VOL. 4, NO. 2, March 2015 ISSN 2307-2466
International Journal of Economics, Finance and Management

http://www.ejournalofbusiness.org

Random Walk Hypothesis in Emerging Stock Markets: Evidence from the Nairobi Securities Exchange

Dennis Bulla
Department of Accounting and Finance, Masinde Muliro University of Science & Technology, P.0. Box 190- 50100, Kakamega, Kenya
vc@mmust.ac.ke, dennisbulla@yahoo.com

ABSTRACT

Random walk theory explains the concept of efficient markets. The markets are described as efficient because they impound information whether private or public very quickly and reflect it in the prices of stocks traded. Investors therefore cannot outperform the markets based on the information gathered. Emerging stock markets have recorded mixed results with regard to their efficiency. Some scholars have argued that for these markets, efficiency is an evolving matter influenced by markets development. The study therefore examined whether the Nairobi Securities Exchange provides evidence of weak form efficiency for the period 2000-2009. This was done by conducting significance tests (at 0.05 level) for serial correlation and run tests to establish if security prices conform to random walk hypothesis. Results indicate that going by the evolving efficiency argument and contrary to prior period findings, the stock market price data pattern in this study yielded result that is consistent with the random walk hypothesis. Consequently, historical price information contained no useful information to use to beat the market in the period reviewed.

Keywords: *Random walk, market efficiency, Nairobi securities Exchange.*

1. INTRODUCTION

A stock market is a place where securities like shares and bonds, etc are issued and traded by public companies. Demand and supply of these securities influence their prices. Stock price movements in an efficient market is said to be random as information (private, public or historical) is readily impounded in stock prices. Since information move freely and randomly, so does security prices.

Three types of market efficiencies according to [1] namely weak form, semi strong form and strong form. A stock market is said to be efficient of the weak form if current prices fully reflect all information on past prices. Consequently, no investor or group of investors can beat the market based on information relating to past prices. The second form of efficiency is the semi strong form where current security prices (read stock prices) not only reflect all information on past prices but include publicly available information. Therefore, an investor(s) cannot be able to consistently get higher returns than the market by using publicly available information if the market is efficient [2]. The strong form efficiency on the other hand is an extreme form of efficient market hypothesis which according to [3] is more of a logical completion of a set of possible hypotheses which has not been tested. This efficiency form occur if prices of stocks adjust quickly to incorporate all available information (past, publicly available and private information).

Emerging markets are generally inefficient, argues [4]. Results from findings of African markets are mixed or inconclusive [5] &[6]. Thus far many of the studies have focused on developing economics of USA and Europe. Studies on the weak form efficiency have been done by [7] and [8] with both producing evidence of weak form market efficiency between periods 1979 – 1988 and 1994 – 1998 respectively. While [7] used price data in their study, [8] used index data which was found to be understating price movement by upto 33% [9]. Using indices to study market efficiency was also criticized by [10] stating aggregate data behaved more systematically than their components. Other authors like [11] have argued that emerging markets are evolving and therefore conclusions about their efficiency or lack of apply only for the period studied. Therefore efficiency studies in emerging markets ought to be done continuously as the markets evolve over time.

2. STATEMENT OF THE PROBLEM

It is observed by [12] that empirical study of weak form efficiency in emerging markets has received only modest attention compared to other forms of market efficiency. African markets are said to suffer from paucity of data, thin trading, and illiquidity. African markets have produced mixed results (1bid).

The foregoing discussion has hence inspired this investigation whose main objects was to discover if indeed emerging markets are efficient particularly on the basis of historical prices. The period covered is between August 2000 and February 2009. Price data which has been supported by many scholars was used to establish if patterns of the past price movements are systematic or non-systematic (random). This is essentially a test for random walk theory which signify test for randomness of a time series data. Random price movement is consistent with an efficient market.

3. HYPOTHESIS

H_0: Stock price movements at the Nairobi Securities exchange is consistent with random walk theory.

H_1: Stock price movements at the NSE is inconsistent with random walk theory.

