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# A TEST FOR WEAK FORM EFFICIENT MARKET HYPOTHESIS: EVIDENCE FROM THE NAIROBI SECURITIES EXCHANGE

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**ABSTRACT**

An efficient stock market should allow security prices to reflect all available information such that stock prices adjust quickly and on average, without bias, to new information. It is expected that no one can detect mispriced securities to make abnormal gains over a period of time and in this way, the market will be deemed to be efficient. Empirical studies have shown mixed results in regards to the efficiency of emerging stock markets rendering the debate on random walk hypothesis to be inconclusive. It is based on this backdrop that this study tested the weak form of market efficiency in the Nairobi Securities Exchange (NSE). It tested the null hypothesis that 42 selected stocks severally took a random walk over a 5 –year period. The selection of the stocks was based on continuous trading over the period of the study. The study used monthly average prices from January 2009 to December 2015 which were converted into natural log returns. Data analysis was carried out using serial correlation analysis and runs test analysis aided by Microsoft Excel and SPSS (version 20). The study plotted correlograms at 95% confidence intervals and further computed Ljung Box Q for 1 to 10 lags and Durbin Watson statistics for each selected stock. The study found inconsistency in the findings between runs test and serial correlation in that some of the companies that were found not to be efficient in one test were found to be efficient in another. However, it was generally found that at least 70% of the stocks were efficient in both tests which can be inferred to mean that NSE is largely efficient with some few outliers. This study recommended that a test of the weak form should be further conducted on the NSE utilizing the market indices (NSE 20 Share Index, All Share Index (NASI) and (NSE 25 Share Index) to confirm the above assertion that NSE is largely efficient.

**Key Words:** Efficient Market Hypothesis, Random Walk Model, Log Returns, Time Series, Technical and Fundamental Analysis

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## INTRODUCTION

An efficient market is one where the security prices reflect all the available information such that prices adjust quickly and, on average, without bias, to new information (Pandey, 2009). Stock prices may take a random walk over a period of time and therefore the prices vary, that is, operating in an irrational manner. According to Fama (1965), competition among the firms causes the effects of new information on the intrinsic values of the stocks to be reflected promptly in the stock market prices such that no one can detect mispriced securities to make abnormal gains.

Rational investors try to identify and invest in stocks that are undervalued and whose values are expected to increase in the future with a view to making an abnormal profit. They believe that with the aid of a variety of forecasting and valuation techniques, they can select stocks that will outperform the market (Degutis & Novickytė, 2014). The Efficient Market Hypothesis (EMH) asserts that none of these latter techniques are effective in predicting future stock prices in the market. This means that the advantage gained does not exceed the transaction and research costs incurred (Sewell, 2012).

The driving force behind price changes is the incorporation of new information in the stock prices. As a result, the current prices of securities reflect all available information at any given point in time. Consequently, there is no reason to believe that prices are too high or too low. Security prices adjust before an investor has time to trade on and profit from a new piece of information (Grzyb, 2007). According to (Pandey, 2009), there are three basic conditions under which the EMH will hold: a large number of competing, profit-maximizing participants analyze and value securities each independently from the others; new information regarding securities comes to the market in a random fashion; the competing investors attempt to adjust security prices rapidly to reflect the new information.

There are three forms of efficient market efficiency considering how information is reflected in market prices. These levels are: Weak form, Semi-Strong form and Strong form of efficient markets hypothesis. The weak form asserts that security prices reflect all past information about the price movements. It is therefore hard for investors to predict future security prices by analyzing historical prices and achieve a performance better than the stock market index. This is so because the capital market has no memory and the stock market has already incorporated past information about the security prices in the current market price (Pandey, 2009). The implication of the weak form of EMH is that the future rates of return of the stocks are independent of their past rates of return.

The semi strong form of EMH indicates that a market is efficient when the current security prices incorporate past history of prices and all publicly available information. Therefore, it incorporates the weak-form of EMH. The implication of this form is that a trader cannot benefit abnormally by trading on new information. However, a trader with private information can make superior profit in a weak and semi-strong form of EMH (Gichaiya & Ishmail, 2014).

The strong-form of EMH states that the market is efficient reflecting all information, that is, past, public and private information, therefore incorporating both the weak and semi-strong form of EMH. People with private or inside information have always been able to outperform the market (Gichaiya & Ishmail, 2014). Given the assumption that stock prices reflect all information (public as well as private) no investor would be able to profit above the average investor even if he was given new information.

The relevance of the EMH in Finance theory remains to be a live debate in the 21st century. According to Shiller & Radikoko (2014), efficient market hypothesis only explains half of the reality in the stock market. The EMH as it is only describes ideal trading conditions in a stock market which do not fully hold in reality. Even if markets are not perfect; there is empirical evidence that markets are efficient to a certain degree as prices do respond to new

information. However, there is no certainty as to whether the markets respond to fundamental values of the companies (Degutis & Novickytė, 2014).

Stock markets in the developing countries especially tend to display high price volatility, and may therefore provide an opportunity for speculators to make abnormal gains which are inconsistent with EMH assumptions. The Nairobi Securities Exchange (NSE) for instance has displayed cases of abnormal price volatility which point to the possibility of underlying inefficiencies which can distort the true shareholder value in a stock (Maronga, Nyamosi, & Onsando, 2015). This paper tests the weak form of the efficient market hypothesis that past information concerning a stock market is not reflected in the current stock prices.

**Statement of the Problem**

The assertion of the weak-form of EMH that the market is efficient, reflecting all past market information is not without critic. This hypothesis assumes that the rates of return on the market should be independent of past rates of return. Contrary to the weak form of EMH, empirical studies reveal that there is presence of forecasting patterns within the existing stock markets indicating that the share return series does not follow a Random Walk Model (Gimba, 2007; Sewell, 2012; Shiller & Radikoko, 2014; Samitas, 2004). However, other empirical studies support the efficiency of the weak form. Grzyb (2007) found that a random walk was present in the Dow Jones Industrial Average Index signifying presence of a weak form of EMH. Nisar & Hanif ( 2012) conducted a run test based on KSE monthly, BSE weekly and monthly, DSE weekly and monthly indices and found evidence supporting weak form of EMH. Phiri (2015) also examined the weak form of EMH based on a linear framework stock indices in the Johannesburg Stock Exchange and established that the results offered support in favour of the weak form of EMH. These studies show that there is mixed results with regards to the efficiency of the weak form. Therefore, this study envisaged to unravel the mystery behind the two opposing contentions of the weak form of EMH based on returns of listed firms in the Nairobi Securities Exchange (NSE).

**Hypotheses**

This study investigated the weak form of stock market efficiency in the NSE. It investigated the null hypothesis that there is a random walk of the stocks in the NSE for the period of the study (Moustafa, 2004).

$\mathbf{H_0}$: The stock returns in the NSE are random over the period of the study.

$\mathbf{H_1}$: The stock returns in the NSE are not random over the period of the study.

**METHODOLOGY**

NSE is an emerging stock market which is thin and with low trading volumes compared to stock exchanges in developed countries. Therefore, this study utilized individual stock price returns rather than the stock market indices returns. This study used stock market data in the NSE from January 2009 to December 2013 which was a period of five years. According to Gimba (2007) and Moustafa (2004), five year period is adequate to determine whether there is a significant random walk within the stock market.

The sample size for the study consisted of 42 listed companies in the NSE for the period of the study. The sample size was determined purposively solely based on continous trading over the period of the study.

**Table 1:** ***List firms listed in the Nairobi Securities Exchange***

| No. | Industry Sector | Name of Company | Symbols |
|---|---|---|---|
| 1 | Agricultural Sector | Eaagads Aims | EGAD |
| 2 | | Kakuzi | KUKZ |

| | | | |
|---|---|---|---|
| 3 | | Kapchorua Tea Aims*** | KAPC |
| 4 | | Limuru Tea Aims*** | LIMT |
| 5 | | Sasini | SASN |
| 6 | | Williamson Tea Aims | WTK |
| 7 | | Rea Vipingo Plantation Ltd* | REA |
| 8 | Automobiles and Accessories | Car & Gen | CG |
| 9 | | Marshalls*** | MASH |
| 10 | | CMC Holdings Limited*** | CMC |
| 11 | | Sameer (FIRE) | FIRE |
| 12 | Banking | Barclays | BBK |
| 13 | | CFC Stanbic | CFC |
| 14 | | Diamond Trust Bank Kenya | DTK |
| 15 | | Equity Bank | EQTY |
| 16 | | HF Group | HFCK |
| 17 | | I&M Holdings*** | IM |
| 18 | | Kenya Commercial Bank | KCB |
| 19 | | National Bank of Kenya | NBK |
| 20 | | NIC Bank | NICB |
| 21 | | Standard Chartered Bank | SCBK |
| 22 | | Cooperative Bank | COOP |
| 23 | Commercial | Atlas Dev. Gems** | AAI |
| 24 | | Express (K) Aims | XPRS |
| 25 | | Hutchings Biemer** | HBL |
| 26 | | Kenya Airways | KQ |
| 27 | | Longhorn Publishers Aims*** | LKL |
| 28 | | Nation Media | NMG |
| 29 | | Standard Group | SGL |
| 30 | | TPS Eastern Africa | TPSE |
| 31 | | Uchumi*** | UCHM |
| 32 | | WPP Scangroup | SCAN |
| 33 | Construction & Allied | ARM Cement Ltd | ARM |
| 34 | | Bamburi | BAMB |
| 35 | | Crown Berger | BERG |
| 36 | | EA Cables | CABL |
| 37 | | East African Portland Cement*** | EAPC |
| 38 | Energy & Petroleum | Kengen | KEGN |
| 39 | | Kenolkobil | KENO |
| 40 | | Kenya Power | KPLC |
| 41 | | Total Kenya | TOTL |
| 42 | | Umeme*** | UMME |
| 43 | Insurance | British American*** | BRIT |

| | | | |
|---|---|---|---|
| 44 | | CIC Insurance*** | CIC |
| 45 | | Jubilee | JUB |
| 46 | | Kenya Re | KNRE |
| 47 | | Liberty Kenya*** | CFCI |
| 48 | | Pan African | PAFR |
| 49 | Investment | Centum Investments | ICDC |
| 50 | | Home Africa Gems*** | HAFR |
| 51 | | Kurwitu Ventures Ltd Gems** | KURV |
| 52 | | Olympia | OCH |
| 53 | | Transcentury Aims*** | TCL |
| 54 | Investment Services | Nairobi Securities Exchange** | NSE |
| 55 | Manufacturing & Allied | A. Baumann Aims** | BAUM |
| 56 | | BOC Gases*** | BOC |
| 57 | | BAT Kenya | BAT |
| 58 | | Carbacid*** | CARB |
| 59 | | East Africa Breweries Limited | EABL |
| 60 | | Eveready EA | EVRD |
| 61 | | Flame Tree Gems** | FTGH |
| 62 | | K. Orchards Aims** | ORCH |
| 63 | | Mumias | MSC |
| 64 | | Unga | UNGA |
| 65 | Telecommunication & Technology | Safaricom | SCOM |
| 66 | | AccessKenya Group*** | ACCS |

**Source: Prepared by the author (2016)**

* Rea Vipingo Plantation Ltd was delisted from the NSE in September, 2015 but was trading continuously over the period of the current study.

** These companies were not listed as of period of this study.

*** These companies were listed as of the period of the study but had not traded continuously.

The data used in this study primarily consisted of average monthly prices of the 42 sample companies chosen over the period of the study. The prices had been collected from the NSE offices in Nairobi covering the period commencing January 2009 to December 2013. Given that the data was picked from the primary trading floor, they were deemed to be reliable and accurate. Returns rather than prices were used because according to Sewell (2012), some statistical tests require a stationary variable. The monthly average price series were converted into returns using logarithmic transformation to get logarithmic returns which are deemed more tractible and are more likely to be normally distributed (Shiller & Radikoko, 2014; Gimba , 2007; Moustafa, 2004; Nisar & Hanif, 2012). According to Freund, Larrain, & Pagano (1997), logarithmic returns remove most of the linear dependency present and past returns in a series of data.

The following logarithmic transformation function was used:

$$R_t = \ln(\frac{P_t}{P_{t-1}}) \quad \text{..... (i)}$$

Where

ln is the natural logarithm

$P_t$ is the average market price at time 't'

$P_{t-1}$ is the average market price at time 't-1' (previous period from time 't' )

For this study, the statistical tests used were: serial correlation and run – tests.

This study used autocorrelation to test the null hypothesis that there is no serial correlation in the data series already transformed into log returns. Autocorrelation coefficent test measures the correlation between the current and lagged obsevations of the time series of stock returns (Kalsie & Kalra, 2015). It is given by the formulae below;

$\rho_k = \frac{\sum_{t-1}^{n-k}(r_t-\bar{r})(r_{t+k}-\bar{r})}{\sum_{t=1}^{n}(r_t-\bar{r})^2}$ ……(i)

where $\rho_k$ is the serial correlation coefficient of stock returns of lag k

n is the number of observations

$r_t$ is the stock return over period t

$r_{t+k}$ is the stock return over the period t+k

$\bar{r}$ is the sample mean of stock returns

K is the lag of the period

The test aims to determine whether the serial correlation coefficients are statistically significant from zero. Statistically, the hypothesis of weak-form EMH should be rejected if stock returns (price changes) are serially correlated ($\rho_k$ is significantly different from zero) (Gimba , 2007). To get the correlogram, a graph of $\rho_k$ against k (Lag) was plotted (Kalsie & Kalra, 2015).

Given the following regression equation;

$R_{i,t} = \alpha_i + \beta_i R_{i,t-1} + e_{i,t}$ ……. (ii)

Where;

$R_{i,t}$ represents the log returns of stock 'i' at time 't'

$\alpha_i$ represents the constant of the regression equation (ii)

$\beta_i$ is the beta coefficient which represents the measure of serial correlation of stock 'i'

$R_{i,t-1}$ represents lagged returns, that is, log returns at time 't-1'

$e_{i,t}$ represents random error

The serial correlation following equation (ii) can also be measured by the null hypothesis that $\beta_i = 0$. To test for the serial correlation coefficient, two test statistics was used: Durbin Watson statistic can be used which is a test for the first order autocorrelation and Ljung-Box Q statistic which is asymptotically distributed like the chi-square (Moustafa, 2004).

Durbin Watson test was used to test that the residuals from the linear regression equation (ii) were independent. The assumption behind Durbin Watson test is that the errors in the regression model are generated by a first – order autoregression process observed at equally spaced time periods, that is;

$e_{i,t} = \rho\, e_{i,t-1} + a_t$ …… (iii)

Since most regression problems involving time series data exhibit positive autocorrelation, hence, the hypotheses tested under the durbin watson test are;

$H_0 : \rho = 0$

$H_1 : \rho > 0$

Where $\rho$ is the coefficient of serial correlation;

$d = \frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$ …… (iv)

Where;

$e_i = y_i - \hat{y}_i$

$y_i and\ \hat{y}_i$ are the observed and predicted values respectively of the response variable for individual stock, 'i'.

d becomes smaller as the serial correlation increases. There are documented upper and lower critical values, $d_U$ and $d_L$ for different values of k (number of explanatory variable) and n (data size for each explanatory variable).

If $d < d_L\ reject\ H_0 : \rho = 0$

If $d > d_U\ do\ not\ reject\ H_0 : \rho = 0$

If $d_L < d < d_U\ test\ is\ inconclusive$

For tests of negative correlation using Durbin Watson statistic, the statistic $4 - d$ is used. Thus the decision rules for $H_0 : \rho = 0$ versus $H_0 : \rho < 0$ are the same as those used in testing for positive autocorrelation.

