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Test of existence of Long-term Memory in Stock Market Returns at Nairobi Securities Exchange

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Abstract

Long term memory in stock market returns has received considerable attention among academicians and finance practitioners. This paper explores the applicability of Fractal market hypothesis and Chaos theory in explaining market behaviour. The rationale of both theories that markets patterns can be studied for the possibility of predictability of returns to inform investment decisions motivated this research subject. The study embarked on the objective to test for existence of long range dependence in stock market returns in Nairobi securities exchange. Based on the fact that post automation the market is expected to have improved efficiency. The study employed a non-parametric test; classical rescaled range analysis to examine long term memory which is measured by the Hurst exponent developed by Hurst (1951). The stock market returns were considered using secondary data. The daily NSE-20 share index was collected for a period of eight years from January 2010 to December 2017.A longitudinal research design was employed for the research. The data was analyzed using E-views financial software. The results show that there is long term memory in stock market returns in NSE with an H-value of 0.7 from the rescaled range analysis. It is further observed that market returns are not normally distributed for the test of normality with a negative skewness of -0.067 and the autocorrelation denoted by P-value <0.05 showing the market does not follow a random which actually invalidates the efficient market hypothesis. This indicates that there exists a chance to predict market returns and make above market profits. The research recommends factoring in long term memory properties in investment decisions.

Keywords: *Long-Term Memory, Stock Market Returns, Securities Exchange*

Introduction

A proper functioning market and its ability to provide efficient allocation of resources for development is the focal point of modern finance. Globalization and market integration has attracted a significant number of investors to emerging markets and especially African stock markets (Sugimoto, Matsuki & Yoshida, 2014). The key attraction being better returns compared to developed markets where the level of efficiency erodes arbitrage opportunities (Hull & Mc Groarty, 2014). Given that the NSE has experienced both bullish and bearish swings in the recent past, investors are keen to find arbitrage opportunities amidst the cycles (Ogega, 2014). The desire of high returns has prompted market participants to employ technical trading techniques in a bid to achieve higher returns. In Kenya, there is lack of general consensus among researchers on whether NSE is weak form efficient or in efficient. For instance, Anyumba, (2010) finds evidence in favour of weak form efficiency while Njuguna, (2016) against weak form efficiency. In this regard, there seems to be an existent a chance to predict returns.

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According to EMH, informational efficiency is achieved if securities prices display all the available information, Fama (1965). This implies a random walk in stock prices i.e. each change in price is completely independent of previous price. Lo (1991), asserts that when stock returns have strong long range dependence properties they fail to portray a truly random walk process. Mandelbrot (1971) proposes that if long memory properties exist in asset returns then new information is not immediately portrayed in prices and events in the remote past are correlated with events in the foreseeable future. This could be due to limits to arbitrage, irrationality and illiquidity among other factors. It's not surprising that alternative models such as Chaos theory and Fractal Market Hypothesis (FMH) have emerged to better explain the behaviour of stock returns. According to Chaos theory, financial markets are complex and dynamic which cannot be easily modelled by linear models of EMH. The complexity may stem from heterogeneous expectations by investors who are not fully rational, that is, they apply available information differently, invest at different investment horizons and react gradually to information (Peters, 1994). The Fractal market hypothesis attempts to put structure on Chaos theory. FMH considers liquidity and investment horizon to be crucial for market stability. Prices changes in the market occur due to differences in interpretation of the same information by investors (Nyamute, Oloko, & Lishenga, 2017).

Nairobi securities exchange has undergone several reforms in the last decade which have attracted significant number of foreign investors with a participation of 65% in the market at the end of 2017(NSE, 2017). This raises the questions whether there opportunities of making above market returns which could indicate presence of market anomalies such as Long term memory. Barkoulas et al, (2000) suggests that Long range dependence in asset market prices contradicts the weak form of EMH. In addition, market returns in developing markets tend to have nonlinear behaviour and this is attributed to the fact that investors have a degree of irrationality and the influence of speculators may drive prices off the equilibrium (Saadi, Gandhi & Dutta (2006).Given this background this study seeks to determine whether long term memory exists in Nairobi Securities Exchange.