4. GENERAL OBJECTIVE

To investigate whether stock prices at Nairobi Securities Exchange provide evidence for Random walk hypothesis in the period 2000-2009.

4.1 Specifically

To determine whether the patterns of stock price movements at the NSE is consistent with the random walk theory.

4.2 Significance of Study

Listed companies in an efficient market are valued correctly as their stock prices reflect their intrinsic value for the investor. Investors may know whether it is possible to beat the market in terms of returns based on historical performance of the stocks. If past prices influence future prices, then analysts and individual investors can outperform the market by making superior returns. Otherwise, an efficient market would not allow investors to beat the market.

4.3 Scope of Study

The study utilized weekly prices derived from daily individual share prices computed and released at the end of each trading session for the period beginning August 2000 – February 2009. The problem of thin trading was mitigated by using stock prices for the day when trading was registered.

4.4 Literature Review/Theoretical Review

Efficient market hypothesis is defined by how security prices react to new information. Three forms of hypotheses describe market efficiency namely: weak form, semi-strong form and strong form. The theory is premised on the idea that in competitive markets, the price of securities incorporates all relevant information so that investors cannot achieve superior returns as a result of their investment [13].

4.5 Random Walk Theory

Random stock price movement and its association with information was first made by Bachilier in 1900 in his paper, "the theory of Speculation" [13]. He concluded that commodity prices fluctuate randomly thus laying the foundation for information efficiency. Empirical work on stock markets preceded the theory of market efficiency and was formulated later to explain randomness in price data. When studying wheat prices [1]; [13] and [14] concluded that the prices were just as random as a series of randomly generated series of numbers. NYSE stock price was analysed by [15] based on indices using spectral analysis and found that time series data conformed to random walk theory. This means it was not possible for an investor to predict future price movement.

4.6 Random Walk Theory and Competitive Markets

Using a chance model [16] demonstrated that a randomly generated series of numbers could have a pattern similar to a 52 week Dow Jones index movement. He argued that technical analysis to predict future prices is not useful in efficient markets. Therefore, a lack of randomness in stock price movement represents an unexploited opportunity for economic rent. This situation represents an inefficient market [14].

In random walk theory (RWT), successive stock price changes are independent of past prices; the current price (P_t) has no relation to previous price (P_{t-1}). Future prices P_{t+1},P_{t+2}, P_{t+n} too have no relation to present or past prices [17]; [18] and [19]. Some assumptions underlying efficient market hypothesis include; a large number of rational profit maximizers actively competing with each trying to predict future market values of individual securities and that information is costless and freely available to all participants. Obtaining on-public information has a cost and hence this has to be balanced against its marginal worth [20]. Efficient market hypothesis (EMH) was then later re-defined by [21] to "security prices fully reflect all information to the point where marginal cost of acting on the information does not exceed the benefit".

5. TYPES OF INFORMATION AND MARKET EFFICIENCY

Three types of market efficiencies distinguish information set used to determine that prices fully reflect available information [1].

5.1 Weak Form Market Efficiency

The information set characteristic weak form efficiency is historical prices of stocks; whatever information is contained in past prices of securities is fully reflected in prices. Consequently, it is not beneficial to look for trends or patterns of price fluctuation to infer future price movement. This is the concept underlying random walk theory. Test for weak form efficiency is therefore test for random walk which is testing independence or randomness in price movement. Two statistical tests have been suggested by [22] for independence in price movement. These are serial correlation coefficients and run test.

5.2 Types of Weak Form Efficiency

Random walks according to [8] have three successively stronger tests.

i) **Random Walk 3 (RW3)**
In this type of market, it is not possible to use past prices to predict future prices. Absence of serial correlation implies prices are driven by insider information or lack of liquidity. The test is least restrictive of the three random walks.

ii) **Random Walk 2 (RW2)**
This random walk imposes an additional condition on random walk 3. That is, it should not be possible to use information on the variance of past prices to predict future volatility of the market. Hence variability of past prices is not related to variability of future prices of stocks.

iii) Random Walk 1 (RW1)

In this market, it is neither possible to predict future price movement nor future price volatility by examining information on past prices. A test for RW1 implies a test for heteroskedasticity in the historical time series of price data. It is much more restrictive and thought to characterize only most mature and efficient equity markets.