Ljung-Box Q statistic was also used to test the joint hypothesis that all autocorrelations are simultaneously equal to zero (Gimba, 2007). According to Oprean (2012), instead of testing the randomness at each distinct lag, it tests the overall randomness based on a number of lags, and is

therefore a portmanteau test. Ljung-Box Q statistic is given by

$Q_{LB} = n\,(n+2)\sum_{t=1}^{i}\frac{p^2\,(t)}{n-t}$ ..... (v)

Where ρ (*t*) is the estimated autocorrelation coefficients, and *t* is a given lag; *t* takes the values of 1 to 10 lags, and *n* denotes the sample size. If the calculated value of $Q_{LB}$ exceeds the critical value of $\chi^2$ with *i* -1 degrees of freedom, then at least one value of ρ (*t* ) is statistically different from 0 at the specified significance level.

Runs test which is also known as Geary test (Vulić, 2010) is a non-parametric statistical approach which tests whether successive price changes are independent. It is a function of two parameters, which are the type of the run and the length. The run type means that stock prices can have positive (+), negative (-) or no change (0). A run is counted every time the price changes its sign. Under the null hypothesis that successive outcomes (share price changes) are independent, the total expected number of runs is distributed as normal with the following mean (Gimba , 2007; Vulić, 2010; Gupta & Gedam, 2014):

E (m) = $\frac{N(N+1)-\sum_{i=1}^{3}n_i^2}{N}$ Alternatively, *E (m)* = $\frac{2n_1n_2}{n_1+n_2}+1$.....(vi)

For large observations (n > 30), the sampling distribution or the runs (m) is approximately normal and the standard error of the runs (m) is;

$\sigma_m = \sqrt{\frac{\sum_{i=1}^{3}n_i^2\left[\sum_{i=1}^{3}n_i^2+N(N+1)\right]-2N\sum_{i=1}^{3}n_i^3-N^3}{N^2\,(N-1)}}$

Alternatively

$\sigma_m = \sqrt{\frac{2n_1n_2(2n_1n_2-n_1-n_2)}{N^2\,(N-1)}}$ .....(vii)

Where N=$\sum_{i=1}^{3}n_i$ is the total number of observations (price changes or returns), $n_i$ is the number of price changes (returns) in each category, $n_1\ and\ n_2$ are the number of positive and negative price changes respectively and 'm' represents the observed number of runs.

The asymptotic Z – statistic which is approximately normal is given by

Z (m) = $\frac{m\pm0.5-E(m)}{\sigma_m}$..... (viii)

Where 0.5 is the continuity adjustment in which the sign is negative (-0.5) if m $\geq E(m)$ and positive otherwise. Since dependence occurs among share returns when runs are too small or too large (Gimba , 2007), this test will therefore be a two-tailed test.

In order to test the weak form of EMH, the Runs Test is applied at 5% significance level where Z (5% two-tailed) = $\pm\,1.96$. The test for serial dependence is carried out by comparing the actual number of runs in the price series to the expected number runs. If the calculated |Z| value is greater than 1.96, we reject the null hypothesis and conclude that the analysed stock return in the NSE cannot be predicted.

**RESULTS AND DISCUSSIONS**

**Table 2:** ***Runs Test Analysis***

| # | Stock | N | M | E(m) | $\sigma\,(m)$ | \|Z\| | p-value | Hypothesis testing where Z (critical) =1.96 at Significance level of 0.05 |
|---|---|---|---|---|---|---|---|---|
| 1 | EGAD | 59 | 30 | 29.81 | 3.717 | 0.050 | 0.960 | DO NOT REJECT HO |
| 2 | KUKZ | 59 | 24 | 29.47 | 3.673 | 1.491 | 0.136 | DO NOT REJECT HO |
| 3 | SASN | 59 | 26 | 29.07 | 3.619 | 0.848 | 0.397 | DO NOT REJECT HO |
| 4 | WTK | 59 | 28 | 30.49 | 3.806 | 0.655 | 0.513 | DO NOT REJECT HO |
| 5 | REA | 59 | 24 | 29.81 | 3.717 | 1.564 | 0.118 | DO NOT REJECT HO |
| 6 | CG | 59 | 26 | 29.47 | 3.673 | 0.946 | 0.344 | DO NOT REJECT HO |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | FIRE | 59 | 27 | 28.59 | 3.557 | 0.448 | 0.654 | DO NOT REJECT HO |
| 8 | BBK | 59 | 27 | 29.81 | 3.717 | 0.757 | 0.449 | DO NOT REJECT HO |
| 9 | CFC* | 59 | 22 | 30.49 | 3.806 | 2.231 | 0.026 | REJECT HO |
| 10 | DTK* | 59 | 14 | 26.76 | 3.317 | 3.848 | 0.000 | REJECT HO |
| 11 | EQTY | 59 | 27 | 30.49 | 3.806 | 0.917 | 0.359 | DO NOT REJECT HO |
| 12 | HFCK* | 59 | 18 | 29.47 | 3.673 | 3.124 | 0.002 | REJECT HO |
| 13 | KCB | 59 | 25 | 30.08 | 3.753 | 1.355 | 0.175 | DO NOT REJECT HO |
| 14 | NBK | 59 | 26 | 29.47 | 3.673 | 0.946 | 0.344 | DO NOT REJECT HO |
| 15 | NICB* | 59 | 20 | 29.47 | 3.673 | 2.580 | 0.010 | REJECT HO |
| 16 | SCBK | 59 | 23 | 28.59 | 3.557 | 1.572 | 0.116 | DO NOT REJECT HO |
| 17 | COOP* | 59 | 21 | 30.29 | 3.779 | 2.458 | 0.014 | REJECT HO |
| 18 | XPRS | 59 | 24 | 28.05 | 3.486 | 1.162 | 0.245 | DO NOT REJECT HO |
| 19 | KQ | 59 | 22 | 29.07 | 3.619 | 1.953 | 0.051 | DO NOT REJECT HO |
| 20 | NMG | 59 | 28 | 28.05 | 3.486 | 0.015 | 0.988 | DO NOT REJECT HO |
| 21 | SGL | 59 | 25 | 28.59 | 3.557 | 1.010 | 0.312 | DO NOT REJECT HO |
| 22 | TPSE | 59 | 24 | 29.81 | 3.717 | 1.564 | 0.118 | DO NOT REJECT HO |
| 23 | SCAN* | 59 | 19 | 30.29 | 3.779 | 2.987 | 0.003 | REJECT HO |
| 24 | ARM | 59 | 24 | 27.44 | 3.406 | 1.010 | 0.312 | DO NOT REJECT HO |
| 25 | BAMB | 59 | 25 | 29.47 | 3.673 | 1.218 | 0.223 | DO NOT REJECT HO |
| 26 | BERG* | 59 | 20 | 29.07 | 3.619 | 2.505 | 0.012 | REJECT HO |
| 27 | CABL | 59 | 27 | 29.81 | 3.717 | 0.757 | 0.449 | DO NOT REJECT HO |
| 28 | KEGN | 59 | 27 | 30.49 | 3.806 | 0.917 | 0.359 | DO NOT REJECT HO |
| 29 | KENO | 59 | 26 | 30.49 | 3.806 | 1.180 | 0.238 | DO NOT REJECT HO |
| 30 | KPLC | 59 | 25 | 30.42 | 3.797 | 1.428 | 0.153 | DO NOT REJECT HO |
| 31 | TOTL | 59 | 23 | 29.81 | 3.717 | 1.833 | 0.067 | DO NOT REJECT HO |
| 32 | JUB | 59 | 28 | 30.29 | 3.779 | 0.605 | 0.545 | DO NOT REJECT HO |
| 33 | KNRE | 59 | 23 | 29.81 | 3.717 | 1.833 | 0.067 | DO NOT REJECT HO |
| 34 | PAFR* | 59 | 16 | 28.59 | 3.557 | 3.540 | 0.000 | REJECT HO |
| 35 | ICDC* | 59 | 20 | 28.59 | 3.557 | 2.416 | 0.016 | REJECT HO |
| 36 | OCH | 59 | 33 | 30.29 | 3.779 | 0.718 | 0.473 | DO NOT REJECT HO |
| 37 | BAT | 59 | 21 | 25.20 | 3.112 | 1.351 | 0.177 | DO NOT REJECT HO |
| 38 | EABL* | 59 | 17 | 28.59 | 3.557 | 3.259 | 0.001 | REJECT HO |
| 39 | EVRD | 59 | 26 | 29.81 | 3.717 | 1.026 | 0.305 | DO NOT REJECT HO |
| 40 | MSC | 59 | 23 | 29.07 | 3.619 | 1.677 | 0.094 | DO NOT REJECT HO |
| 41 | UNGA | 59 | 27 | 29.81 | 3.717 | 0.757 | 0.449 | DO NOT REJECT HO |
| 42 | SCOM* | 59 | 18 | 28.05 | 3.486 | 2.883 | 0.004 | REJECT HO |

**Source: Prepared by the author (2016)**

***** These were the stocks that did not exhibit a weak form of market efficiency in the NSE in this study based on the Runs test analysis.

**Serial Correlation Tests Analysis**

**Autocorrelation Function (correlogram) Test (ACF)**

The graphs below showed the autocorrelation of the 42 companies against lag periods. This study used up to ten lag periods to check whether there was serial correlation in the time series of each of the 42 companies that were chosen for the study. The 95% confidence limits for the correlogram was plotted at $\pm 2/\sqrt{N}$ where N (observations) = 59. Therefore, the 95% confidence limits was $\pm 2/\sqrt{59} = \pm 0.260$. To see if the ACFs were significant, we calculated the Ljung Box Q statistics for 1 to 10 lags which tests the joint null hypothesis that all autocorrelations across the lags were simultaneously equal to zero or that the returns were independently distributed. The Q – statistics were then compared to the critical value for the chi-square distribution with 'i' degrees of freedom at the 5 per cent level of significance where 'i' is the number of lags.

**Table 3:** ***Kenya Airways (KQ)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.025 | 0.037459 | 3.841 | DO NOT REJECT HO |
| 2 | 0.112 | 0.823452 | 5.991 | DO NOT REJECT HO |
| 3 | -0.056 | 1.023676 | 7.815 | DO NOT REJECT HO |
| 4 | 0.084 | 1.489593 | 9.488 | DO NOT REJECT HO |
| 5 | 0.018 | 1.511664 | 11.07 | DO NOT REJECT HO |
| 6 | 0.053 | 1.703173 | 12.592 | DO NOT REJECT HO |
| 7 | 0.034 | 1.784012 | 14.067 | DO NOT REJECT HO |
| 8 | 0.090 | 2.35596 | 15.507 | DO NOT REJECT HO |
| 9 | 0.067 | 2.682096 | 16.919 | DO NOT REJECT HO |
| 10 | -0.144 | 4.203572 | 18.307 | DO NOT REJECT HO |

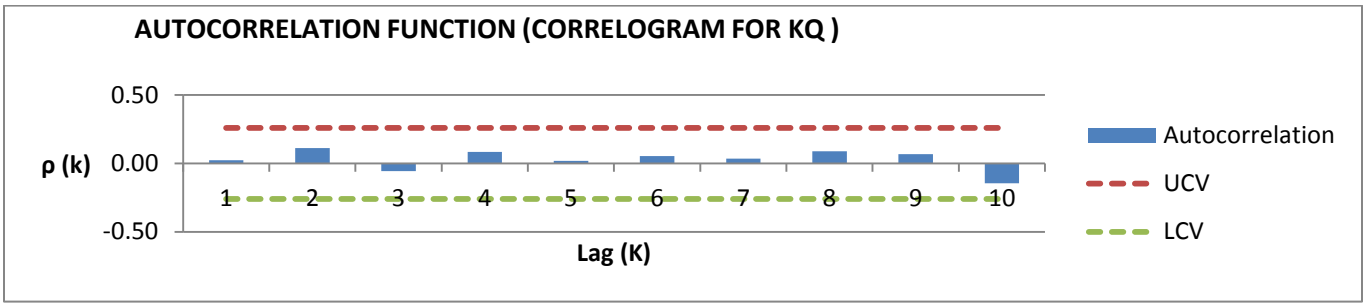


Figure 1: Correlogram for KQ

The correlogram above showed that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it was concluded that the Kenya Airways stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 4:** ***ARM Cement Ltd (ARM)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.008 | 0.004467 | 3.841 | DO NOT REJECT HO |
| 2 | -0.055 | 0.192762 | 5.991 | DO NOT REJECT HO |
| 3 | -0.034 | 0.268803 | 7.815 | DO NOT REJECT HO |
| 4 | -0.047 | 0.415964 | 9.488 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 5 | 0.052 | 0.596603 | 11.07 | DO NOT REJECT HO |
| 6 | -0.010 | 0.603022 | 12.592 | DO NOT REJECT HO |
| 7 | -0.022 | 0.63722 | 14.067 | DO NOT REJECT HO |
| 8 | -0.088 | 1.187343 | 15.507 | DO NOT REJECT HO |
| 9 | -0.075 | 1.595726 | 16.919 | DO NOT REJECT HO |
| 10 | -0.097 | 2.289978 | 18.307 | DO NOT REJECT HO |

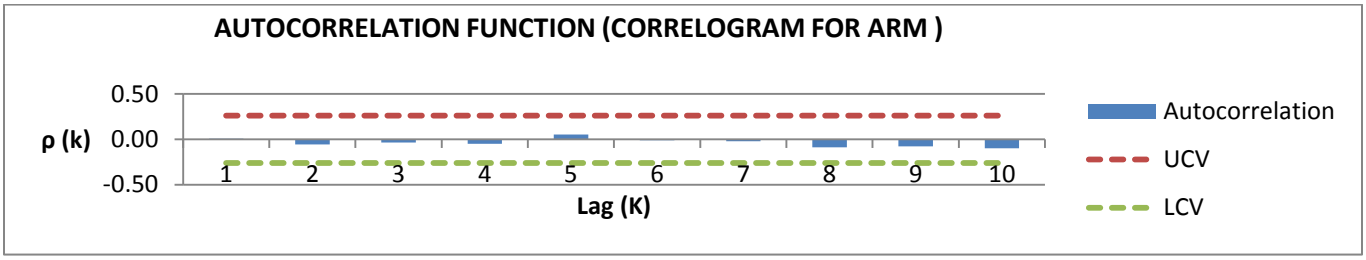


Figure 2: Correlogram for ARM

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it was concluded that the ARM stock prices were not serially correlated and thus they exhibited a weak form of EMH.

**Table 5:** ***BAT Kenya (BAT)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.427 | 11.32855 | 3.841 | REJECT HO |
| 2 | 0.137 | 12.51332 | 5.991 | REJECT HO |
| 3 | 0.169 | 14.35438 | 7.815 | REJECT HO |
| 4 | 0.149 | 15.80271 | 9.488 | REJECT HO |
| 5 | 0.044 | 15.92989 | 11.07 | REJECT HO |
| 6 | -0.027 | 15.98041 | 12.592 | REJECT HO |
| 7 | -0.013 | 15.99294 | 14.067 | REJECT HO |
| 8 | -0.015 | 16.00805 | 15.507 | REJECT HO |
| 9 | -0.297 | 22.33603 | 16.919 | REJECT HO |
| 10 | -0.394 | 33.72659 | 18.307 | REJECT HO |

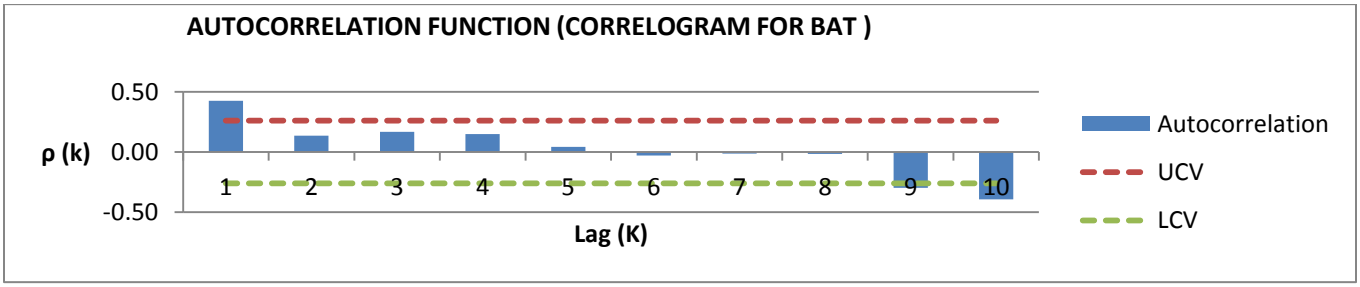


Figure 3: Correlogram for BAT

The correlogram above showed that three of the autocorrelations among the 10 lags were significant in that they were higher than critical values. Hence, based on the ACF analysis, it was concluded that the

BAT stock prices were serially correlated at 1, 9 and 10 lags and thus they did not exhibit a weak form of EMH.

