clustering as seen in all the countries as well as Africa between 2016 and 2020.

Table I: Heteroskedasticity Test (ARCH effect)

Heteroskedasticity Test **Null Hypothesis: No ARCH Effect**				
Market	**F-Stat**	**Obs-squared**	**Prob**	**Decision**
South Africa	7.66	7.22	0.00**	Reject
Nigeria	549.60	81.25	0.00**	Reject
Kenya	349.55	75.0	0.00**	Reject
Morocco	440.76	78.44	0.00**	Reject
Mauritius	350.3	75.0	0.00**	Reject
Market Aggregate	215.56	66.36	0.00**	Reject

The traditional ARCH effect test in Table 1 buttresses the revelation of the residual based tests. It is found that the Chi-squared value is high while the probability is lower than the alpha value of 0.05, leading to a rejection of all null hypotheses of no ARCH effect. These imply that there is ARCH effect in each country's

market return, culminating to the aggregate (African) market. The presence of volatility clustering then paves way for the performance of the EGARCH to determine the level of volatility in each market including the aggregate market.

Leverage Effect Estimation (E-GARCH)

In view of the confirmation of volatility clustering in each of the market returns as well as the aggregate African market, EGARCH estimation is conducted to verify the level of volatility in the markets being investigated.

Nigeria Exchange Group: In Table 2, The ARCH term for Nigeria Market has a probability value of 0.47. This means that the size of shock has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.03 is significant at 0.05 level. The GARCH effect has probability value of 0.0000. Therefore, past volatility helps predict future volatility. Again, the coefficient of the ARCH term is positive. This indicates a positive relationship between the past variance and the current variance in absolute value. This means that the bigger the magnitude of the shock, the higher the volatility. The leverage effect value is negative. The result here reiterates the study by Coffie (2015) on volatility asymmetric with GARCH models in Nigeria (1995 to 2013) stock market returns.

***Johannesburg Stock Exchange*:** With reference to Table 2, the South Africa Market ARCH term has a probability value of 0.28 which indicates that the size of shock has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.03 is significant at 0.05 level. The GARCH effect has probability value of 0.0000. Therefore, past volatility helps predict future volatility. Again, the coefficient of the ARCH term is positive. This shows a direct relationship between the past variance and the current variance in absolute value. This means that the bigger the magnitude of the shock, the higher the volatility. The leverage effect value is negative. Emenike (2018) holds same position as this study with his research on stock market volatility clustering and asymmetry in Africa.

***Kenya Stock Market*:** Referencing Table 2, the Kenyan Stock Market ARCH term has a probability value of 0.54. This means that the size of shock has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.00 is significant at 0.01 level. So, shocks have impact on volatility of the returns. The GARCH effect has probability value of 0.85. However, the coefficient of

the ARCH term is negative. This indicates a negative relationship between the past variance and the current variance in absolute value. That is, the bigger the magnitude of the shock, the lower the volatility. The leverage effect value is negative.

***Casablanca Stock Exchange*:** In Table 2, The ARCH term for Morocco Market has a probability value of 0.24. This means that the size of shock has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.53 is not significant. So, shocks have no impact on volatility of the returns. The GARCH effect has probability value of 0.511. Therefore, past volatility cannot predict future volatility. Again, the coefficient of the ARCH term is positive. This indicates a positive relationship between the past variance and the current variance in absolute value. This means that the bigger the magnitude of the shock, the higher the volatility. The leverage effect value is positive. This implies that bad news will not necessarily increase volatility more than good news of the same size – no evidence of leverage effect. This is not consistent with the findings of Emenike (2018) which means that the Casablanca Stock Market exhibits volatility clustering.