5.2 Semi Strong Market Efficiency

Information set in semi strong market efficiency is all publicly available information, stock prices should fully reflect all publicly available information that has been released or is available to the general public. This information includes dividends, earnings per share, profit projection, mergers and takeovers, etc. publicly available information also include historical prices. Semi strong efficiency is tested by event studies which determines on the average past announcement effect on stock prices [14].

5.3 Strong Market Efficiency

This is an extreme form of market efficiency that portends that all information both public and private is fully reflected in share prices. Although conditions for market efficiency may be rarely met in a practical world, they are particularly difficult in emerging markets. This is because, investors are not likely to have a common interpretation of information released. In addition, corporations have greater potential to influence their own stock market price to move in a manner not justified by information available [7].

Weak form efficiency(WFE) was realized in non-African markets by [23] in their study of Gulf Coast countries of UAE, Bahrain, Kuwait, Oman, Saudi Arabia and Qatar stock exchange. South African's (JSE) in a study by [11] where they tested for evolving efficiency (TEE) to detect changes in efficiency over time returned weak form efficiency throughout the period 1990 – 2001. However, Egypt, Morocco and Nigeria were found to be showing WFE toward the end of period. Kenya and Zimbabwe showed no weak form efficiency whereas Mauritius displayed tendency toward efficiency.

In a study by [8] of three types of weak form efficiency of African Markets, Kenya, South Africa and Mauritius conformed to RW3 weak efficiency but Ghana, Nigeria did not conform to RW3. None of the markets conformed to the more stringent RW1.Other scholars [5] studied 10 selected African markets and found only Namibia, Kenya and Zimbabwe to have weak form efficiency. They utilized serial correlation test and run test.

Results from a study of NSE for the period 1994 – 1998 using monthly index data using serial correlation test and concluded that NSE has weak form efficiency based on RW2 and RW3[8].

5.4 Conceptualization of Weak Form Efficient Market Hypothesis

Price formation process is characterized by random changes due to new information which occur randomly. Past prices have no relationship with current price (Pt) since no trends can be discerned. This conforms to weak form market efficiency theory illustrated by the equation 1 below:

$$P_t \neq \alpha + \beta_1 P_{t-1} + \beta_2 P_{t-2} + \beta_3 P_{t-3} \ldots . \beta_n P_{t-n} + \varepsilon \qquad (1)$$

Where P_t = Price at time t
α = Constant intercept
β = Slope coefficient
ε = Error term
n = n^{th} term

In weak form market efficiency, past prices for a security (j) have no informational content to influence future prices, price movement is hence non-systematic or random. This is represented conceptually as;