Long Term Memory

Long term memory or Long range dependence can be defined as events in the distant past being highly correlated with events in the foreseeable future (Lo, 1991). Cajuerior and Tabak, (2010) describes long range dependence in stock returns to be a stylized fact. Mandelbrot (1971), was among the first to study Long term memory and used Hurst 'rescaled range 'statistics to examine Long memory behaviour in stock

market returns. Mandelbrot &Wallis (1968) coined the term the 'Joseph Effect' referring to a prophet in the bible who foretold a cycle of seven years of plenty would precede seven years of famine. In a time series data, this implies events happening in the present have an impact on events that will happen in the future i.e. infinite memory.

There several methods that can be used to measure long range dependence in time series data. These methods can be grouped into parametric, semi-parametric and non-parametric. The parametric methods which are linear in nature include AFRIMA. The semi-parametric are like Wavelet method which was introduced by Jensen (1999) but works better in combination with other methods and lastly the non-parametric approach are the classical Rescaled range analysis and Modified rescaled range analysis developed by Lo (1989).There is no consensus among researchers on the best method to use to examine long term memory.

Stock Market Returns

Stock markets returns as defined by Alagidede and Panagiotidis, (2010) are a reflection of cash flow valuations into the future. Basically, investors are driven by profit and returns are the compensation expected from investment. According to Wang, (2012) Stock market returns indicate how much profit/loss a company is making and investors realise positive returns in form of capital gains and dividends. Hamrita and Trifi, (2011) defines returns as economic and financial signal of development in a country in current and future state.

Individuals or institutional investors consider several factors in purchase of stocks such as price earnings ratios, the return on equity, and the earnings per share and governance structure among other factors (Wang, 2012). In addition, markets are expected to be efficient and information available to all market participants. This is not always the case, proponents of behavioural finance emphasize that investors are normal and make decisions at times based on emotions, market trends and how they perceive the effect of the new information (Stanman, 2014).

As a collection of returns from different companies in different sectors in the economy that are listed in stock exchange, an index is used to give measure of market performance. Stock exchange index is the weighted average of selected stocks of companies listed in Stock market the selection is based on

capitalization, outstanding company performance among other variables (Daferighe & Sunday, 2012.). The NSE has three market indices which are calculated from the 64 listed companies for Trading. The three indices are the NSE-20 Share index which is derived from weighted prices, the NSE-25 Share index which is a recent addition that is arrived at by calculating the weighted market capitalization of the 25 companies reviewed and NSE All Share Index (NASI) the weighted market capitalization of all listed companies The indices are reviewed periodically in line with world best practices to capture the accurate market performance (NSE, 2017).

Literature Review

Efficient Market Hypothesis (EMH)

An efficient market is one whereby the prices of securities are reflective of the available information according to Fama, (1965) who is the originator of Efficient Market Hypothesis. EMH categorises market efficiency into three with respect to information available, that is, weak- form, semi- strong, and strong-form of efficiency. In weak form, all market prices bear all historical news on stock prices and arbitrage approaches cannot be employed to beat the market. The semi-strong EMH suggests that the current asset prices incorporate all public information and investors cannot make above average risk adjusted returns (Fama, 1970). Finally, the strong form holds prices reflect all information, both private and public information (inside information).The implication is that company insiders cannot consistently derive above-average risk adjusted returns.

In a nutshell, EMH holds that investors make rational decisions while markets are efficient and investors cannot make above average returns (Lo, 1991). Anomalies in the market like Calendar effect, Days of the Week and January effect invalidate EMH. The presence of long term memory in financial data implies that stock market do not immediately reflect new information as assumed by EMH (Peters, 1994). Peter's conclusion is further backed by Armachie, (2017) who also using the R/S test observed evidence of long range dependence in Ghanaian stock exchange both in the squared and absolute returns tested. This relates to this study because it forms the basis upon which efficiency in related to long term memory.