***Stock Exchange of Mauritius*:** In Table 2, The ARCH term for Mauritius Market has a probability value of 0.00. This means that the size of shock has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.00 is significant at 0.01 level. So, shocks have impact on volatility of the returns. The GARCH effect has probability value of 0.0000. Therefore, past volatility helps predict future volatility. Again, the coefficient of the ARCH term is negative. This indicates a negative relationship between the past variance and the current variance in absolute value. This means that the bigger the magnitude of the shock, the lower the volatility. The leverage effect value is negative. This implies that bad news will increase volatility more than good news of the same size – evidence of leverage effect. This is not exactly consistent with study by Agathee (2009) which concluded that although the Stock Exchange of Mauritius did not manifest volatility clustering, there was evidence of volatility asymmetry.

***African (aggregate) Market*:** Although only the Morocco market manifested no presence of volatility, this did not affect the aggregate African market because earlier tests had led to the decision to conduct the EGARCH. In Table 2, the ARCH term for the Aggregate Market has a probability value of 0.25. This means that the size of shock in the African Market has a significant impact on the volatility of the market returns. Also, the leverage effect with a probability value of 0.05 is significant at 0.05 level. So, shocks have impact

on volatility of the returns. The GARCH effect has probability value of 0.0000. Therefore, past volatility helps predict future volatility. Meanwhile, the coefficient of the ARCH term is positive. This indicates a positive relationship between the past variance and the current variance in absolute value. This means that the bigger the magnitude of the shock, the higher the volatility in African Market. The leverage effect value is negative. This implies that bad news will increase volatility more than good news of the same size – evidence of leverage effect. This buttresses similar research by Emenike (2018) which concluded that African markets returns exhibit volatility clustering, persistence and asymmetry.

Table 2: Summary of E-GARCH Estimate

Method: ML ARCH-Normal Distribution						
Parameters	Nigeria	South Africa	Kenya	Morocco	Mauritius	Market Aggregate
ω	0.39 (0.22)	0.23 (0.60)	3.69 (0.00)	3.50 (0.03)	-5.21 (0.00)	0.28 (0.25)
δ	0.17 (0.47)	0.37 (0.28)	-0.16 (0.54)	0.26 (0.24)	-0.37 (0.00)	0.19 (0.26)
γ	-0.22 (0.03)*	-0.40 (0.03)*	-0.80 (0.00)**	0.09 (0.53)	-0.17 (0.00)*	-0.21 (0.05)*
β	0.85 (0.00)**	0.79 (0.00)**	-0.04 (0.85)	-0.38 (0.511)	-1.01 (0.00)	0.84 (0.00)**

Source: Authors computation (2023)
*NB: * and ** signify significance at 5% and 1% respectively.*
Where:
ω = Intercept (constant) *γ = Asymmetric term (leverage effect)*
β = GARCH term *δ = ARCH ter*

Market Efficiency Estimation (Augmented Dickey Fuller)

As earlier noted by Fama (1970), a market is efficient when share prices reflect in full, information relating to a specific stock quoted in a stock market. In view, prices of stock in such a market follow a random walk. This implies that a time series plotted with data of such a market is not expected to possess any form of trend or pattern. The Augment Dickey Fuller estimates the presence of a unit root in a time series sample (market return). It investigates stationarity in a time series using the natural logarithm of the values. The presence of stationarity in a time series suggests predictability which negates the underlying principles of efficient market hypothesis. The results from Table 3 indicate that all the markets as well as the aggregate African market manifest market efficiency in the weak form as evident in their non-stationarity. This counters the work of Nwidobie (2014), which tested the Nigerian Stock Exchange between January 2000 and December 2012, for random walk using the Augmented Dickey-Fuller (ADF) test. The result shows that movement of price in the NSE did not follow random walk as proposed by Fama (1965). Same can be

said about the test by Smith, Jeffersis and Ryoo (2002), which tested for random walk hypothesis in the Stock Markets of South Africa, Kenya, Botswana, Morocco, Egypt, Nigeria, Zimbabwe, and Mauritius, wherein only the JSE (South Africa) passed weak-form efficiency test.