**Table 6: *Barclays Bank of Kenya (BBK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.030 | 0.055 | 3.841 | DO NOT REJECT HO |
| 2 | 0.101 | 0.704 | 5.991 | DO NOT REJECT HO |
| 3 | 0.102 | 1.371 | 7.815 | DO NOT REJECT HO |
| 4 | -0.028 | 1.424 | 9.488 | DO NOT REJECT HO |
| 5 | -0.186 | 3.722 | 11.070 | DO NOT REJECT HO |
| 6 | 0.156 | 5.366 | 12.592 | DO NOT REJECT HO |
| 7 | -0.018 | 5.389 | 14.067 | DO NOT REJECT HO |
| 8 | -0.029 | 5.450 | 15.507 | DO NOT REJECT HO |
| 9 | -0.010 | 5.457 | 16.919 | DO NOT REJECT HO |
| 10 | 0.033 | 5.536 | 18.307 | DO NOT REJECT HO |

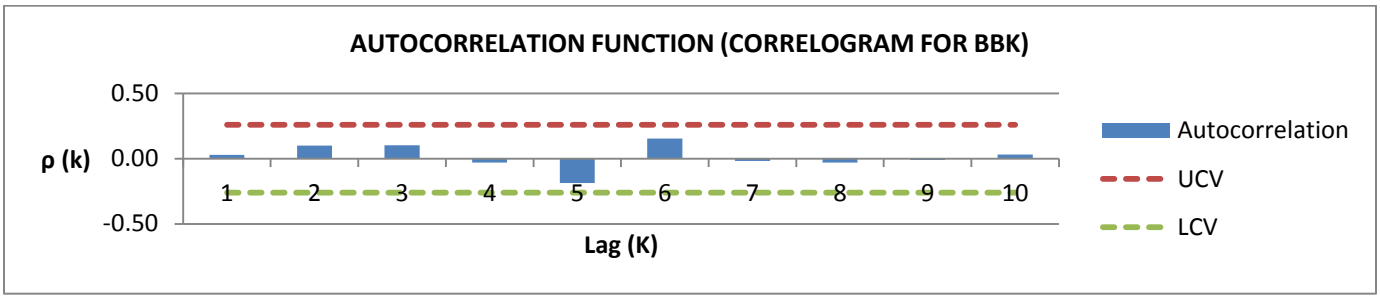


Figure 4: Correlogram for BBK

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the BBK stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 7: *Car & Gen (CG)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.019 | 0.022 | 3.841 | DO NOT REJECT HO |
| 2 | 0.045 | 0.151 | 5.991 | DO NOT REJECT HO |
| 3 | -0.094 | 0.713 | 7.815 | DO NOT REJECT HO |
| 4 | -0.018 | 0.733 | 9.488 | DO NOT REJECT HO |
| 5 | -0.115 | 1.608 | 11.070 | DO NOT REJECT HO |
| 6 | -0.095 | 2.216 | 12.592 | DO NOT REJECT HO |
| 7 | 0.105 | 2.973 | 14.067 | DO NOT REJECT HO |
| 8 | -0.037 | 3.071 | 15.507 | DO NOT REJECT HO |
| 9 | 0.197 | 5.874 | 16.919 | DO NOT REJECT HO |
| 10 | -0.296 | 12.303 | 18.307 | DO NOT REJECT HO |

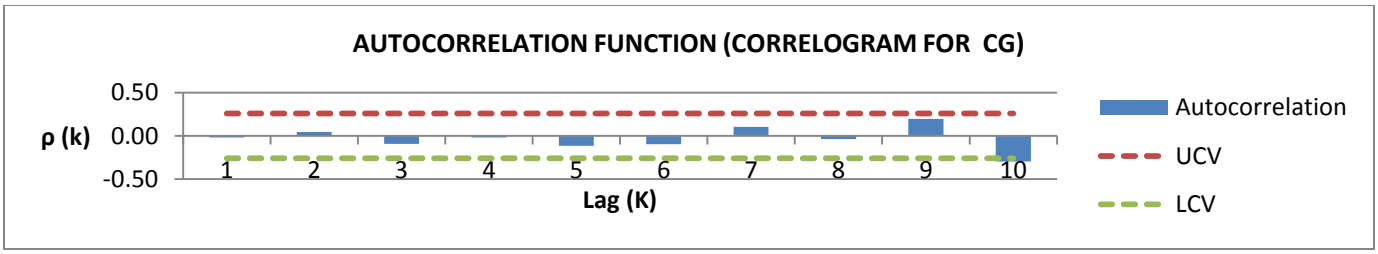


Figure 5: Correlogram for CG

The correlogram above shows that one of the autocorrelations among the 10 lags was significant in that they were higher than critical values. Hence, based on the ACF analysis, it can be concluded that CG stock prices are serially correlated at 10 lags.

**Table 8:** ***CFC Stanbic (CFC)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.040 | 0.101 | 3.841 | DO NOT REJECT HO |
| 2 | -0.349 | 7.795 | 5.991 | REJECT HO |
| 3 | 0.019 | 7.818 | 7.815 | REJECT HO |
| 4 | 0.025 | 7.860 | 9.488 | DO NOT REJECT HO |
| 5 | 0.046 | 7.998 | 11.070 | DO NOT REJECT HO |
| 6 | -0.105 | 8.746 | 12.592 | DO NOT REJECT HO |
| 7 | -0.011 | 8.754 | 14.067 | DO NOT REJECT HO |
| 8 | 0.011 | 8.762 | 15.507 | DO NOT REJECT HO |
| 9 | 0.004 | 8.763 | 16.919 | DO NOT REJECT HO |
| 10 | 0.008 | 8.767 | 18.307 | DO NOT REJECT HO |

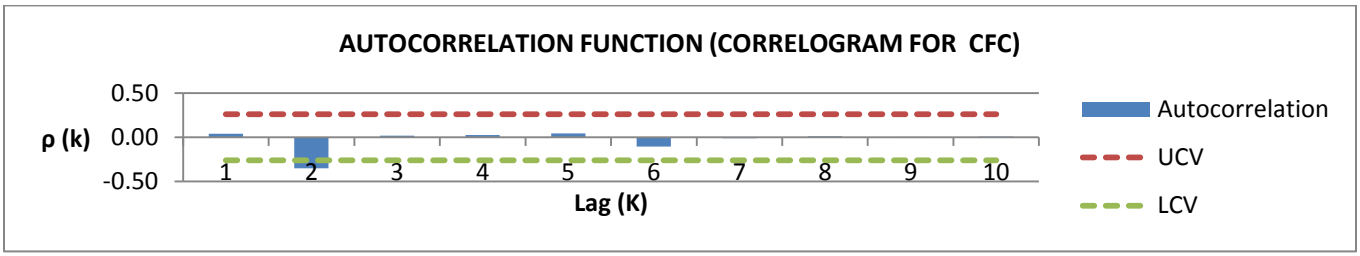


Figure 6: Correlogram for CFC

The correlogram above shows that one of the autocorrelations among the 10 lags was significant in that they were higher than critical values. Hence, based on the ACF analysis, it can be concluded that CFC stock prices are serially correlated at 2 lags.

**Table 9:** ***Diamond Trust Bank of Kenya (DTK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.131 | 1.070 | 3.841 | DO NOT REJECT HO |
| 2 | 0.025 | 1.109 | 5.991 | DO NOT REJECT HO |
| 3 | -0.017 | 1.127 | 7.815 | DO NOT REJECT HO |
| 4 | 0.004 | 1.128 | 9.488 | DO NOT REJECT HO |
| 5 | 0.161 | 2.859 | 11.070 | DO NOT REJECT HO |
| 6 | -0.012 | 2.869 | 12.592 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 7 | 0.024 | 2.908 | 14.067 | DO NOT REJECT HO |
| 8 | -0.029 | 2.968 | 15.507 | DO NOT REJECT HO |
| 9 | -0.016 | 2.987 | 16.919 | DO NOT REJECT HO |
| 10 | -0.082 | 3.485 | 18.307 | DO NOT REJECT HO |

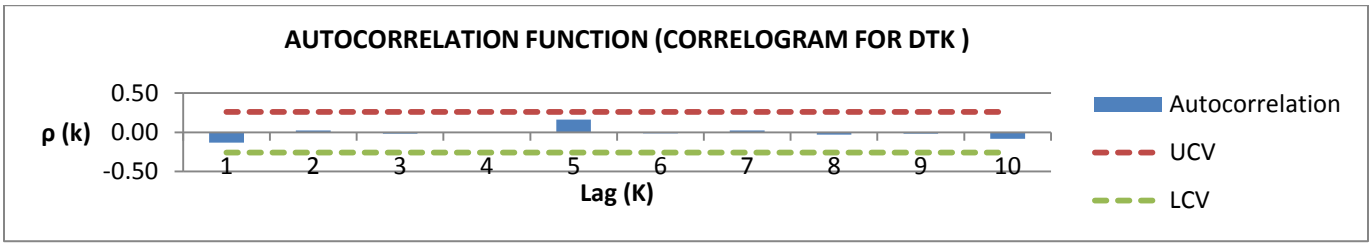


Figure 7: Correlogram for DTK

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the DTK stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 10: *JUBILEE (JUB)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.143 | 1.276 | 3.841 | DO NOT REJECT HO |
| 2 | -0.084 | 1.721 | 5.991 | DO NOT REJECT HO |
| 3 | -0.093 | 2.281 | 7.815 | DO NOT REJECT HO |
| 4 | -0.077 | 2.668 | 9.488 | DO NOT REJECT HO |
| 5 | -0.009 | 2.673 | 11.070 | DO NOT REJECT HO |
| 6 | 0.013 | 2.685 | 12.592 | DO NOT REJECT HO |
| 7 | 0.089 | 3.237 | 14.067 | DO NOT REJECT HO |
| 8 | 0.069 | 3.574 | 15.507 | DO NOT REJECT HO |
| 9 | -0.031 | 3.645 | 16.919 | DO NOT REJECT HO |
| 10 | -0.069 | 3.997 | 18.307 | DO NOT REJECT HO |

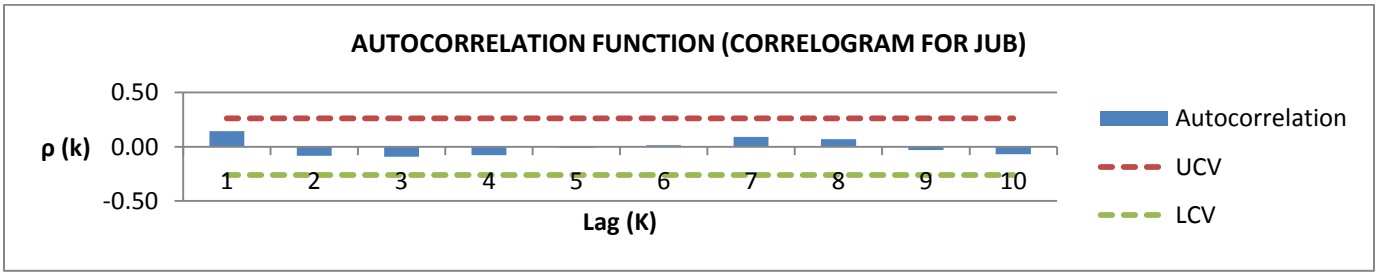


Figure 8: Correlogram for JUB

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the JUB stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 11: *Kenya Commercial Bank (KCB)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.233 | 3.358 | 3.841 | DO NOT REJECT HO |
| 2 | 0.112 | 4.152 | 5.991 | DO NOT REJECT HO |
| 3 | -0.153 | 5.653 | 7.815 | DO NOT REJECT HO |
| 4 | -0.044 | 5.779 | 9.488 | DO NOT REJECT HO |
| 5 | -0.001 | 5.779 | 11.070 | DO NOT REJECT HO |
| 6 | -0.075 | 6.163 | 12.592 | DO NOT REJECT HO |
| 7 | 0.068 | 6.488 | 14.067 | DO NOT REJECT HO |
| 8 | 0.041 | 6.604 | 15.507 | DO NOT REJECT HO |
| 9 | 0.004 | 6.605 | 16.919 | DO NOT REJECT HO |
| 10 | -0.045 | 6.751 | 18.307 | DO NOT REJECT HO |

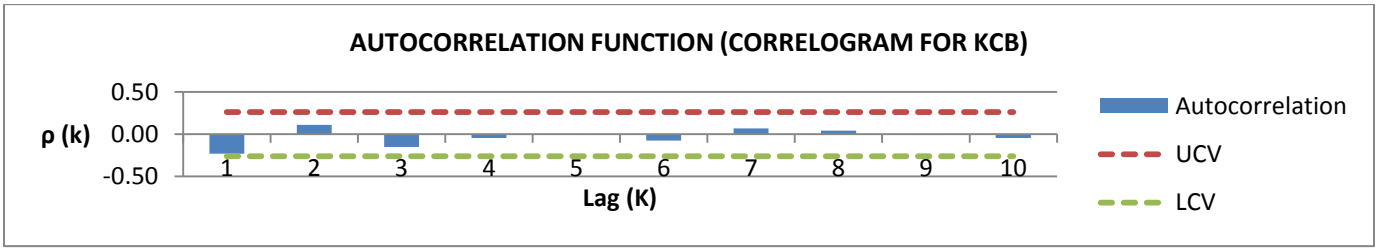


Figure 9: Correlogram for KCB

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KCB stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 12:** ***Mumias Sugar Company (MSC)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.306 | 5.802 | 3.841 | REJECT HO |
| 2 | 0.095 | 6.372 | 5.991 | REJECT HO |
| 3 | 0.209 | 9.179 | 7.815 | REJECT HO |
| 4 | -0.095 | 9.772 | 9.488 | REJECT HO |
| 5 | -0.128 | 10.871 | 11.070 | DO NOT REJECT HO |
| 6 | 0.045 | 11.009 | 12.592 | DO NOT REJECT HO |
| 7 | -0.002 | 11.009 | 14.067 | DO NOT REJECT HO |
| 8 | 0.045 | 11.150 | 15.507 | DO NOT REJECT HO |
| 9 | 0.148 | 12.731 | 16.919 | DO NOT REJECT HO |
| 10 | -0.023 | 12.768 | 18.307 | DO NOT REJECT HO |

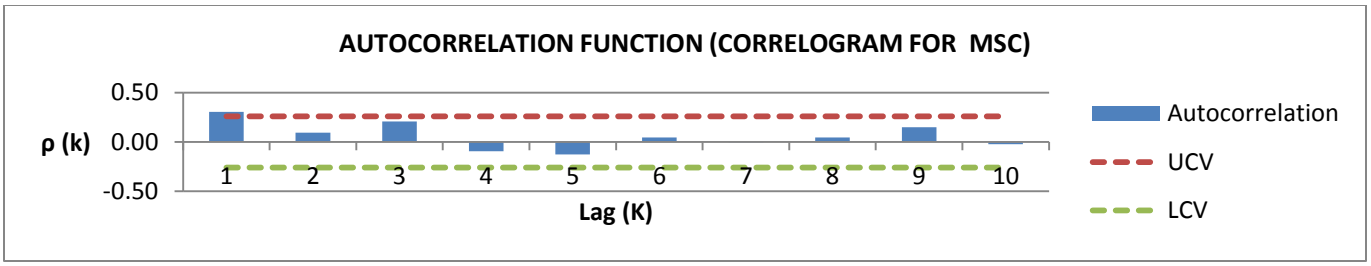


Figure 10: Correlogram for MSC

The correlogram above shows that not all the autocorrelations among the 10 lags were significant in that one was beyond critical values. Hence, based on the ACF analysis, it can be concluded that the MSC stock prices are not serially correlated at lag 1.