Determinants of Stock Market Returns

Company News

Company news is a factor that affects stock market returns because the news concerning company performance is paramount to investors. Sometimes the news could be genuine news or rumours. Good news and bad news receive shareholders reaction in their buy and sell decisions. The profits made by the company affects dividend payments and given that return can be in form of capital gains and dividends; this influences the buy, hold or sells moves (Wang, 2012). Changes in management in company's especially key positions like Chief executive officer can be perceived positively or negatively by investors. This definitely affects share price movements as market participants react to the news. Aduda and Chemarum, (2010) found evidence of abnormal returns in NSE after earnings announcement by companies.

Industry Performance

Industry performance affects stocks prices in the sense that companies in the same industry are prone to the same challenges and mostly likely are affected in the same way by changes in the industry for instance legislative requirements (Otieno, 2017). However, in certain instances one company may thrive when a competitor in the same industry is facing a down fall and this makes investing in such a company more profitable to investors. On the other hand investors in the company facing difficulties may experience share dummying in the market and this affects the price at the end of the day. Layoffs for instance what happened in Kenya's banking industry between years 2016-2017 may cause investors to shy away from buying from those counters yet not all listed banks laid off their staff (Mbua, 2017).

Investor's Confidence

Investor's confidence can cause price volatility in the market as they react to arrival of information. A bullish market receives over reaction to good news and bearish market conditions receive over reaction to bad news. For instance Sinha, (2016) found evidence of under reaction to news among large cap stocks in New York stock returns. Strong market conditions attract investors and improve on their confidence and market activities while weak market conditions turn investors to pessimistic modes and dampen their confidence this happens especially in periods of high inflation, unemployment and financial crisis like GFC (Otieno, 2017).

Economic and Political Stability

Economic and Political stability in a country has an impact on stock returns. When a country has high interest rates the cost of capital goes up and companies have to pay more when they acquire credit from

financial institutions and this affects their profits (Ogega, 2014).Given that investors analyze stocks to buy based on measures such as earning per share, return on investment among other variables, then in such instances the economy has a negative impact on returns. Political instability affects development and in turn the stock market and puts investors off. This is evidenced in market index during the post election violence in Kenya (2007) when the NSE 20 share index was its lowest (Waithiru, 2015).

Empirical Literature

Oprean and Tanasescu, (2013) studied the application of chaos theory and fractal theory in 8 emerging markets which are: India, Romania, China, Russia, Brazil, Czech Republic, Hungary and Estonia. The study employed rescaled range analysis in investigating presences of long term memory and concluded with Hurst exponents of 0.5 and above which is consistent with long range dependence presence asset returns. The study also found the indices daily returns portrayed persistent behaviour that invalidates EMH.

Consequently, Hull and McGroarty, (2014) used Hurst–Mandelbrot–Wallis rescaled range i.e. classical rescaled analysis in testing whether emerging markets become efficient over time and long memory persistence. They sampled 22 countries in a span of 16 years .As from the above studies they find evidence of volatility clustering in returns. They equally argue that markets do not necessarily improve in efficiency with time. They equally advocated for classification of emerging markets in terms of being secondary or advanced.

In ranking capital markets by efficiency Baciu, (2014) examined 20 stock markets in Europe. The markets were ranked in accordance to, fractal dimension, efficiency index and long term memory. Using rescaled analysis the study found developed markets are most efficient especially UK which showed no features of long range dependence and fractal dimension. Emerging like Greece, Czech Republic and Bulgaria and markets were least in efficiency. The study focused on emerging markets in Europe and with some relatively more developed and with different trading systems compared to African markets.

There are limited local studies from those reviewed that have examined stock returns for long term memory in NSE from the reviewed studies. However, these studies provide mixed evidence of the same. Alagidede and Panagiotidis, (2009) in modelling returns for the seven biggest stock markets in Africa using GARCH and Smooth transition regression ranked on capitalization and liquidity which included: Tunisia, Egypt,

Morocco, Kenya, Nigeria, South Africa, and Zimbabwe concluded stock market returns have shown non linearity from the volatility observed and they rejected the Random walk hypothesis. This study used a linear model in statistical analysis of long term memory stock market returns.