5.5 Historical prices

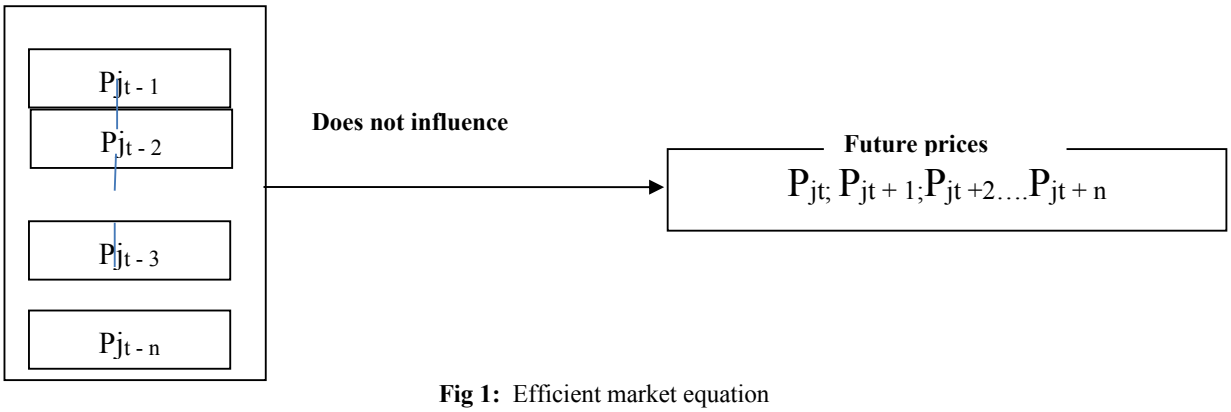

Fig 1: Efficient market equation

5.6 Operationalization

The relation of a variable, price with itself over a period of time is autocorrelation or serial correlation. Autocorrelation is established by looking for correlation of a variable against its lag. Zero correlation coefficient means there is no relation in price series data.

6. METHODOLOGY

The study was quantitative research using historical prices for quoted companies at NSE. Security prices were correlated to determine if there is evidence of serial correlation between a security price and its past prices for the period 2000 – 2009.

6.1 Study Population and Sampling Selection

This is a list of security prices quoted on the NSE for the period 2000-2009. At least sixty observations for each security price was assembled. Shares should not have been suspended from trading for a period longer than a week and had not been part of a merger or acquisition for the period under review.

Thirty nine stocks met the criteria and given the small number, the entire population was studied. Weekly data as suggested by [5] and [7] was used in the analysis after adjusting for day of week effects; based on Wednesday's closing price, Tuesdays price if Wednesday is a holiday or Thursday price if Tuesday price is missing.

6.2 Data Collection

Data was purchased from NSE licensed vendors in the form it was transmitted by NSE. Overall, weekly data of 39 qualifying stocks over the 10 year period was assembled for analysis.

6.3 Data Analysis Procedure

A serial correlation test and run test were conducted on the data of security prices to discover if there was evidence of random walk which is the basis for weak form efficiency. The tests which are both parametric and non-parametric (Run test) are to reveal whether current price Pt has any significant relationship to previous prices Pt-1, Pt-2, P6-3……Pt-n. The linear relationship in this model is expressed in equation 2 below.

$$P_t = \alpha + \beta_1 P_{t-1} + \beta_2 P_{t-2} + \beta_3 P_{t-3} \ldots . \beta_n P_{t-4} + \varepsilon \quad (2)$$

where P_t = Current price at time t
α = Intercept value
β = Beta coefficients or slope coefficients
$\sum$ = Error term
n = n^{th} term
$\beta = 0$ If past series of prices have no relation to subsequent prices
Pt = $\alpha + \varepsilon$; since error term is random, so changes to price Pt will be random.

6.4 Serial Correlation Test

The correlation coefficient is computed from the equation 3 given below;

$$\rho j = \frac{\text{Cov (pjt, Pjt-k)}}{\text{Var(Pjt)}} \quad (3)$$

Adapted from [7].

Where Pj = Correlation coefficient of stock j
Cov (Pjt; Pjt-k) = Covariance of the price of stock over the period.
t – 1, = Lagged price (one lag)
t – k = Lagged k periods earlier
Var (Pjt) = Variance of stock j over time period.

The test was for over 30 lags where K = 1, 2,3..30. With 30 lags, the test provides a more robust result for generalization than first-order serial correlation. Overall significance of the serial correlation is tested using ljung box Q statistic, equation (4).Critical value from the chi square table (Qk =30 lags), is 43.77.

$$Q_k = N \sum_{J=1}^{k} \rho j^2 \quad (4)$$

ρ= serial correlation coefficients for security j and lag k.
N= the number of coefficients.

6.5 Run Test

This is a non-parametric test for statistical independence or randomness in data. It does not require assumption of normality [24]. The number of runs of the NSE data series will be computed and compared with the expected number of runs. If the number of runs are significantly different from the expected then null hypothesis is rejected. Therefore, too few or too many runs compared with expected runs indicate non-randomness corresponding to positive and negative serial correlations respectively [ibid]. The tests are conducted at 5% significance level with ljung-box Q statistic and Z-statistics used in the used in the significance tests for serial correlation and run tests respectively.