**Table 13: *National Bank of Kenya (NBK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.149 | 1.370 | 3.841 | DO NOT REJECT HO |
| 2 | -0.011 | 1.377 | 5.991 | DO NOT REJECT HO |
| 3 | -0.070 | 1.688 | 7.815 | DO NOT REJECT HO |
| 4 | -0.060 | 1.927 | 9.488 | DO NOT REJECT HO |
| 5 | -0.052 | 2.104 | 11.070 | DO NOT REJECT HO |
| 6 | -0.054 | 2.304 | 12.592 | DO NOT REJECT HO |
| 7 | 0.112 | 3.173 | 14.067 | DO NOT REJECT HO |
| 8 | 0.156 | 4.897 | 15.507 | DO NOT REJECT HO |
| 9 | 0.022 | 4.932 | 16.919 | DO NOT REJECT HO |
| 10 | 0.136 | 6.291 | 18.307 | DO NOT REJECT HO |

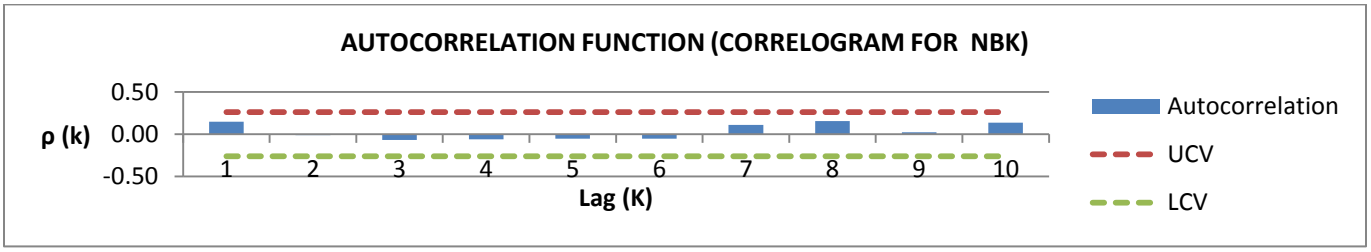


Figure 11: Correlogram for NBK

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the NBK stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 14: *NIC Bank (NICB)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.109 | 0.742 | 3.841 | DO NOT REJECT HO |
| 2 | -0.156 | 2.277 | 5.991 | DO NOT REJECT HO |
| 3 | -0.076 | 2.653 | 7.815 | DO NOT REJECT HO |
| 4 | 0.044 | 2.782 | 9.488 | DO NOT REJECT HO |
| 5 | 0.060 | 3.026 | 11.070 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 6 | 0.072 | 3.376 | 12.592 | DO NOT REJECT HO |
| 7 | -0.031 | 3.442 | 14.067 | DO NOT REJECT HO |
| 8 | 0.096 | 4.090 | 15.507 | DO NOT REJECT HO |
| 9 | 0.060 | 4.351 | 16.919 | DO NOT REJECT HO |
| 10 | -0.124 | 5.474 | 18.307 | DO NOT REJECT HO |

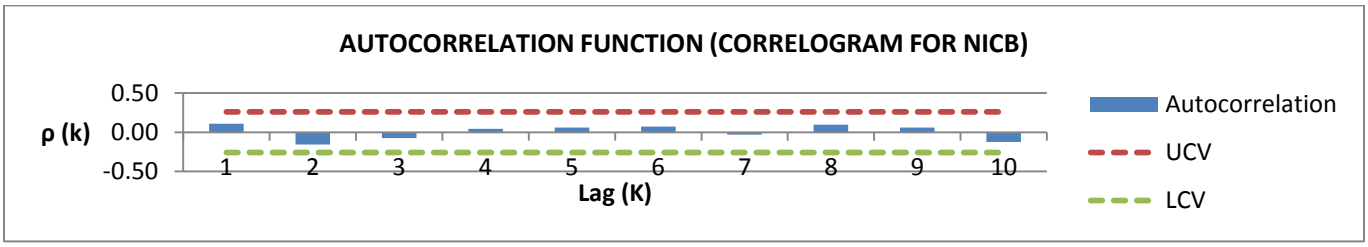


Figure 12: Correlogram for NICB

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the NICB stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 15: *Nation Media Group (NMG)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.125 | 0.970 | 3.841 | DO NOT REJECT HO |
| 2 | 0.089 | 1.466 | 5.991 | DO NOT REJECT HO |
| 3 | -0.021 | 1.496 | 7.815 | DO NOT REJECT HO |
| 4 | -0.004 | 1.497 | 9.488 | DO NOT REJECT HO |
| 5 | 0.168 | 3.388 | 11.070 | DO NOT REJECT HO |
| 6 | 0.093 | 3.982 | 12.592 | DO NOT REJECT HO |
| 7 | 0.151 | 5.559 | 14.067 | DO NOT REJECT HO |
| 8 | -0.137 | 6.891 | 15.507 | DO NOT REJECT HO |
| 9 | -0.133 | 8.156 | 16.919 | DO NOT REJECT HO |
| 10 | -0.022 | 8.192 | 18.307 | DO NOT REJECT HO |

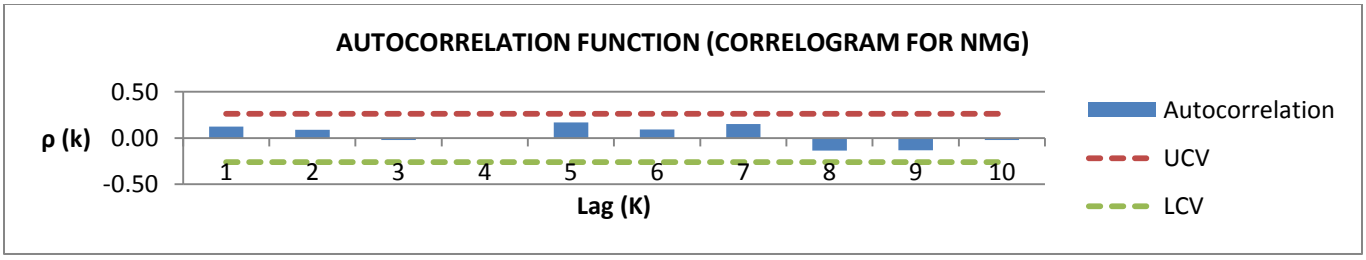


Figure 13: Correlogram for NMG

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the NMG stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 16: *Olympia (OCH)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.103 | 0.659 | 3.841 | DO NOT REJECT HO |
| 2 | 0.153 | 2.146 | 5.991 | DO NOT REJECT HO |
| 3 | -0.146 | 3.510 | 7.815 | DO NOT REJECT HO |
| 4 | -0.046 | 3.646 | 9.488 | DO NOT REJECT HO |
| 5 | 0.084 | 4.117 | 11.070 | DO NOT REJECT HO |
| 6 | 0.021 | 4.146 | 12.592 | DO NOT REJECT HO |
| 7 | 0.039 | 4.253 | 14.067 | DO NOT REJECT HO |
| 8 | -0.120 | 5.269 | 15.507 | DO NOT REJECT HO |
| 9 | 0.027 | 5.320 | 16.919 | DO NOT REJECT HO |
| 10 | -0.072 | 5.705 | 18.307 | DO NOT REJECT HO |

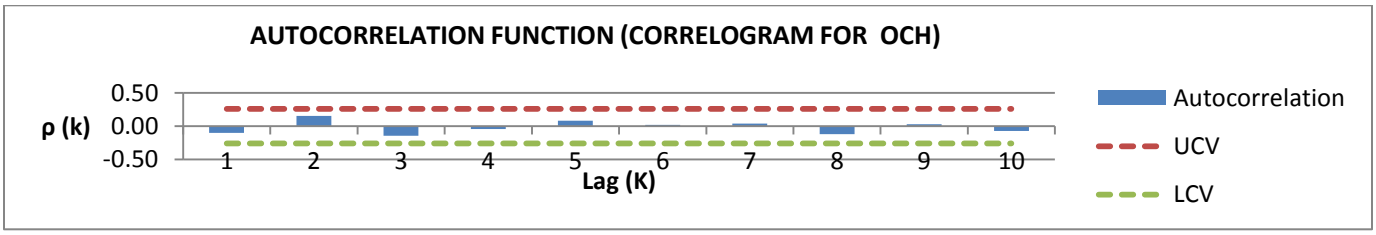


Figure 14: Correlogram for OCH

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the OCH stock prices are not serially correlated and thus they exhibit a weak form of EMH

**Table 17: *REA Vipingo (REA)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.109 | 0.740 | 3.841 | DO NOT REJECT HO |
| 2 | -0.251 | 4.731 | 5.991 | DO NOT REJECT HO |
| 3 | -0.137 | 5.942 | 7.815 | DO NOT REJECT HO |
| 4 | 0.083 | 6.397 | 9.488 | DO NOT REJECT HO |
| 5 | 0.017 | 6.416 | 11.070 | DO NOT REJECT HO |
| 6 | -0.059 | 6.652 | 12.592 | DO NOT REJECT HO |
| 7 | -0.140 | 8.014 | 14.067 | DO NOT REJECT HO |
| 8 | 0.011 | 8.023 | 15.507 | DO NOT REJECT HO |
| 9 | 0.009 | 8.028 | 16.919 | DO NOT REJECT HO |
| 10 | 0.091 | 8.630 | 18.307 | DO NOT REJECT HO |

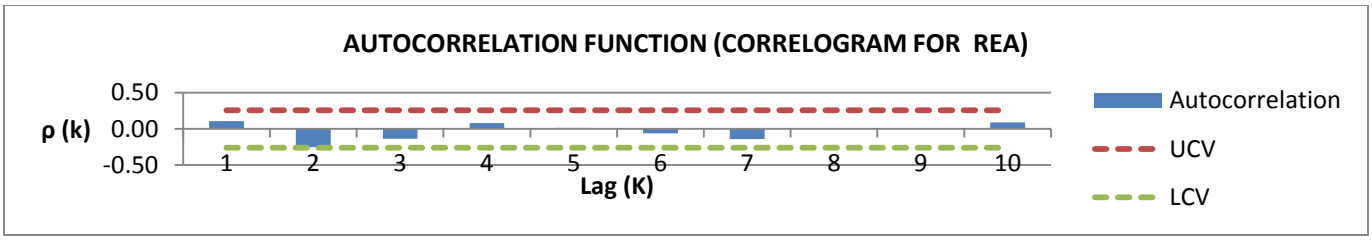


Figure 15: Correlogram for REA

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the REA stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 18: *Standard Group (SGL)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.110 | 0.747 | 3.841 | DO NOT REJECT HO |
| 2 | 0.004 | 0.749 | 5.991 | DO NOT REJECT HO |
| 3 | -0.009 | 0.753 | 7.815 | DO NOT REJECT HO |
| 4 | -0.134 | 1.935 | 9.488 | DO NOT REJECT HO |
| 5 | 0.010 | 1.942 | 11.070 | DO NOT REJECT HO |
| 6 | 0.132 | 3.126 | 12.592 | DO NOT REJECT HO |
| 7 | 0.014 | 3.140 | 14.067 | DO NOT REJECT HO |
| 8 | 0.018 | 3.162 | 15.507 | DO NOT REJECT HO |
| 9 | 0.128 | 4.345 | 16.919 | DO NOT REJECT HO |
| 10 | -0.021 | 4.379 | 18.307 | DO NOT REJECT HO |

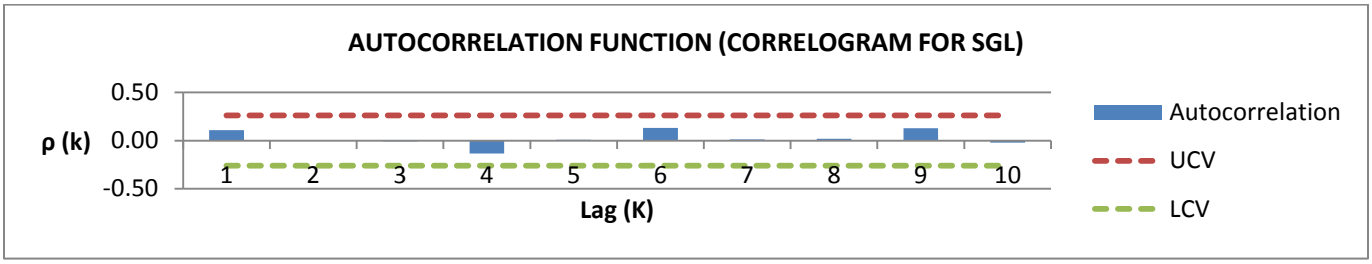


Figure 16: Correlogram for SGL

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the SGL stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 19: *Williamsons Tea AIMS (WTK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.056 | 0.198 | 3.841 | DO NOT REJECT HO |
| 2 | -0.200 | 2.730 | 5.991 | DO NOT REJECT HO |
| 3 | 0.226 | 6.022 | 7.815 | DO NOT REJECT HO |
| 4 | 0.105 | 6.746 | 9.488 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 5 | 0.051 | 6.921 | 11.070 | DO NOT REJECT HO |
| 6 | -0.125 | 7.981 | 12.592 | DO NOT REJECT HO |
| 7 | 0.052 | 8.167 | 14.067 | DO NOT REJECT HO |
| 8 | 0.065 | 8.465 | 15.507 | DO NOT REJECT HO |
| 9 | -0.126 | 9.606 | 16.919 | DO NOT REJECT HO |
| 10 | 0.071 | 9.979 | 18.307 | DO NOT REJECT HO |

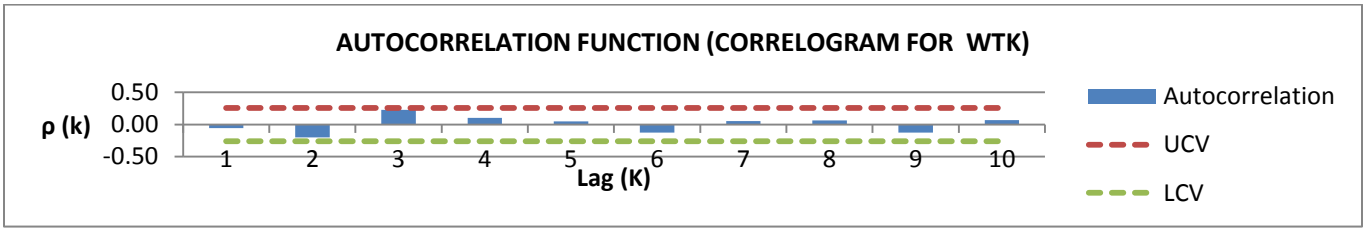


Figure 17: Correlogram for WTK

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the WTK stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 20: *Bamburi Cement (BAMB)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.258 | 4.140 | 3.841 | REJECT HO |
| 2 | -0.078 | 4.519 | 5.991 | DO NOT REJECT HO |
| 3 | -0.073 | 4.861 | 7.815 | DO NOT REJECT HO |
| 4 | 0.083 | 5.308 | 9.488 | DO NOT REJECT HO |
| 5 | -0.032 | 5.378 | 11.070 | DO NOT REJECT HO |
| 6 | -0.088 | 5.906 | 12.592 | DO NOT REJECT HO |
| 7 | -0.053 | 6.103 | 14.067 | DO NOT REJECT HO |
| 8 | 0.129 | 7.278 | 15.507 | DO NOT REJECT HO |
| 9 | 0.045 | 7.424 | 16.919 | DO NOT REJECT HO |
| 10 | 0.076 | 7.849 | 18.307 | DO NOT REJECT HO |