In support of the above studies Thupayagale, (2010) explored aspects of long memory behaviour in 11 ASM which include: Mauritius, Tunisia, Nigeria, Ghana, Namibia, Morocco, Kenya, Egypt, Zimbabwe, South Africa, and Botswana. Using GARCH and ARMA which are linear models found that ASM generally found evidence of asymmetric and long memory components in stock returns. These findings are a deviation from EMH and show a delay in processing new information. The study used a parametric test while this research paper used a non-parametric test and focused on Kenya only.

Ogega, (2014) in analysing NSE for volatility, persistence and asymmetric and in returns volatility in Market while using FIEGARCH model, finds evidence of persistence in bullish phases where unexpected positive returns resulted in more volatility compared to negative returns of the same intensity as well as unexpected negative returns in bearish phases were more volatile than unexpected positive returns of the same intensity. This alludes to information asymmetric and market inefficiency.

Gichana, (2009) in a Comparison of Linear and Nonlinear models in Predicting stock returns at Nairobi securities exchange while using ARMA and ARCH models concluded that stock returns are nonlinear and ARCH model is the best nonlinear model in predicting returns. On the other hand Ndigwa and Murui, (2016) in examining volatility in stock return of emerging markets a case study of NSE applied GARCH models and found no evidence of volatility persistence and asymmetric effect in stock market returns. This signifies absence of long memory because of lack of volatility in returns.

Methodology

A longitudinal research design was adopted for this research paper. This is because the study involved taking repetitive measures overtime for the purpose of comparing returns. This design is also suitable in analysing and comparing the behaviour of returns in the period of the study. The population considered for this study includes all listed companies in the Nairobi Securities Exchange. There were 64 listed companies trading at NSE as at December 2017.Daily data collected on the NSE-20 share index was for a period of 8 years, that is, 4th Jan 2010-29th Dec 2017. Daily secondary data on the NSE-20 share index was obtained

from NSE Database and Capital Markets Authority (CMA) statistical bulletins. EViews financial econometric software was used for calculation of returns on the index and modelling. The return on the index (R_t) at period t was computed as continuously compounded as per below equation

$$\mathbf{r_t = Inp_t - Inp_{t-1}}$$

R_t = Daily returns for NSE 20-share index for period $_t$

P_t= NSE 20-share index for day t.

P_{t-1} = NSE 20-share index for day $_{t-1}$.

In= Natural Logarithm.

Findings

Descriptive Statistics

A preliminary analysis of the daily return on the index and the NSE 20 share index was done. The results are presented in the table.

Table 1: Descriptive Statistics

	Daily returns on the index	NSE 20 share index
Mean	0.007%	4147.27
Median	0.004%	4037.99
Maximum	6.071%	5499.64
Minimum	-5.903%	2789.64
Std. Dev.	0.684%	661.070
Skewness	-0.0672	0.044
Kurtosis	12.1979	1.893
Jarque-Bera	6999	101.9171
Probability	0.00	0.00
Observations	1985	1985

The daily returns have a mean of 0.007% (Table 4.1). The positive return implies that given a holding period of 8 years, investors would have gained on their investment. This could be attributed to the bullish ran that lasted for four years i.e. 2012 to 2015 after a period of depression (figure 4.2). This also explains why the mean of the NSE 20 share index is quite high for the period under study. The standard deviation for the daily return is 0.684% while that of the index is 661. The high standard deviation of the index is expected

