STATISTICAL ANALYSIS OF EFFICIENCY OF NIGERIA STOCK MARKET

[1*]AMUSA, S.O, [2]AGUNBIADE, D.A, [1]AKINGBADE, A.A, [1]OKORAFOR, U. [1]AYODEJI, A.A, IKEGWU,E.M.,

[1]Department of Statistics, Yaba College of Technology, Yaba-Lagos State.
[2]Department of Mathematical Sciences, Olabisi Onabanjo University, Ago-Iwoye, Ogun State.
Corresponding Author's Address: oyedelehamusa1970@gmail.com;

ABSTRACT

Efficient market hypothesis has been a topical issue in the field of finance since the discovery that financial variables might exhibit long memory properties. The exhibition of long memory properties by asset returns could be exploited by investors to anticipate price movements and earn positive average returns. A large body of literature has documented the behavior of asset returns in the developed stock markets but the literature that focuses on the Nigerian stock market is limited. Time varying Hurst exponent is employed to test the efficiency of Nigeria Stock market by applying Rescaled-range method (R/S) and results indicate that there is serial correlation in asset return series with evidence of long memory persistence. The study however concluded that Nigeria stock market is inefficient with opportunities for arbitrage activities.

Keywords: Hurst exponent, Long memory, All-Share Index, R/S Analysis, Market efficiency.

Introduction

Efficient market hypothesis has become a topical issue in the field of finance with the discovery that some financial variables might exhibit long memory properties (Sensoy, 2013). A market is efficient when all known information are well represented by the prices which implies that it is impossible to beat the market by any investment strategy and serial correlation is not possible between the observations, while the strong serial dependence between distant apart observations often observed in time series is termed long memory. Mandelbrot (1963); Segova et al (2008) and Lai et al (2019) affirmed that long memory presence could lead to the rejection of an efficient market hypothesis. Gyamfi et al (2016) however cited Grossman and Stigitz (1980) who contended that a level of inefficiency is required in a market to bring about efficiency so that arbitrageurs could trade in underpriced assets. A large body of literature has documented the behavior of asset returns in the developed stock markets (Mandelbrot, 1963; Qian & Rasheed, 2004; Khaled, 2007; Danilenko, 2009; Sensoy, 2013; Gyamfi et al, 2016; Segova et al, 2017; Lai et al, 2019); By contrast, Barkoulas et al (2000) asserted that relatively little attention has been devoted to stock market returns in the emerging market like Nigerian stock market. Gil-Alana (2015) considered long memory investigation for banking sector in Nigeria while Gyamfi et al (2016) studied serial dependence in eight African stock markets including Nigeria. Our effort is to enrich the literature by analyzing the dynamics of the stock market returns in Nigeria. There are many statistical tools of estimating long memory, Mandelbrot and Wallis (1968) rescaled-range method which centred on Hurst (1951) work, Detrended fluctuation analysis, Aggregated variances, Periodogram regression technique, local whittle estimation, wavelet technique both in frequency and time domain. Application of any of these tools does not involve knowledge of factors which act in the price generating process; the only

requirement is the series of returns for which long memory estimation is desired (Danilenko 2009) but Segova et al (2017) however affirmed that Hurst exponent is an effective tool for testing efficient market hypothesis because of its usefulness in practical applications. Therefore, this work tends to build on the earlier works of Gil-Alana et al (2015) and Gyamfi et al (2016) on Nigeria stock market. The results obtained would allow investors to anticipate price movements and earn positive average returns.

MATERIALS AND METHOD

Nigeria All –Share Index monthly data from 1985 to 2019 was used for the empirical validation of the proposal. The data employed for this study is secondary data obtained from official catalogue of the Central Bank of Nigeria. This ensures coverage of extensive periods of time which might have tendencies of long memory properties and effective analysis of the objectives of this study. Analyzes of the data was carried out with Gretl Statistical package. In this work, the rescaled range $(R/S)_t$ method is employed and the steps involves are as follows:

Let $y = (y_m)_{m\geq 0}$, the Nigeria Stock Exchange All-Share Index Series ……..(i)

the proportionate change in share price, $g_m = \left(\frac{y_m}{y_{m-1}}\right), m \geq 1$…….. ..(ii)

Sequence, $g = (g_m)_{m\geq 0}$ properties is to be investigated with Rescaled range $(R/S)_t$ and defined as:

Addition of the sequence, $G_m = g_1 + g_2 + \ldots\ldots\ldots + g_m$…… (iii)

The Mean k, is first obtained for the series, $\overline{g_m} = \frac{1}{m}\sum_{i=1}^{m} g_i$……..(iv)

Deviation from the mean series, $g_t = g_t - k$ for $t = 1,2, \ldots . . m$……(v)

Form a cumulative deviation of series G, $G_t = \sum_1^t g_i$ for $t = 1.2, \ldots . . , m$…(vi)

The range series, $R_t = \max(G_1, G_2, \ldots\ldots, G_t) - \min(G_1, G_2, \ldots\ldots, G_t)$ for $t = 1, 2, \ldots\ldots . . , n$……(vii)

Standard deviation of the series, $S_t = \sqrt{\frac{1}{t}\sum_{i=1}^{t}(G_i - U)^2}, t = 1,2, \ldots . . , n.$ ……(viii)

Calculate the rescaled range $(R/S)_t$ and average over all the partial time series of length

Rescaled range $(R/S)_t = \frac{R_t}{S_t}$ $for\ t = 1,2, \ldots\ldots . . , m$……(ix)

Plot the logarithms of rescaled range $(R/S)_t$ and Log (n) which is the size of observation of each range.

Hurst exponent is obtained by fitting power law to the data, the slope of the line gives the estimated value.

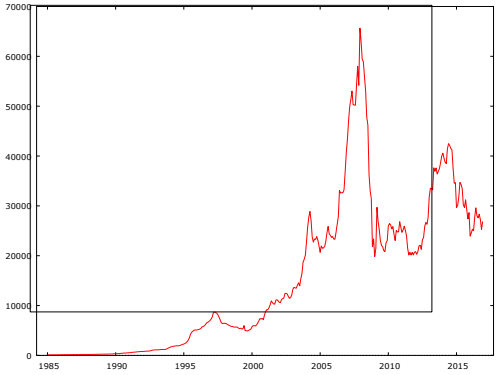
Hurst exponent value H; $(0 < H < 1)$; For random process, (H= 0.5); Persistent behavior, $(0.5 < H < 1)$ while Anti-persistent behavior, $(0 < H < 0.5)$

RESULTS:

Table 1: NSEASI Summary Statistics

Statistics	Values
Mean	16134.24
Standard Deviation	14850.15
Variance	220506.94
Skewness	-0.716
Kurtosis	-1.132
Minimun	111.30
Maximum	65652.38
Range	65541.08

Figure 1: Nigeria All-Share Index Series



In table 1, the descriptive statistics show that the data series is negatively skewed and the kurtosis value is low. The maximum value the series attained is 65652.33 while the minimum is 111.30. The data has a very large range implying that the stock market experienced time varying variation which is due to economic, sociological, psychological and environmental factors among the actors in the stock market. Figure 1 also show the plot of NSEASI series from 1985 to 2019. The plot exhibit a trending behavior with a see-saw pattern. The peak of the graph was in 2008 and it was preceded by the economic meltdown which resulted to massive loss of capital and since then market actors have been cautious and intelligent in their trading activities with the index revolving around the long-time mean.

Table 1: Rescaled range figures for All Share Index

The data was collected over 384 time intervals and the rescaled range gave the values in table 1 and other time intervals respectively shown below:

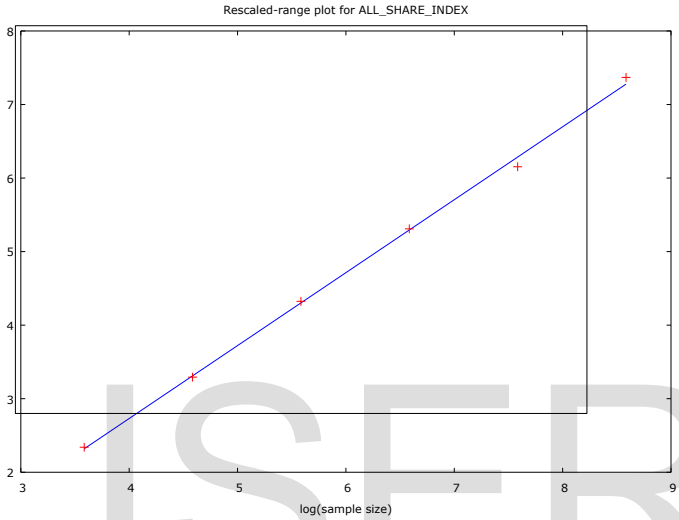
Size	R/S(Avg)	Log(Size)	Log(R/S)
384	165.28	8.5850	7.3688
192	71.194	7.5850	6.1537
96	39.658	6.5850	5.3095
48	20.028	5.5850	4.3239