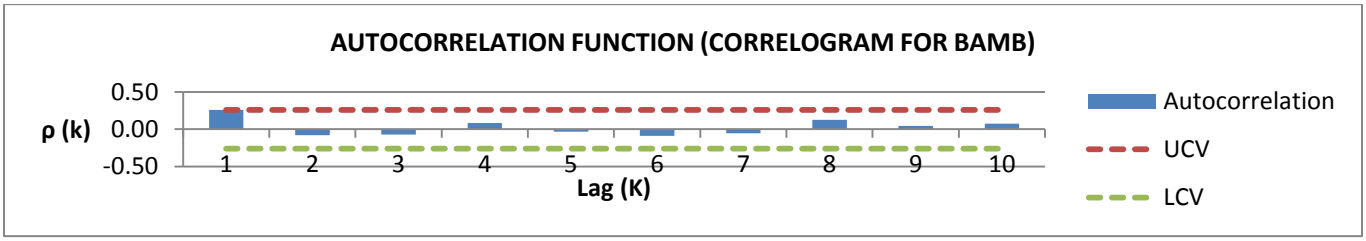


Figure 18: Correlogram for BAMB

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the BAMB stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 21:** ***Crown Berger (BERG)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.229 | 3.253 | 3.841 | DO NOT REJECT HO |
| 2 | -0.207 | 5.968 | 5.991 | DO NOT REJECT HO |
| 3 | -0.187 | 8.204 | 7.815 | REJECT HO |
| 4 | 0.023 | 8.240 | 9.488 | DO NOT REJECT HO |
| 5 | -0.002 | 8.240 | 11.070 | DO NOT REJECT HO |
| 6 | -0.218 | 11.472 | 12.592 | DO NOT REJECT HO |
| 7 | 0.128 | 12.604 | 14.067 | DO NOT REJECT HO |
| 8 | 0.108 | 13.426 | 15.507 | DO NOT REJECT HO |
| 9 | 0.037 | 13.524 | 16.919 | DO NOT REJECT HO |
| 10 | 0.067 | 13.852 | 18.307 | DO NOT REJECT HO |

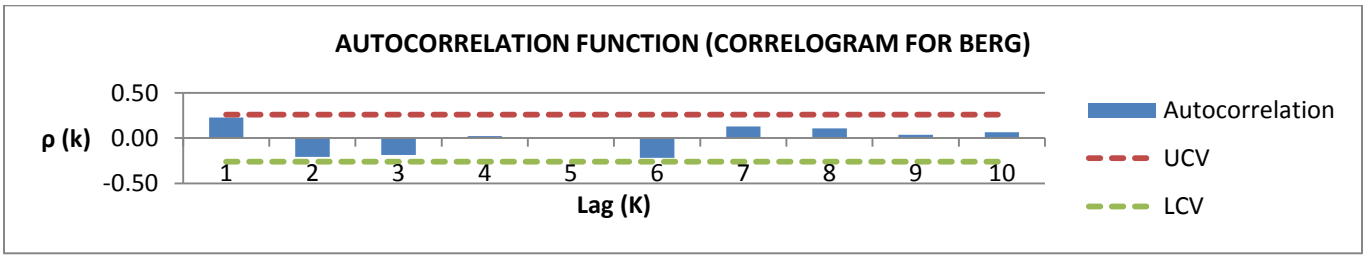


Figure 19: Correlogram for BERG

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the BERG stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 22:** ***EA Cables (CABL)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.139 | 1.196 | 3.841 | DO NOT REJECT HO |
| 2 | -0.179 | 3.222 | 5.991 | DO NOT REJECT HO |
| 3 | -0.024 | 3.258 | 7.815 | DO NOT REJECT HO |
| 4 | -0.060 | 3.495 | 9.488 | DO NOT REJECT HO |
| 5 | -0.033 | 3.568 | 11.070 | DO NOT REJECT HO |
| 6 | 0.042 | 3.688 | 12.592 | DO NOT REJECT HO |
| 7 | 0.065 | 3.977 | 14.067 | DO NOT REJECT HO |
| 8 | 0.145 | 5.452 | 15.507 | DO NOT REJECT HO |
| 9 | 0.156 | 7.193 | 16.919 | DO NOT REJECT HO |
| 10 | -0.073 | 7.588 | 18.307 | DO NOT REJECT HO |

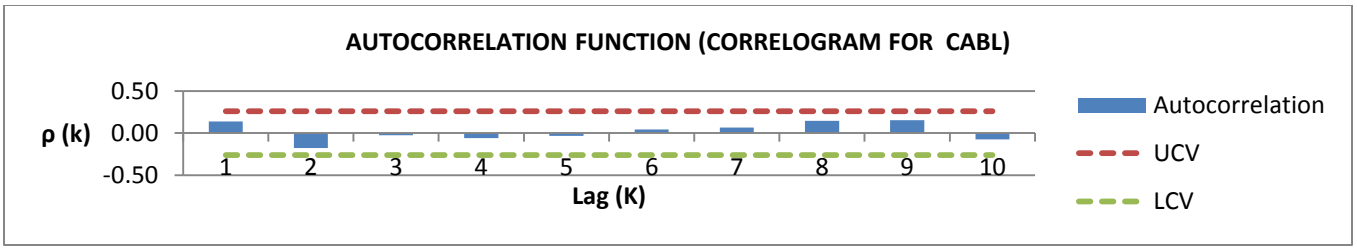


Figure 20: Correlogram for CABL

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the CABL stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 23: *Cooperative Bank (COOP)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.260 | 4.181 | 3.841 | REJECT HO |
| 2 | 0.054 | 4.368 | 5.991 | DO NOT REJECT HO |
| 3 | -0.133 | 5.497 | 7.815 | DO NOT REJECT HO |
| 4 | -0.137 | 6.717 | 9.488 | DO NOT REJECT HO |
| 5 | 0.091 | 7.265 | 11.070 | DO NOT REJECT HO |
| 6 | 0.152 | 8.839 | 12.592 | DO NOT REJECT HO |
| 7 | 0.094 | 9.454 | 14.067 | DO NOT REJECT HO |
| 8 | -0.049 | 9.621 | 15.507 | DO NOT REJECT HO |
| 9 | -0.098 | 10.316 | 16.919 | DO NOT REJECT HO |
| 10 | -0.038 | 10.423 | 18.307 | DO NOT REJECT HO |

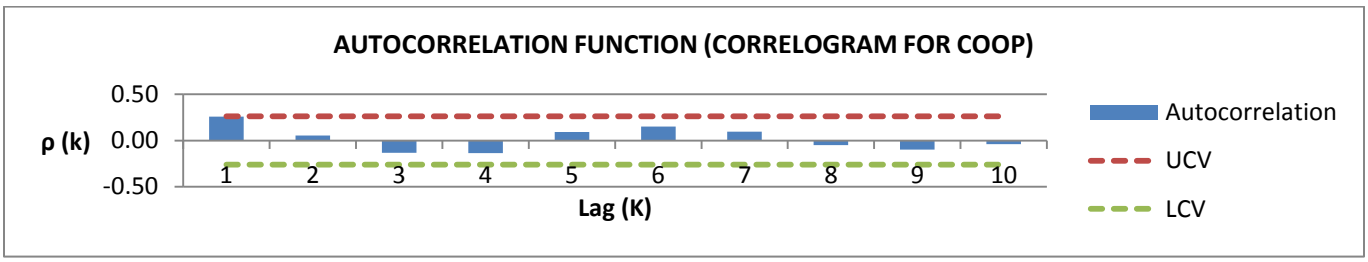


Figure 21: Correlogram for COOP

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the COOP stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 24: *East Africa Breweries (EABL)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.144 | 1.288 | 3.841 | DO NOT REJECT HO |
| 2 | -0.009 | 1.294 | 5.991 | DO NOT REJECT HO |
| 3 | -0.112 | 2.101 | 7.815 | DO NOT REJECT HO |
| 4 | -0.148 | 3.527 | 9.488 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 5 | 0.008 | 3.532 | 11.070 | DO NOT REJECT HO |
| 6 | -0.083 | 4.001 | 12.592 | DO NOT REJECT HO |
| 7 | 0.061 | 4.260 | 14.067 | DO NOT REJECT HO |
| 8 | 0.003 | 4.261 | 15.507 | DO NOT REJECT HO |
| 9 | -0.038 | 4.366 | 16.919 | DO NOT REJECT HO |
| 10 | 0.102 | 5.125 | 18.307 | DO NOT REJECT HO |

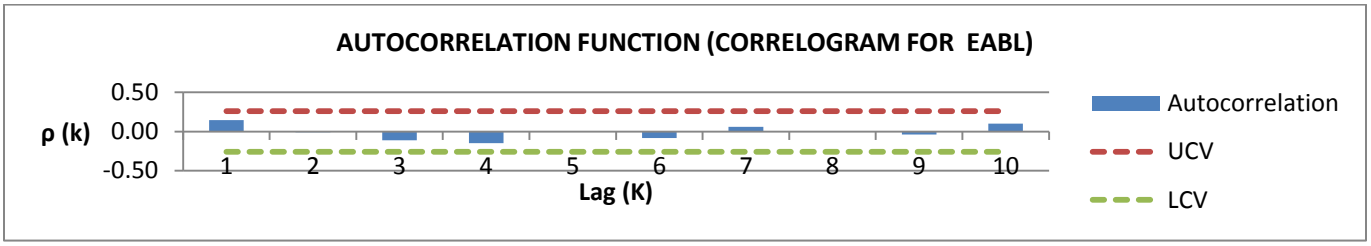


Figure 22: Correlogram for EABL

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the EABL stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 25: *Eaagads Aims (EGADS)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.075 | 0.351 | 3.841 | DO NOT REJECT HO |
| 2 | -0.067 | 0.632 | 5.991 | DO NOT REJECT HO |
| 3 | -0.075 | 0.992 | 7.815 | DO NOT REJECT HO |
| 4 | -0.064 | 1.263 | 9.488 | DO NOT REJECT HO |
| 5 | -0.045 | 1.396 | 11.070 | DO NOT REJECT HO |
| 6 | -0.052 | 1.582 | 12.592 | DO NOT REJECT HO |
| 7 | 0.044 | 1.714 | 14.067 | DO NOT REJECT HO |
| 8 | -0.022 | 1.748 | 15.507 | DO NOT REJECT HO |
| 9 | -0.149 | 3.339 | 16.919 | DO NOT REJECT HO |
| 10 | 0.085 | 3.871 | 18.307 | DO NOT REJECT HO |

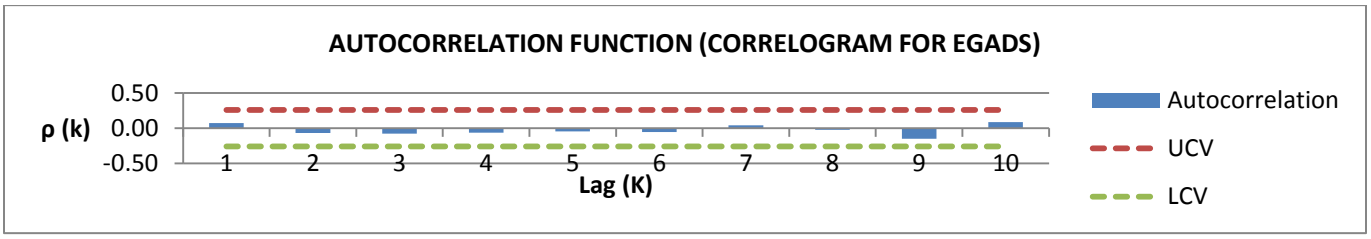


Figure 23: Correlogram for EGADS

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the EGADS stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 26: *Equity Bank (EQTY)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.258 | 4.132 | 3.841 | REJECT HO |
| 2 | 0.042 | 4.246 | 5.991 | DO NOT REJECT HO |
| 3 | -0.034 | 4.321 | 7.815 | DO NOT REJECT HO |
| 4 | 0.024 | 4.360 | 9.488 | DO NOT REJECT HO |
| 5 | 0.064 | 4.634 | 11.070 | DO NOT REJECT HO |
| 6 | 0.038 | 4.733 | 12.592 | DO NOT REJECT HO |
| 7 | 0.013 | 4.746 | 14.067 | DO NOT REJECT HO |
| 8 | 0.005 | 4.747 | 15.507 | DO NOT REJECT HO |
| 9 | -0.070 | 5.097 | 16.919 | DO NOT REJECT HO |
| 10 | -0.006 | 5.100 | 18.307 | DO NOT REJECT HO |

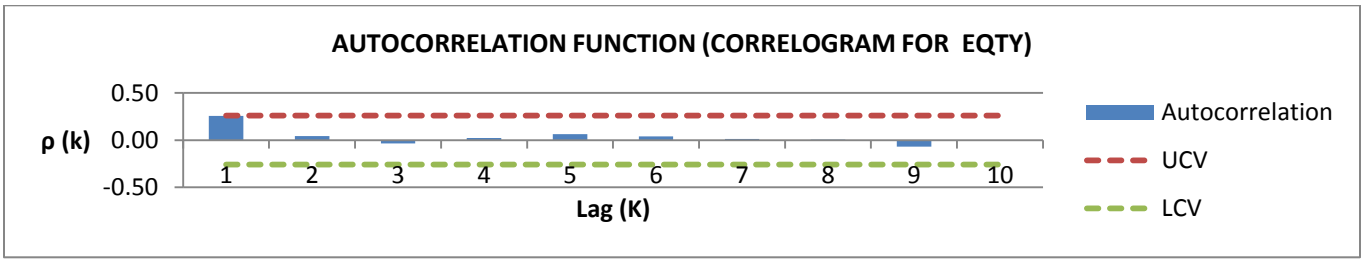


Figure 24: Correlogram for EQTY

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the EQTY stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 27: *Eveready EA (EVRD)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.024 | 0.036 | 3.841 | DO NOT REJECT HO |
| 2 | 0.185 | 2.203 | 5.991 | DO NOT REJECT HO |
| 3 | 0.108 | 2.951 | 7.815 | DO NOT REJECT HO |
| 4 | 0.267 | 7.607 | 9.488 | DO NOT REJECT HO |
| 5 | -0.047 | 7.755 | 11.070 | DO NOT REJECT HO |
| 6 | -0.020 | 7.781 | 12.592 | DO NOT REJECT HO |
| 7 | 0.025 | 7.823 | 14.067 | DO NOT REJECT HO |
| 8 | 0.074 | 8.206 | 15.507 | DO NOT REJECT HO |
| 9 | -0.116 | 9.176 | 16.919 | DO NOT REJECT HO |
| 10 | -0.081 | 9.659 | 18.307 | DO NOT REJECT HO |

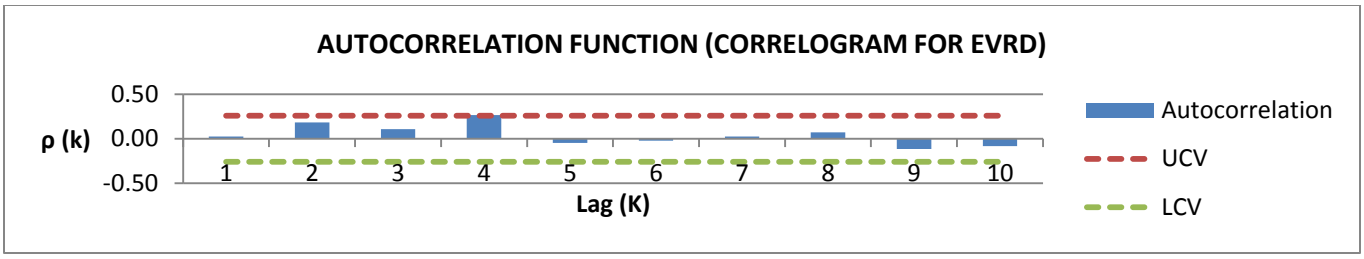


Figure 25: Correlogram for EVRD

The correlogram above shows that all the autocorrelations among the 10 lags except the 4th lag were not significant in that they were within the upper and lower critical values.