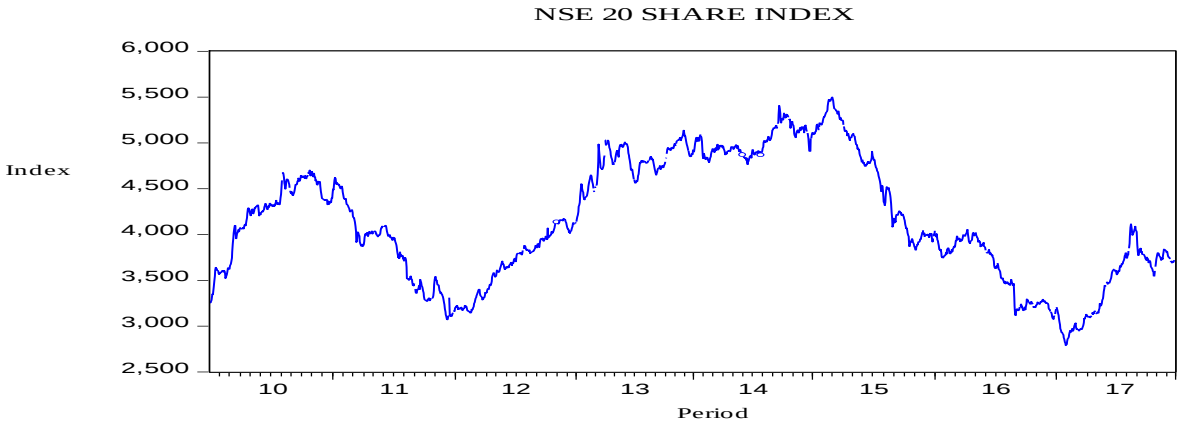
especially with the introduction of changes such as automation, the volatility of prices should be higher they adjust quickly to new information.

Both the daily returns and NSE 20 share index for the period show a departure from normality. This is evidenced by the negative skewness of value -0.067 and positive skewness value of 0.044 for the daily returns and index respectively. Daily returns have a high positive kurtosis value of 12.197 indicating that the distribution has fatter tails. The significant p-values for Jarque-Bera test further suggests that daily returns and index are non-normal. Although, Finance theory posits that stock returns follow a normal distribution, empirical evidence has shown that returns exhibit certain stylized facts such as non-normality, skewness and volatility clustering (Opong, et al., 2010).

Trend Analysis

A plot of the NSE 20 share index shows that there is an upward trend from 2012 to 2015 followed by a downward trend (figure 1). This could suggest that NSE 20 share index is not stationary. The presence of a trend could imply predictability of prices.

Figure 1: Time series plot of the NSE-20 share index



The objective of the study was to test for existence of Long term memory in stock market returns in Nairobi securities exchange. The Hurst exponent was used to measure long term memory in stock returns while the daily NSE 20 share index was used to measure stock market returns for the period between January 2010 and December 2017. One of the advantages of Rescaled range analysis is its ability to depict cycles in time series data (Gayathri, Murugesan & Gayathri, 2012). The findings show H value of 0.7 which indicates presence of long range dependence in NSE and signifies that current prices are more likely to be influenced

by events in the past and a possibility of arbitrage opportunities. Long term memory should be considered in trading strategies for instance, Gayathri, Murugesan and Gayathri, (2012) illustrates the 10 day Hurst exponent index where the value of H is <0.43 influence a sell decision and a value > 0.66 influences a buy decision within an average 10 days of a trading cycle.

The results of the study are in line with to Thupayagale, (2010) who investigated NSE among other ASM for a period between 1996 and 2007 using the NSE-20 index found evidence of long term memory in stock market returns in NSE using GARCH model presented by strong persistence levels in volatility of equity returns. The results rejected EMH which is also in agreement with the findings of this study.

In the context of market efficiency, the results suggest that the market is weak form inefficient denoted by the autocorrelation test which rejects the the null hypothesis of no serial correlation (Table 4.4).These findings are supported by the study results of Jefferis and Smith, (2005) who investigated emerging markets for improved efficiency with time and found NSE not to be weak form efficient. Njuguna, (2016) backs up the findings when she tested for weak form efficiency of NSE and found it to be inefficient.

Conclusions

The objective of the research was to determine existence of long term memory in stock market returns and based on the findings, there does exists long term memory in the daily returns of the NSE. This is further supported by the results of autocorrelation test that indicate that the market does not follow a random walk. The presence of the long term memory is evidence against the EMH. This implies that investors can study the patterns in NSE and develop strategies to earn higher returns.