Table 3: Analysis of Market Efficiency

Market	**Augmented Dickey Fuller (ADF) At Levels**		**Remark**
	Intercept	**Trend & intercept**	
Nigeria	-1.16 (0.68)	-1.06 (0.92)	Non-stationary
South Africa	-0.29 (0.92)	-1.70 (0.74)	Non-stationary
Kenya	-0.65 (0.85)	-1.96 (0.61)	Non-stationary
Mauritius	-2.35 (0.15)	-2.45 (0.35)	Non-stationary
Morocco	-1.24 (0.65)	-2.93 (0.15)	Non-stationary
Market Aggregate			
	-2.30 (0.17)	-1.00 (0.93)	Non-stationary
ADF Statistics (intercept)		**ADF statistics (Trend & Intercept)**	
1%	*-3.50*	*-4.05*	
5%	*-2.892*	*-3.45*	
10%	*-2.58*	*-3.15*	

Values in parentheses are probability values.

The African Stock Market, based on the findings of this study do not only manifest leverage effect but they are also weak-form efficient. This is based on the results as shown in Tables 2 and 3, respectively. The EGARCH estimation showed a negative leverage effect value of the aggregate (African) market and non-stationary of the aggregate (African) market using the Augmented Dickey Fuller tests. The results thereof can form a guide for quoted companies in Africa while formulating financing decision, especially those intending to go public. The gearing policy of quoted companies in these African markets can be guided on the basis of the outcomes of this research. As earlier noted, a high gearing ratio in a market that manifests leverage effect leads to high volatility and causes the company to be riskier. Also, an efficient market attracts investment. This implies that African markets will attract more investors, as this study also exposes foreign investors to the nature of the African Stock Markets in terms of when and which market to invest

in. It may serve as a guide for investors who wish to re-balance their investment mix and hedge against unexpected losses.

The study's findings corroborate the conclusion of Okpara and Nwezeaku (2009) study between 1996 and 2005 of forty-one randomly selected firms from Nigerian Exchange Group Limited to estimate the impact of systematic risk on returns applying EGARCH model. The result shows less volatility persistence and showed the NSE to manifest asymmetric volatility which means the effect of bad news is greater than that of good news of equal magnitude. The results also indicate that although the CSE does not manifest leverage effect, the rest of the markets and the aggregate market reflect leverage effect. This may be attributed to the size and development stage of CSE. This could imply that appropriate policies are not being executed to harness the growth potential of the CSE and vice versa for the rest of the sampled countries. On the other hand, according to the results, all the sampled countries are weak form efficient, and these translate to a weak form efficient African market. The implication is that these markets cannot be predicted and no investor can make abnormal returns.

Conclusions and Recommendations

Much effort has been made to establish if leverage effect actually exist in African stock markets and determine their efficiency. This informed the estimation of their individual leverage effect and market efficiency before aggregate returns of the markets were used for Africa. Having in mind that foreign direct investments can intermediate between desired investment and savings in an economy, the need for investors worldwide to have knowledge of the African stock markets in terms of leverage effect and market efficiency cannot be overemphasized. In view, regulatory authorities must put in place different policies to develop stock markets and engender leverage effect and market efficiency. Many developed and developing economies have taken key advantage of similar empirical investigation in order to propagate their stock markets to the world and by so doing, attract investors. It is against this, that foreign capital flow and stock market are expected to enhance growth through their joint role in the accumulation and redistribution of capital.

This research will benefit policy makers and Regulatory institutions, as it reveals the nature of the markets under study in terms of leverage effect and market efficiency and guide them to take corrective steps where necessary. They can better appreciate the state of their market and institute in-depth inquiries. Such inquiries

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would reveal the exact cause(s) of such a market's inefficiency or high leverage effect, as the case may be. These then guide the decision as to whether stiffer or more relaxed conditions are to be emplaced in the markets.

Market regulators and policy makers should make appropriate policies aimed at strengthening stock markets in terms of breadth and depth to attract capital inflows in term of investment, as this form of capital has been seen to intermediate between investment and levels of savings. Financial systems must be adequately capitalized and deepened so as to accommodate bulk of funds streaming in from abroad through trade openness.

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