**Table 28: *Sameer (FIRE)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.386 | 9.255 | 3.841 | REJECT HO |
| 2 | -0.033 | 9.323 | 5.991 | REJECT HO |
| 3 | 0.009 | 9.328 | 7.815 | REJECT HO |
| 4 | 0.075 | 9.696 | 9.488 | REJECT HO |
| 5 | 0.029 | 9.753 | 11.070 | DO NOT REJECT HO |
| 6 | -0.045 | 9.888 | 12.592 | DO NOT REJECT HO |
| 7 | -0.030 | 9.949 | 14.067 | DO NOT REJECT HO |
| 8 | -0.061 | 10.208 | 15.507 | DO NOT REJECT HO |
| 9 | -0.058 | 10.453 | 16.919 | DO NOT REJECT HO |
| 10 | 0.080 | 10.918 | 18.307 | DO NOT REJECT HO |

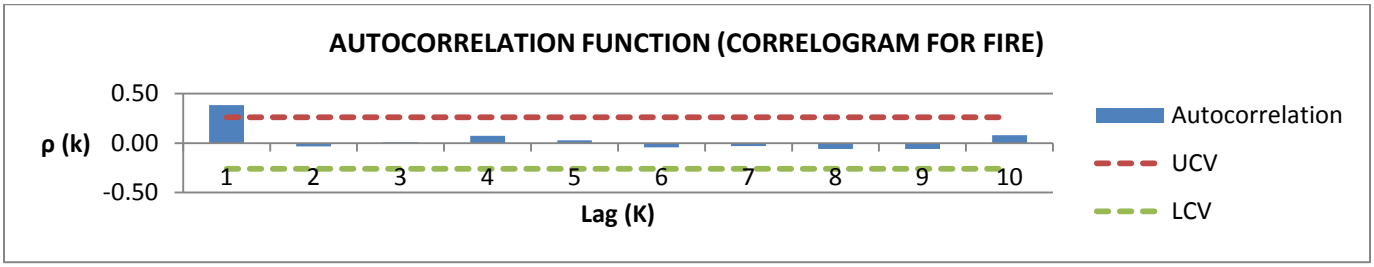


Figure 26: Correlogram for FIRE

The correlogram above shows that all the autocorrelations among the 10 lags except the 1st lag were not significant in that they were within the upper and lower critical values.

**Table 29: *HF Group (HFCK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.346 | 7.419 | 3.841 | REJECT HO |
| 2 | 0.097 | 8.008 | 5.991 | REJECT HO |
| 3 | 0.128 | 9.067 | 7.815 | REJECT HO |
| 4 | 0.066 | 9.350 | 9.488 | DO NOT REJECT HO |
| 5 | 0.155 | 10.947 | 11.070 | DO NOT REJECT HO |
| 6 | -0.066 | 11.240 | 12.592 | DO NOT REJECT HO |
| 7 | -0.037 | 11.335 | 14.067 | DO NOT REJECT HO |
| 8 | 0.154 | 13.014 | 15.507 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 9 | 0.123 | 14.105 | 16.919 | DO NOT REJECT HO |
| 10 | -0.082 | 14.596 | 18.307 | DO NOT REJECT HO |

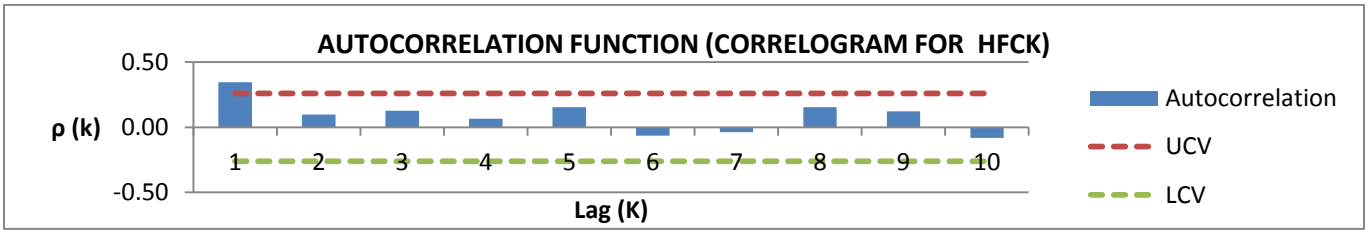


Figure 27: Correlogram for HFCK

The correlogram above shows that all the autocorrelations among the 10 lags except the 1st lag were not significant in that they were within the upper and lower critical values.

**Table 30: *Centum (ICDC)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.405 | 10.199 | 3.841 | REJECT HO |
| 2 | 0.096 | 10.779 | 5.991 | REJECT HO |
| 3 | -0.168 | 12.603 | 7.815 | REJECT HO |
| 4 | -0.169 | 14.476 | 9.488 | REJECT HO |
| 5 | 0.062 | 14.735 | 11.070 | REJECT HO |
| 6 | 0.104 | 15.473 | 12.592 | REJECT HO |
| 7 | 0.117 | 16.424 | 14.067 | REJECT HO |
| 8 | -0.026 | 16.473 | 15.507 | REJECT HO |
| 9 | 0.021 | 16.504 | 16.919 | DO NOT REJECT HO |
| 10 | 0.047 | 16.669 | 18.307 | DO NOT REJECT HO |

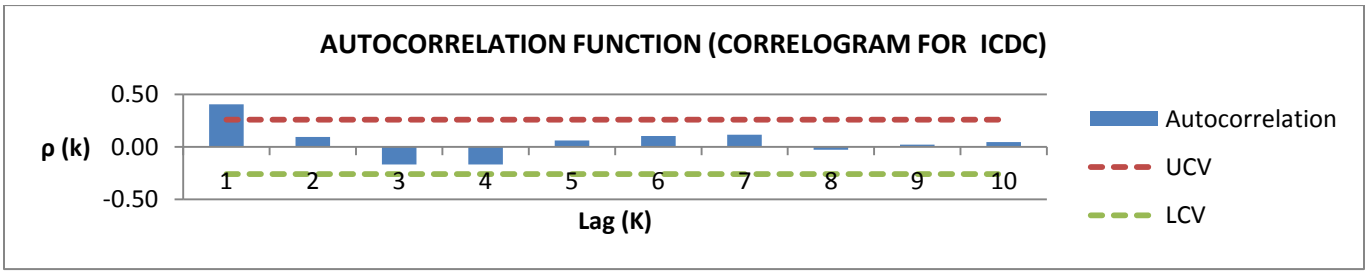


Figure 28: Correlogram for ICDC

The correlogram above shows that all the autocorrelations among the 10 lags except the 1st lag were not significant in that they were within the upper and lower critical values.

**Table 31: *KenGen (KEGN)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.227 | 3.192 | 3.841 | DO NOT REJECT HO |
| 2 | 0.188 | 5.416 | 5.991 | DO NOT REJECT HO |
| 3 | 0.034 | 5.489 | 7.815 | DO NOT REJECT HO |
| 4 | -0.065 | 5.767 | 9.488 | DO NOT REJECT HO |
| 5 | 0.192 | 8.231 | 11.070 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 6 | 0.176 | 10.327 | 12.592 | DO NOT REJECT HO |
| 7 | 0.171 | 12.361 | 14.067 | DO NOT REJECT HO |
| 8 | -0.053 | 12.563 | 15.507 | DO NOT REJECT HO |
| 9 | 0.020 | 12.593 | 16.919 | DO NOT REJECT HO |
| 10 | -0.158 | 14.415 | 18.307 | DO NOT REJECT HO |

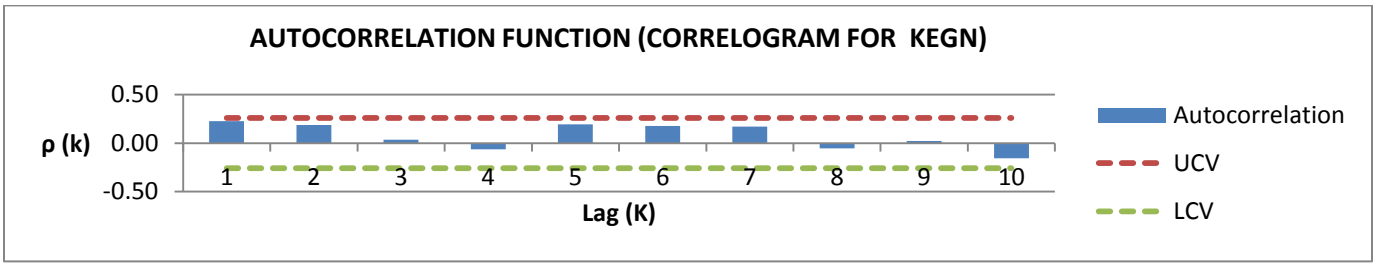


Figure 29: Correlogram for KEGN

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KEGN stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 32: Kenol Kobil (KENO)**

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.102 | 0.645 | 3.841 | DO NOT REJECT HO |
| 2 | -0.031 | 0.706 | 5.991 | DO NOT REJECT HO |
| 3 | -0.024 | 0.744 | 7.815 | DO NOT REJECT HO |
| 4 | -0.102 | 1.422 | 9.488 | DO NOT REJECT HO |
| 5 | -0.082 | 1.869 | 11.070 | DO NOT REJECT HO |
| 6 | 0.015 | 1.885 | 12.592 | DO NOT REJECT HO |
| 7 | -0.020 | 1.912 | 14.067 | DO NOT REJECT HO |
| 8 | 0.018 | 1.934 | 15.507 | DO NOT REJECT HO |
| 9 | -0.003 | 1.934 | 16.919 | DO NOT REJECT HO |
| 10 | 0.037 | 2.034 | 18.307 | DO NOT REJECT HO |

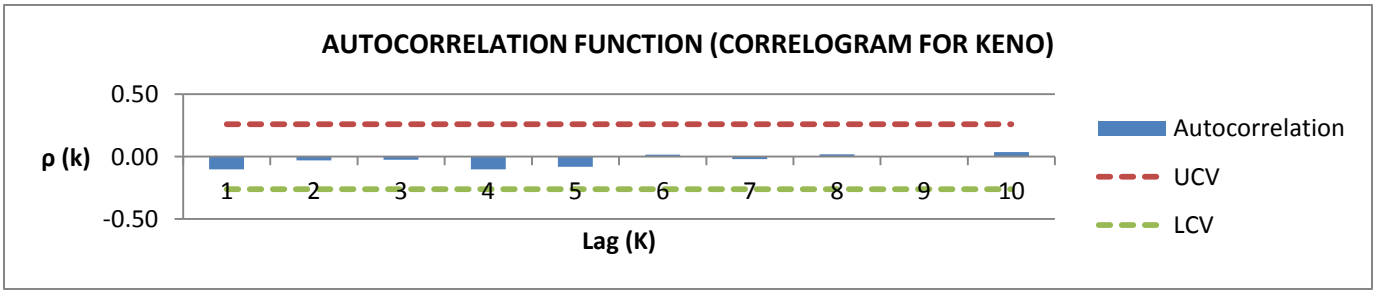


Figure 30: Correlogram for KENO

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KENO stock

prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 33: *Kenya Re-insurance (KNRE)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.234 | 3.398 | 3.841 | DO NOT REJECT HO |
| 2 | -0.156 | 4.943 | 5.991 | DO NOT REJECT HO |
| 3 | -0.168 | 6.760 | 7.815 | DO NOT REJECT HO |
| 4 | 0.013 | 6.770 | 9.488 | DO NOT REJECT HO |
| 5 | 0.018 | 6.792 | 11.070 | DO NOT REJECT HO |
| 6 | 0.002 | 6.792 | 12.592 | DO NOT REJECT HO |
| 7 | 0.032 | 6.865 | 14.067 | DO NOT REJECT HO |
| 8 | 0.050 | 7.045 | 15.507 | DO NOT REJECT HO |
| 9 | 0.080 | 7.510 | 16.919 | DO NOT REJECT HO |
| 10 | 0.039 | 7.624 | 18.307 | DO NOT REJECT HO |

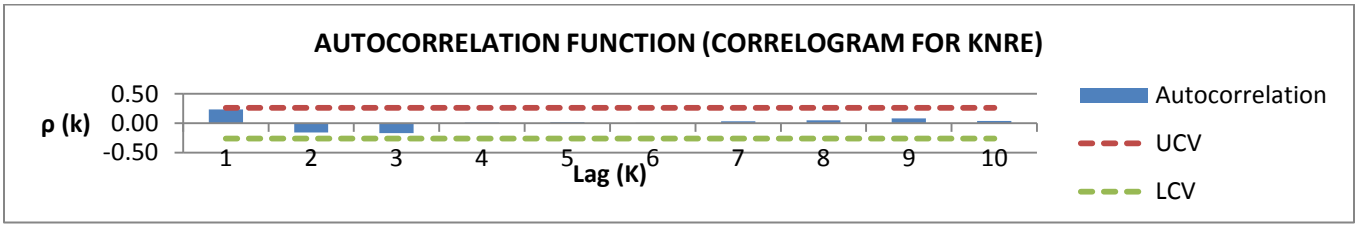


Figure 31: Correlogram for KNRE

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KNRE stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 34: *Kenya Power Lighting Company (KPLC)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.141 | 1.229 | 3.841 | DO NOT REJECT HO |
| 2 | -0.105 | 1.925 | 5.991 | DO NOT REJECT HO |
| 3 | -0.030 | 1.984 | 7.815 | DO NOT REJECT HO |
| 4 | 0.008 | 1.988 | 9.488 | DO NOT REJECT HO |
| 5 | -0.007 | 1.991 | 11.070 | DO NOT REJECT HO |
| 6 | -0.026 | 2.039 | 12.592 | DO NOT REJECT HO |
| 7 | -0.023 | 2.074 | 14.067 | DO NOT REJECT HO |
| 8 | 0.006 | 2.076 | 15.507 | DO NOT REJECT HO |
| 9 | -0.049 | 2.250 | 16.919 | DO NOT REJECT HO |
| 10 | 0.032 | 2.328 | 18.307 | DO NOT REJECT HO |

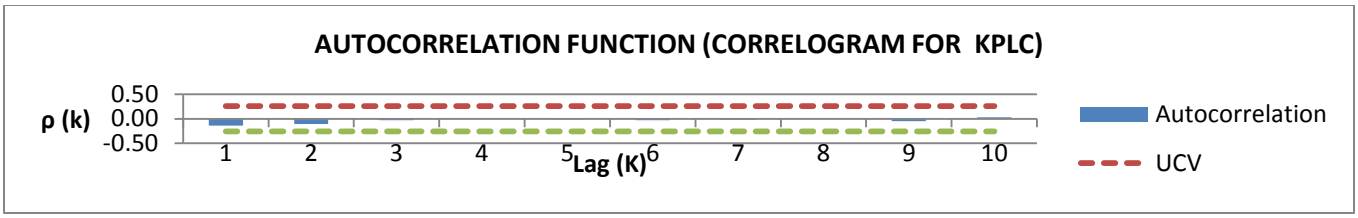


Figure 32: Correlogram for KPLC

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KPLC stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 35: *KAKUZI (KUKZ)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.184 | 2.098 | 3.841 | DO NOT REJECT HO |
| 2 | -0.041 | 2.205 | 5.991 | DO NOT REJECT HO |
| 3 | -0.054 | 2.392 | 7.815 | DO NOT REJECT HO |
| 4 | -0.117 | 3.288 | 9.488 | DO NOT REJECT HO |
| 5 | -0.013 | 3.298 | 11.070 | DO NOT REJECT HO |
| 6 | 0.008 | 3.303 | 12.592 | DO NOT REJECT HO |
| 7 | -0.038 | 3.402 | 14.067 | DO NOT REJECT HO |
| 8 | 0.214 | 6.638 | 15.507 | DO NOT REJECT HO |
| 9 | 0.104 | 7.420 | 16.919 | DO NOT REJECT HO |
| 10 | 0.048 | 7.592 | 18.307 | DO NOT REJECT HO |