References

Aduda, J.O. & Chemarum, C.S. (2010). Market Reaction to Securities Splits; Empirical Evidence from NSE, *African Journal of Business Studies*, 1 165-185.

Alagidede, P. (2009). Modelling stock returns in Africa's emerging equity markets. *International Review of Financial Analysis*, 18(1-2), 1-11.

Anyumba, A.P. (2010). An Empirical Test of the Random Walk Model for the NSE. Unpublished MBA Project, University of Nairobi.

Armachie, J. (2017). Arbitrage Opportunity in the Ghanaian Stock Market an Arfima Approach. (Doctoral dissertation, University of Ghana).

Baciu, O. A. (2014). Ranking capital markets efficiency: the case of twenty European stock markets. *Journal of Applied Quantitative Methods*, 9(3). 24-45

Balparda, B., Caporale, G. M., & Gil-Alana, L. A. (2015). The Kenyan stock market: inefficiency, long memory, persistence and anomalies in the NSE-20. *African Journal of Economic and Sustainable Development*, *4*(3), 254-277.

Bekaert, G., & Harvey, C. R. (2003). Emerging markets finance. *Journal of Empirical Finance*, *10*(1-2), 3-55.

Daferighe, E. & Sunday, C. S. (2012). The Impact of Inflation on Stock Market Performance in Nigeria. *American Journal of Social and Management Sciences*, 3 (2), 76-82

Damodaran, A. (2007). Valuation approaches and metrics: a survey of the theory and evidence. Foundations and Trends® in Finance, 1(8), 693-784.

Dickinson, J. P. & Muragu, K. (1994). Market Efficiency in Developing Countries: A Case Study of the Nairobi Securities Exchange, *Journal of Business Finance and Accounting*, 133-149.

Fama, E. (1965). Random Walks In Securities Market Prices. *Selected papers No.16*, 1- 16.

Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical work, *Journal of Finance*, 383–417.

Gayathri, M., Murugesan, S., & Gayathri, J. (2012). Persistence and long range dependence in Indian stock market returns. *International Journal of management and business studies*, *2*(4), 72-77.

Gichana I. M. (2009). A Comparison of Linear and Non-Linear Models in Predicting Stock Returns at the Nairobi Stock Exchange. Unpublished MBA Project, University of Nairobi.

Greene, M. T., & Fielitz, B. D. (1977). Long-term dependence in common stock returns. *Journal of Financial Economics*, *4*(3), 339-349.

Hamrita, M. E., & Trifi, A. (2011). The relationship between interest rate, exchange rate and stock price: A wavelet analysis. *International Journal of Economics and Financial Issues*, *1*(4), 220-228.

Hiremath, G. S., & Kumari, J. (2015). Is There Long Memory in Indian Stock Market Returns? An Empirical Search. *Journal of Asia-Pacific Business*, 16(2), 128-145.

Hull, M., & McGroarty, F. (2014). Do emerging markets become more efficient as they develop? Long memory persistence in equity indices. *Emerging Markets Review*, 18, 45-61.

Jefferis, K. and Smith, G. (2005). The changing efficiency of African securities markets, *South African Journal of Economics*, 54−67.

Korkmaz, T., Cevik, E. I., & Özataç, N. (2009). Testing for long memory in ISE using ARFIMA-FIGARCH model and structural break test (No. 71302). University Library of Munich, Germany.

Lehoczky, J., & Schervish, M. (2018). Overview and History of Statistics for Equity Markets. *Annual Review of Statistics and Its Application*, *5*, 265-288.

Lo, A. W., & MacKinlay, A. C. (1988). Stock market prices do not follow random walks: Evidence from a simple specification test. *The Review of Financial Studies*, *1*(1), 41-66.

Mandelbrot, B. (1972). Statistical methodology for nonperiodic cycles: from the covariance to R/S analysis. In *Annals of Economic and Social Measurement, Volume 1, Number 3* (pp. 259-290). NBER.