24	9.8029	4.5850	3.2932
12	5.0643	3.5850	2.3404

Table 2: Regression Result

Parameter	Coefficient	Standard Error
Intercept	-1.2361	0.12470
Slope	0.99169	0.019730

Figure 2: Regression Line which estimates Hurst Exponent, Y=-1.2361+0.99169x



DISCUSSION

The summary statistics show that the series is not normally distributed, showing a form of skewness and exhibiting time varying variation over time with the plot of the return series in figures 1 and 2 showing an upward trend. The estimated Hurst exponent value for the NSEASI is 0.999 implying that the NSEASI series exhibit persistent behavior implying the presence of long-term dependence which contradicts random walk behavior. The study found out that the Nigeria stock market seems inefficient which is in line the position of Gil-Alana et al (2015); Mandelbrot, (1963); Qian & Rasheed, (2004); Khaled, (2007); Danilenko, (2009); Sensoy, 2013; Gyamfi et al (2016); Segova et al, 2017 and Lai et al, 2019) and invalidates Grossman and Stigitz (1980) position on inefficient market becoming efficient over time.

CONCLUSION

This paper has assessed the degree of efficiency over time of Nigeria stock market. It builds on the work of Gil-Alana et al (2015) and Gyamfi et al (2016) who observed that there is a degree of dependence across time for asset returns. The study considered the entire stock market and concluded that Nigeria stock market is inefficient which implies opportunity for arbitrage activities.

REFERENCES

Barkoulas, J., Baum, C., & Travlos, N., 2000. Long memory in the Greek stock market, Applied. Finance. Economics. Issue 10, Volume 2, pp. 177-184.

Danilenko, S., 2009. Hurst analysis of Baltic sector indices. Applied stochastic models and data analysis, 2009. pp. 329-333.

Gil-Alana, A., OlaOluwa, S. Yaya., & Adepoju, A.A., 2015. Fractional integration and structural breaks in bank share prices in Nigeria. Review of Development Finance. Volume 5, issue 1, pp. 13-23.

Grossman, S., Stiglitz, J. (1980), On the impossibility of informationally efficient markets, American Economy Review. Volume 70, pp. 393-408.

Gyamfi1, E. N., Kyei, K., & Gill, R., 2016. Long - memory persistence in African stock markets. EuroEconomica. Volume 1(35), pp. 1-10.

Hurst, H., 1951. Long term storage capacity of reservoirs. Trans. American Society of Civil Engineers. Volume 116, pp. 770-808.

Khaled, H. H., 2007. Improved finite-sample Hurst exponent estimates using rescaled range analysis. Water resources research. Volume 43, pp. 1-9.

Lai, Y., Jian, L., Cheng, C., Xianglin, Y., & Lizhao, Y., 2019. Analysis of the efficiency of Hong Kong REITs market based on Hurst exponent. Statistical Mechanics and its Applications. Volume 534, pp. 1-17.

Mandelbrot, B.B., 1963. The Variation of Certain Speculative Prices. Journal of Business. Volume 36, pp. 394-419.

Mandelbrot, B, B., & Wallis, J.R., 1968. Noah, joseph, and operational hydrology, Water Resources Research Volume 5, pp. 909-918.

Qian, B., & Rasheed, K., 2004. Hurst exponent and financial market predictability. Financial Engineering and applications. pp. 203-209.

Segova, J.E., Requena, J. P., & Granero, M.A., 2017. Physical A: Statistical Mechanics and its Application. Volume 32, pp.1-15.

Segovia, J.E. T., Granero, M.A.S., & Pérez, J.G., 2008. Some comments on Hurst exponent and the long memory processes on capital markets. Physica A 387, pp. 5543–5551.

Sensoy, A., 2013. Generalized Hurst exponent approach to efficiency in MENA markets. Statistical Mechanics and its Applications. Volume (20), pp. 5019–5026.