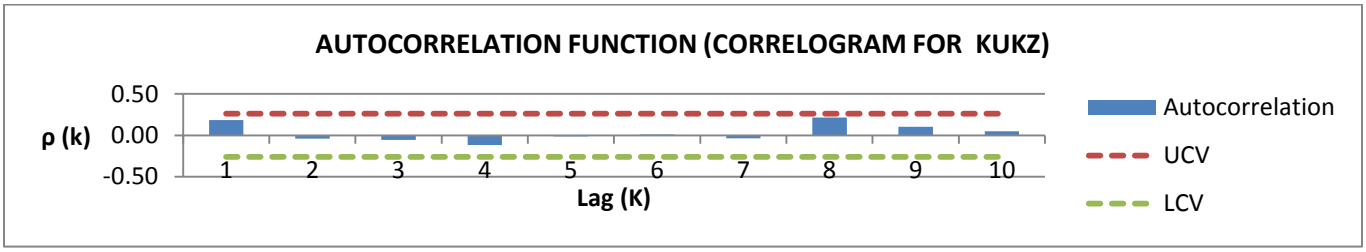


Figure 33: Correlogram for KUKZ

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the KUKZ stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 36: *Pan African (PAFR)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.385 | 9.188 | 3.841 | REJECT HO |
| 2 | 0.261 | 13.482 | 5.991 | REJECT HO |
| 3 | 0.005 | 13.483 | 7.815 | REJECT HO |
| 4 | -0.061 | 13.729 | 9.488 | REJECT HO |
| 5 | -0.031 | 13.793 | 11.070 | REJECT HO |

| | | | | |
|---|---|---|---|---|
| 6 | 0.077 | 14.200 | 12.592 | REJECT HO |
| 7 | 0.033 | 14.276 | 14.067 | REJECT HO |
| 8 | 0.024 | 14.316 | 15.507 | DO NOT REJECT HO |
| 9 | -0.163 | 16.222 | 16.919 | DO NOT REJECT HO |
| 10 | -0.128 | 17.424 | 18.307 | DO NOT REJECT HO |

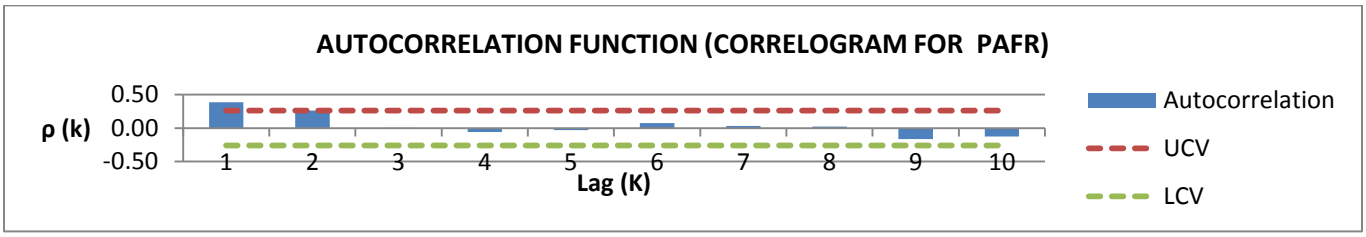


Figure 34: Correlogram for PAFR

The correlogram above shows that all there was autocorrelations in the 1st and 2nd lags.

**Table 37: *Sasini (SASN)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.089 | 0.495 | 3.841 | DO NOT REJECT HO |
| 2 | -0.076 | 0.860 | 5.991 | DO NOT REJECT HO |
| 3 | -0.098 | 1.481 | 7.815 | DO NOT REJECT HO |
| 4 | 0.087 | 1.982 | 9.488 | DO NOT REJECT HO |
| 5 | 0.080 | 2.408 | 11.070 | DO NOT REJECT HO |
| 6 | -0.170 | 4.360 | 12.592 | DO NOT REJECT HO |
| 7 | 0.168 | 6.322 | 14.067 | DO NOT REJECT HO |
| 8 | -0.082 | 6.801 | 15.507 | DO NOT REJECT HO |
| 9 | -0.116 | 7.764 | 16.919 | DO NOT REJECT HO |
| 10 | 0.010 | 7.772 | 18.307 | DO NOT REJECT HO |

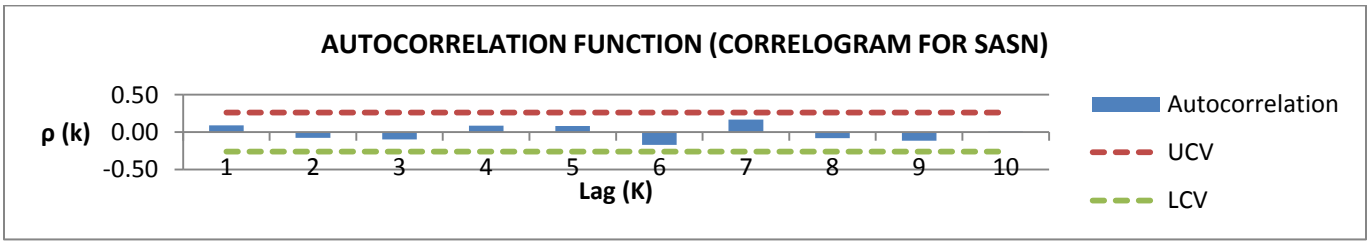


Figure 35: Correlogram for SASN

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the SASN stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 38: *WPP Scangroup (SCAN)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.205 | 2.608 | 3.841 | DO NOT REJECT HO |
| 2 | 0.038 | 2.701 | 5.991 | DO NOT REJECT HO |

| | | | | |
|---|---|---|---|---|
| 3 | 0.199 | 5.255 | 7.815 | DO NOT REJECT HO |
| 4 | 0.053 | 5.438 | 9.488 | DO NOT REJECT HO |
| 5 | -0.086 | 5.928 | 11.070 | DO NOT REJECT HO |
| 6 | 0.019 | 5.954 | 12.592 | DO NOT REJECT HO |
| 7 | 0.009 | 5.960 | 14.067 | DO NOT REJECT HO |
| 8 | -0.060 | 6.215 | 15.507 | DO NOT REJECT HO |
| 9 | -0.129 | 7.405 | 16.919 | DO NOT REJECT HO |
| 10 | -0.146 | 8.979 | 18.307 | DO NOT REJECT HO |

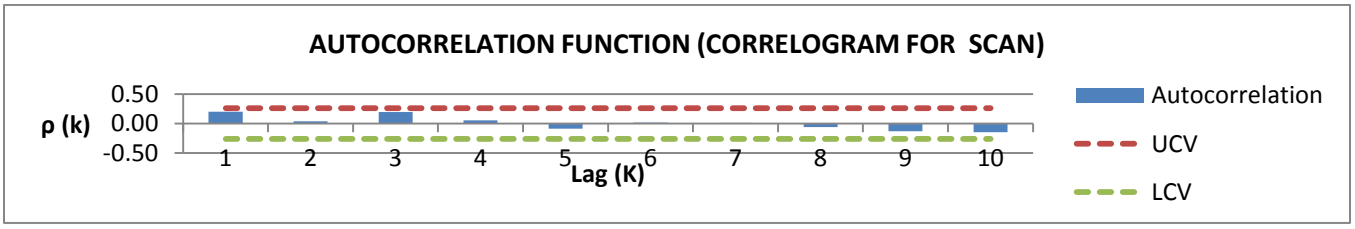


Figure 36: Correlogram for SCAN

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the SCAN stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 39: *Standard Chartered Bank (SCBK)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.326 | 6.607 | 3.841 | REJECT HO |
| 2 | 0.170 | 8.438 | 5.991 | REJECT HO |
| 3 | 0.138 | 9.667 | 7.815 | REJECT HO |
| 4 | 0.012 | 9.677 | 9.488 | REJECT HO |
| 5 | 0.083 | 10.141 | 11.070 | DO NOT REJECT HO |
| 6 | -0.026 | 10.188 | 12.592 | DO NOT REJECT HO |
| 7 | -0.007 | 10.191 | 14.067 | DO NOT REJECT HO |
| 8 | 0.058 | 10.432 | 15.507 | DO NOT REJECT HO |
| 9 | -0.037 | 10.530 | 16.919 | DO NOT REJECT HO |
| 10 | -0.011 | 10.538 | 18.307 | DO NOT REJECT HO |

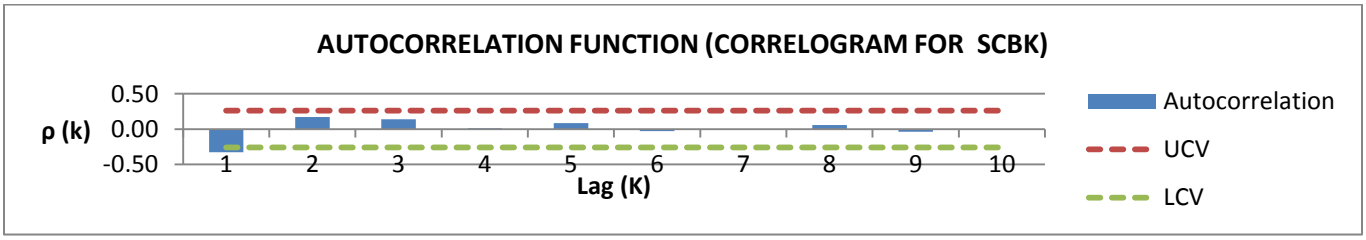


Figure 37: Correlogram for SCBK

The correlogram above shows that all the autocorrelations among the 10 lags except the 1st lag were not significant in that they were within the upper and lower critical values.

**Table 40*: Safaricom (SCOM)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.342 | 7.257 | 3.841 | REJECT HO |
| 2 | 0.300 | 12.930 | 5.991 | REJECT HO |
| 3 | 0.189 | 15.214 | 7.815 | REJECT HO |
| 4 | 0.210 | 18.113 | 9.488 | REJECT HO |
| 5 | 0.137 | 19.359 | 11.070 | REJECT HO |
| 6 | 0.408 | 30.675 | 12.592 | REJECT HO |
| 7 | 0.119 | 31.662 | 14.067 | REJECT HO |
| 8 | -0.018 | 31.684 | 15.507 | REJECT HO |
| 9 | 0.048 | 31.848 | 16.919 | REJECT HO |
| 10 | -0.038 | 31.953 | 18.307 | REJECT HO |

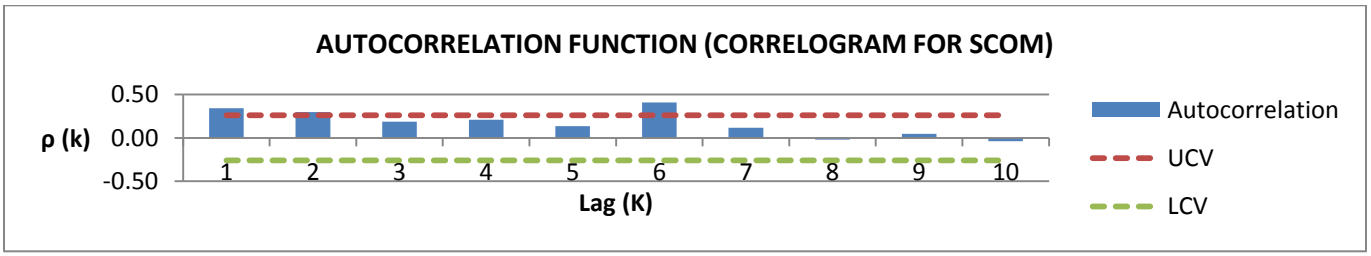


Figure 38: Correlogram for SCOM

The correlogram above shows that all the autocorrelations among the 10 lags except for the 1st, 2nd and 6th lag were not significant in that they were within the upper and lower critical values.

**Table 41: *Total (TOTL)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.201 | 2.506 | 3.841 | DO NOT REJECT HO |
| 2 | 0.072 | 2.831 | 5.991 | DO NOT REJECT HO |
| 3 | -0.020 | 2.858 | 7.815 | DO NOT REJECT HO |
| 4 | -0.001 | 2.858 | 9.488 | DO NOT REJECT HO |
| 5 | 0.038 | 2.956 | 11.070 | DO NOT REJECT HO |
| 6 | 0.222 | 6.294 | 12.592 | DO NOT REJECT HO |
| 7 | 0.074 | 6.676 | 14.067 | DO NOT REJECT HO |
| 8 | 0.007 | 6.679 | 15.507 | DO NOT REJECT HO |
| 9 | 0.032 | 6.752 | 16.919 | DO NOT REJECT HO |
| 10 | -0.012 | 6.763 | 18.307 | DO NOT REJECT HO |

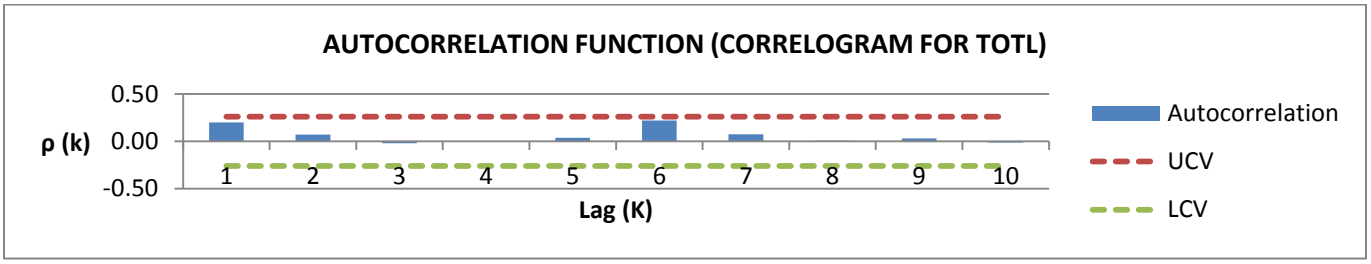

Figure 39: Correlogram for TOTL

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the TOTL stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 42: *TPS Eastern Africa (TPSE)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | -0.052 | 0.171 | 3.841 | DO NOT REJECT HO |
| 2 | -0.066 | 0.446 | 5.991 | DO NOT REJECT HO |
| 3 | -0.099 | 1.075 | 7.815 | DO NOT REJECT HO |
| 4 | -0.149 | 2.521 | 9.488 | DO NOT REJECT HO |
| 5 | 0.047 | 2.671 | 11.070 | DO NOT REJECT HO |
| 6 | 0.063 | 2.942 | 12.592 | DO NOT REJECT HO |
| 7 | -0.024 | 2.982 | 14.067 | DO NOT REJECT HO |
| 8 | 0.097 | 3.650 | 15.507 | DO NOT REJECT HO |
| 9 | 0.039 | 3.758 | 16.919 | DO NOT REJECT HO |
| 10 | -0.012 | 3.768 | 18.307 | DO NOT REJECT HO |