Magnusson, M. A. & Wydick, B. (2002). How efficient are Africa's emerging markets? *The Journal of Development Studies*, Vol.38 No.4, 141−156.

Mbua, S. N. (2017). Effect of interest rates capping by the Central Bank of Kenya on the banks listed on the Nairobi Securities Exchange (Doctoral dissertation, United States International University-Africa).

Mlambo, C. and Biekpe, N. (2005). The Efficient Market Hypothesis: Evidence from Ten African Securities Markets. *Investment Analyst Journal*, 7-15.

Ndigwa, D. & Muriu, P. W. (2016). Stock returns and volatility in an emerging equity market: Evidence from Kenya. *European Scientific Journal*, 12(4), 79-98.

Njuguna, J. (2016). Testing the efficient market hypothesis on the Nairobi Securities Exchange. *Investment Management and Financial Innovations*, *13*(3), 75-83.

NSE PLC. (2017). Annual Report 2017. Retrieved from http://www.nse.co.ke/annualreport

Nyamute, W., Oloko, M., & Lishenga, J. (2017). The Relationship between Investor Behavior and Portfolio Performance at the Nairobi Securities Exchange

Ogega, H. O. (2014). Analysis of asymmetric and persistence in stock return volatility in the Nairobi Securities Exchange market phases (Doctoral dissertation, Strathmore University).

Opong, K.K., Li, Y., and Hamill, P.A. (2010). Do benchmark African equity indices exhibit the stylized facts? Global Finance Journal, vol 21, 71-97.

Oprean, C., & Tanasescu, C. (2013). Applications of Chaos and Fractal Theory on Emerging Capital Markets. *International Journal of Academic Research in Business and Social Sciences*, *3*(11), 633

Otieno, D. A. (2017). Macroeconomic Determinants of Stock Market Returns in Kenya*: 1993-2015* (Doctoral dissertation, University Of Nairobi)

Peters E. E., (1994). Fractal Market Analysis: Applying Chaos Theory to Investment and Economics, NY. : John Wiley & Sons, 336 p.

Rachael, N., & Moses, W. (2017). The Effect of Interest Rate Control on the Stock Market Performance, a Case of Nairobi Securities Exchange Market. *International Journal of Current Aspects in Finance (IJCAF)*, *4*(1).

Saadi, S., Gandhi, D., & Dutta, S. (2006). Testing for nonlinearity &Modelling volatility in emerging capital markets: The case of Tunisia. *International Journal of Theoretical and Applied Finance*, *9*(07), 1021-1050.

Sadique, S., & Silvapulle, P. (2001). Long-term memory in stock market returns: international evidence. *International Journal of Finance & Economics*, *6*(1), 59-67.

Sinha, N. R. (2016). Underreaction to news in the US stock market. *Quarterly Journal of Finance*, *6*(02), 1650005.

Statman, M. (2014). Behavioral finance: Finance with normal people. *Borsa Istanbul Review*, *14*(2), 65-73.

Sugimoto, K., Matsuki, T., & Yoshida, Y. (2014). The global financial crisis: An analysis of the spillover effects on African stock markets. *Emerging Markets Review*, *21*, 201-233.

Tabak, B. M., Serra, T. R., & Cajueiro, D. O. (2010). Topological properties of stock market networks: The case of Brazil. *Physical A: Statistical Mechanics and its Applications*, *389*(16), 3240-3249.

Thomas, C. M. (2002). Chaos Theory versus the Efficient Market Hypothesis in Financial Markets. (Honors Thesis Projects, University of Tennessee).

Thupayagale, P. (2010). Essays in long memory: evidence from African stock markets (Doctoral dissertation, University of St Andrews).

Vácha, L., & Vosvrda, M. S. (2005). Dynamical agents' strategies and the fractal market hypothesis. *Prague Economic Papers*, *14*(2), 172-179.

Wang F. (2012) Determinants of Chinese Stock Market Returns. Unpublished Msc Thesis. University of Utara Malaysia.