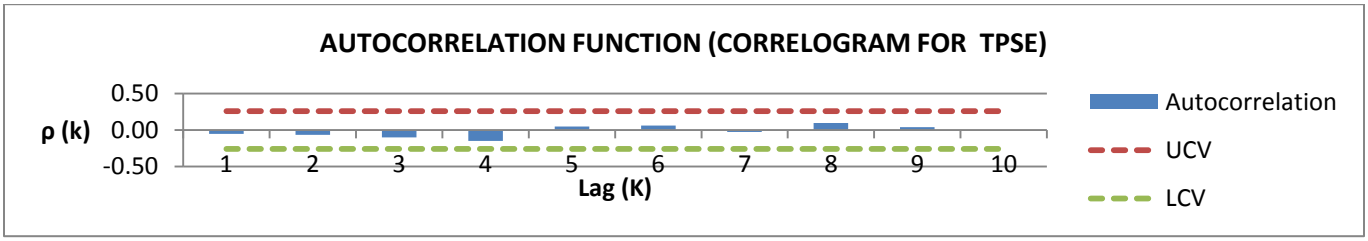


Figure 40: Correlogram for TPSE

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the TPSE stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 43: *UNGA***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.155 | 1.486 | 3.841 | DO NOT REJECT HO |
| 2 | -0.108 | 2.217 | 5.991 | DO NOT REJECT HO |
| 3 | -0.091 | 2.746 | 7.815 | DO NOT REJECT HO |
| 4 | -0.217 | 5.819 | 9.488 | DO NOT REJECT HO |
| 5 | -0.111 | 6.647 | 11.070 | DO NOT REJECT HO |
| 6 | 0.040 | 6.755 | 12.592 | DO NOT REJECT HO |
| 7 | -0.036 | 6.843 | 14.067 | DO NOT REJECT HO |
| 8 | 0.187 | 9.319 | 15.507 | DO NOT REJECT HO |
| 9 | -0.032 | 9.392 | 16.919 | DO NOT REJECT HO |
| 10 | 0.036 | 9.489 | 18.307 | DO NOT REJECT HO |

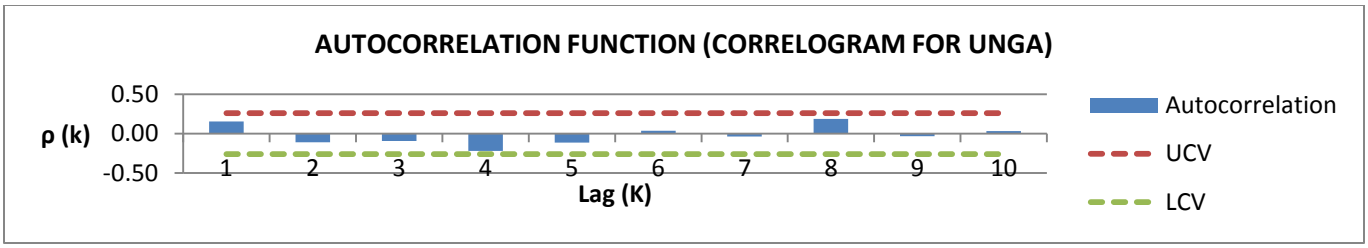


Figure 41: Correlogram for UNGA

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the UNGA stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Table 44: *Express (K) Aims (XPRS)***

| Lag | Autocorrelation | Q-stat | Q-Crit | Conclusion (Q-Stat) |
|---|---|---|---|---|
| 1 | 0.209 | 2.713 | 3.841 | DO NOT REJECT HO |
| 2 | 0.035 | 2.789 | 5.991 | DO NOT REJECT HO |
| 3 | -0.087 | 3.274 | 7.815 | DO NOT REJECT HO |
| 4 | -0.059 | 3.505 | 9.488 | DO NOT REJECT HO |
| 5 | 0.160 | 5.213 | 11.070 | DO NOT REJECT HO |
| 6 | 0.163 | 7.021 | 12.592 | DO NOT REJECT HO |
| 7 | -0.067 | 7.334 | 14.067 | DO NOT REJECT HO |
| 8 | 0.013 | 7.345 | 15.507 | DO NOT REJECT HO |
| 9 | 0.036 | 7.437 | 16.919 | DO NOT REJECT HO |
| 10 | -0.082 | 7.933 | 18.307 | DO NOT REJECT HO |

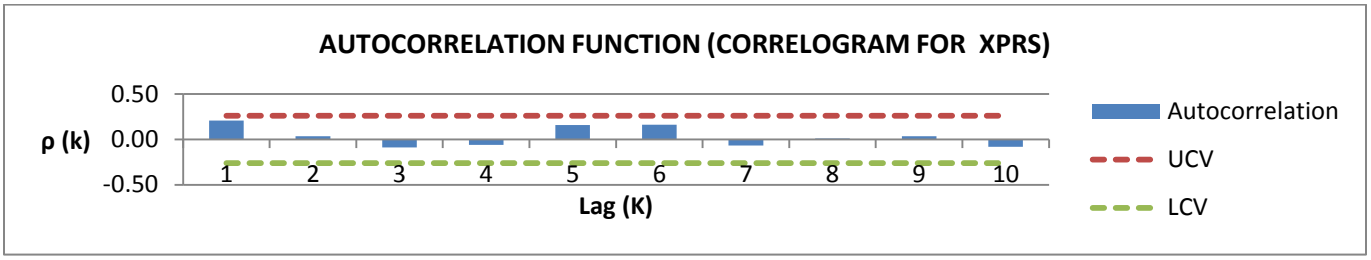


Figure 42: Correlogram for XPRS

The correlogram above shows that all the autocorrelations among the 10 lags were not significant in that they were within the upper and lower critical values. Hence, based on the ACF analysis, it can be concluded that the XPRS stock prices are not serially correlated and thus they exhibit a weak form of EMH.

**Durbin Watson Test**

To conduct Durbin Watson test, we used SPSS software (version 20) to regress the current returns against one-month lagged returns to get the Durbin Watson statistic. The assumption behind Durbin Watson test is that the errors in the regression model are generated by a first – order autoregression process observed at equally spaced time periods, that is;

$$e_{i,t} = \rho\, e_{i,t-1} + a_t \quad \text{..... (iii)}$$

$$\text{d (Durbin Watson Statistic)} = \frac{\sum_{i=2}^{n} (e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2} \quad \text{..... (iv)}$$

Where;

$e_i = y_i - \hat{y}_i$

$y_i and\ \hat{y}_i$ are the observed and predicted values respectively of the response variable for individual stock, 'i'.

d becomes smaller as the serial correlation increases. There are documented upper and lower critical values, $d_U$ and $d_L$ for different values of k (number of explanatory variable) and n (data size for each explanatory variable).

**General Decision Criteria;**

If d=2, no serial correlation. If d<2, there is positive serial correlation and if d>2, there is negative serial correlation.

**Decision Criteria for Positive serial correlation;**

If $d < d_L\ reject\ H_0 : \rho = 0$ (presence of serial correlation)

If $d > d_U\ do\ not\ reject\ H_0 : \rho = 0$ (no serial correlation)

If $d_L < d < d_U\ test\ is\ inconclusive$

In our case; $d_L$ = 1.53; $d_U$ =1.60 based on Durbin Watson table (5% S.L, n=58)

For tests of negative correlation using Durbin Watson statistic, the statistic $4 - d$ is used. Thus the decision rules for $H_0 : \rho = 0$ versus $H_0 : \rho < 0$ are the same as those used in testing for positive autocorrelation.

**Decision Criteria for negative serial correlation;**

Test $H_o : \rho$ =0 against $H_A : \rho < 0$ (There is negative Serial Correlation)

Compute $4 - d$

If $4 - d \leq d_L$, Reject the null

If $4 - d \geq d_U$, do not reject the null,

If $d_L < 4 - d < d_U$, the test is inconclusive

**Table 45:** ***Conclusion***

| # | Stock | d | 4-d | $d_L$ | $d_U$ | Conclusion |
|---|---|---|---|---|---|---|
| 1 | EGAD | 1.988 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 2 | KUKZ | 1.983 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 3 | SASN | 1.987 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 4 | WTK | 2.026 | 1.974 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 5 | REA | 1.631 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 6 | CG | 1.981 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 7 | FIRE | 1.781 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 8 | BBK | 2.015 | 1.985 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 9 | CFC | 1.974 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 10 | DTK | 2.067 | 1.933 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 11 | EQTY | 1.981 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 12 | HFCK | 1.966 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 13 | KCB | 2.003 | 1.997 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 14 | NBK | 2.04 | 1.96 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 15 | NICB | 2.003 | 1.997 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 16 | SCBK | 1.975 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 17 | COOP | 2.07 | 1.93 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 18 | XPRS | 2.040 | 1.96 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 19 | KQ | 2.041 | 1.959 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 20 | NMG | 1.974 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | SGL | 2.008 | 1.992 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 22 | TPSE | 2.135 | 1.865 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 23 | SCAN | 1.980 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 24 | ARM | 2.005 | 1.995 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 25 | BAMB | 2.031 | 1.969 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 26 | BERG | 1.961 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 27 | CABL | 2.119 | 1.881 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 28 | KEGN | 2.125 | 1.875 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 29 | KENO | 2.011 | 1.989 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 30 | KPLC | 2.036 | 1.964 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 31 | TOTL | 1.918 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 32 | JUB | 1.993 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 33 | KNRE | 1.906 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 34 | PAFR | 2.122 | 1.878 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 35 | ICDC | 2.059 | 1.941 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 36 | OCH | 1.971 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 37 | BAT | 1.932 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 38 | EABL | 2.083 | 1.917 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 39 | EVRD | 2.013 | 1.987 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 40 | MSC | 1.758 | | 1.52 | 1.60 | Do not reject H0; No significant positive serial correlation |
| 41 | UNGA | 2.006 | 1.994 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |
| 42 | SCOM | 2.167 | 1.833 | 1.52 | 1.60 | Do not reject H0; No significant negative serial correlation |

**Source: Prepared by author (2016)**

## CONCLUSION

**Runs Tests;**

According to Runs Test analysis, the following firms did not depict a weak form of EMH: CFC, DTK, HFCK, NICB, COOP, SCAN, BERG, PAFR, ICDC, EABL and SCOM. These companies formed a total of 11 out of 42 companies studied in the NSE (26.2%). All the other remaining stocks of 31companies (73.8%) exhibited a random walk. This therefore shows that majority of the firms listed in the NSE are efficient in the weak form.

**Serial (Auto) Correlation tests;**

The autocorrelation function analysis (correlogram) showed 10 out of 42 listed firms (23.8%) in the NSE did not show random walk at particular lag periods. These companies include: BAT ($1^{st}$ $9^{th}$ and $10^{th}$ lags), CG ($10^{th}$ lag), CFC ($2^{nd}$ lag), MSC ($1^{st}$ lag), FIRE ($1^{st}$ lag), HFCK ($1^{st}$ lag), ICDC ($1^{st}$ lag), PAFR ($1^{st}$ and $2^{nd}$ lag), SCBK ($1^{st}$ lag) and SCOM ($1^{st}$, $2^{nd}$, and $6^{th}$ lag). All the other remaining 32 firms (76.2%) depicted a random walk over the 10 lags used in the study.

Ljung Box Q tests (10 lags) revealed that only 2 companies, that is, BAT and SCOM which formed 4.8% were not efficient in the weak form. This test is based on an aggregation of all the lags used in the ACF analysis. Therefore, this shows that despite the following firms (CG, CFC, MSC, FIRE, HFCK, ICDC, PAFR and SCBK) having serial correlation in particular lags, they were still found to be efficient using the aggregate test of Ljung Box Q for 10 lags.

Durbin Watson (DW) test which measures the serial correlation in the lagged error terms, did not find any significant serial (auto) correlation among the 42 stocks used in this study. This test therefore

concludes that NSE as a whole is efficient in the weak form.

Based on the findings of the two main tests used in this study, there are conflicting results therefore indicating that the different firms in the NSE used in this study responded uniquely to both tests which support the finding of Nisar & Hanif (2012). This means that it not comprehensive to conclude on the efficiency of a stock based on one test. However, this study found that a correlogram provided more detailed results for each particular lag.

In conclusion, the findings of this study are consistent with other previous studies (Grzyb, 2007; Nisar & Hanif, 2012; Phiri, 2015) which found evidence of weak form EMH in other stock exchanges. However, it contradicts the findings of Gimba (2007), Sewell (2012), Shiller & Radikoko (2014) and Samitas (2004) who found there is presence of forecasting patterns within the existing stock markets indicating that the share return series does not follow a Random Walk Model.

**REFERENCES**


Degutis, A., & Novickytė, L. (2014). The efficient market hypothesis: A critical review of literature and methodolgy. *EKONOMIKA, 93*(2), 7-23.

Elbarghouthi, S., Qasim, A., & Yassin, M. (2012). The Use of Runs Test in Amman Stock Exchange. *International Business Research, 5*(2), 159-172.

Freund, W. C., Larrain, M., & Pagano, M. S. (1997). Market efficiency before and after the introduction of electronic trading at the Toronto stock exchange. *Review of Financial Economics, 6*(1), 29-56.

Gichaiya, W., & Ishmail, M. (2014). Evaluation of Financial Distress: A Case Study of UCHUMI Supermarket Ltd. *International Journal of Financial Economics, 3*(3), 178-183.

Gimba , V. K. (2007). Testing the Weak-form Efficiency Market Hypothesis: Evidence from Nigerial Stock Market. *CBN Journal of Applied Statistics, 3*(1), 117-136.

Grzyb, J. (2007). Testing Different Forms of Market Efficiency Using the Dow Jones Industrial Average Index. *Seminar Paper, Faculty of Business Administration and Economics*. Viadrina, Frankfurt: Europa-Universitat.

Gupta, N., & Gedam, A. (2014). Testing of Efficient Market Hypothesis: a study on Indian Stock Market. *IOSR Journal of Business and Management, 16*(8), 28-38.

Kalsie, A., & Kalra, K. J. (2015). An empirical study on efficient market hypothesis if Indian Capital Markets. *Journal of Management Research and Analysis, 2*(2), 108-114.

Maronga, E., Nyamosi, D., & Onsando, L. P. (2015). Nairobi Securities Exchange: A review of pricing efficiency after earnings announcement. *International journal of arts and commerce, 4*(4), 172-186.

Moustafa, M. (2004). Testing the Weak-Form Efficiency of the United Arab Emirates Stock Market. *INTERNATIONAL JOURNAL OF BUSINESS, 9*(3), 309-325.

Nayak, S., Misra, B., & Behera, H. (2014). Impact of Data Normalization on Stock Index Forecasting. *International Journal of Computer Information Systems and Industrial Management Applications, 6*, 257-269.

Nisar, S., & Hanif, M. (2012). Testing Weak Form of Efficient Market Hypothesis: Empirical Evidence from South-Asia. *World Applied Sciences Journal, 17*(4), 414-427.

Okpara, C. G. (2010). Stock market prices and the random walk hypothesis:. *Journal of Economics and International Finance, 2*(3), 49-57.

Oprean, C. (2012). Testing the financial market informational efficiency in emerging states. *Review of Applied Socio-Economic Research, 4*(2), 181-190.

Pandey, I. M. (2009). *Financial Management* (9th ed.). New Dehli: ViKas Publishing House.

Patel, N., Radadia, N., & Dhawan, J. (2012). An Empirical Study on Weak-Form of Market Efficiency of Selected Asian Stock Markets. *Journal of Applied Finance & Banking, 2*(2), 99-148.

Phiri, A. (2015). Efficient Market Hypothesis in South Africa: Evidence from Linear and Nonlinear Unit Root Tests. *Managing Global Transitions, 13*(4), 369-387.

Samitas, A. G. (2004). Testing the Efficient Market Hypothesis in the Greek Secondary Market. *Zagreb International Review of Economics and Business, 7*(1), 23-38.

Sewell, M. (2012). The Efficient Market Hypothesis: Empirical Evidence. *International Journal of Statistics and Probability, 1*(2), 164-178.

Shiller, I., & Radikoko, I. (2014). Testing Weak-Form Market Efficiency on the TSX. *The Journal of Applied Business Research, 30*(3), 647-658.

Vulić, B. T. (2010). *Testing the Efficient Market Hypothesis and its Critics - Application on the Montenegrin Stock Exchange.* Podgorica: University of Montenegro.