7. RESULTS AND DISCUSSIONS

The sample of stocks selected reduced to 33 from 39 after editing because 6 stocks were newly listed within the period. Serial correlation tests were performed over 30 lags for each of the stock series at the 0.05 level of significance. Hypothesis tested is;

Ho: $\rho j = \rho jk = 0$ The correlation coefficient for security j is zero for K= 1, 2.30

H_1: $\rho j1 + \rho j2 + .. \rho jk \neq 0$ ..The correlation j is not coefficient for security j is not zero for K = 1, 2…30

Where ρ = Serial correlation coefficient for security j
K = Number of lags

7.1 Results for serial correlation at lag 1

Out of the 39 stocks included in the study, 17 or 43.5% had significant correlation coefficients at 5% level. Majority of stocks (74%) had negative coefficients with 13% (ρ>0.06) and 83% (ρ<0.05). Rho (ρ) represents the correlation coefficient. Autocorrelation coefficient distribution table 1 below shows that majority of the stocks had very low coefficients in absolute terms.

Table 1: Distribution of Auto Correlation Coefficients

Coefficients (ρ)	Percentage (%)
< 0.01	63
< 0.02	70
< 0.03	75
< 0.04	77
< 0.05	83
< 0.06	87
>0.06	13

Table 1 above shows that 87% of the stocks exhibited correlation coefficients of 0.06 and below. While 63% had a coefficient of less than 0.01. This shows weak correlation. Overall 54% of the coefficients were negative as 46% were positive.

The hypothesis of independence of price series was tested using Qk = 30 statistic at the 5% significance level. The joint coefficients across 30 lags was less than 43.77, thus the null hypothesis for independence could not be rejected for all the stocks from the data studied.

7.3 Results for Run Test

Run test was performed for each stock price series. The hypothesis tested at 0.05 level is;

H0: $Z \leq \pm$ 1.96…Stock price series at NSE is random.
H1: $Z > \pm 1.96$…Stock price series at NSE is random.

The findings indicate that only 6 stocks or 15% failed randomness test; 85% were not statistically significant; their Z – values were between ± 1.96. When newly listed stocks were also analyzed separately namely; Safaricom, Scan group, Equity bank, Kengen and Mumias Sugar Company with capitalization proportion of 21%.Three stocks passed serial correlation independence tests while in runs tests, all the 6 stocks passed independence tests.

8. CONCLUSION AND RECOMMENDATIONS

The study had its main objective as; to determine whether the Nairobi securities exchange experiences weak form efficiency particularly random walk 3. Tests for random walk in this investigation include serial correlation and run test which are parametric and non-parametric respectively. Significance of these tests were conducted at 5% using Q statistic and Z statistic. The critical value for Q statistic with 30 lags was 43.77 and all the stocks had values below this critical value. Thus the hypothesis for independence of price series could therefore not be rejected. This also means that historical prices of stocks were not related to future prices at the Nairobi Securities Exchange for the period studied. The market provides evidence of random walk hypothesis (RW3) in the period 2000-2009.

Results from the non-parametric run test show that majority of the stocks had values between $\pm$ 1.96 and therefore the hypothesis could not be rejected at the 0.05 significance level. These results were also realized from the newly listed stocks after August 2000.Therefore for the period studies, majority of NSE stocks are found to exhibit random price movement and therefore non-systematic. This is consistent with efficient market hypothesis. The implication is that within the period studied it was not possible for any investor or group of investors to outperform the market by making excels returns based on historical pattern of prices f stocks.

The findings are consistent with [5] and [8]. However, [11] while testing for evolving efficiency failed to come up with similar findings for the period 1990 – 20001. Perhaps they were right arguing that information efficiency theory is evolving and hence should be studied at different times of a markets development.

9. RECOMMENDATION FOR FURTHER STUDY

i) A study may be done on EMH considering data that is more recent or even belonging to other African markets.
ii) Similar studies could also be carried out to compare between index stock behavior and overall market behavior within the same period or another outside 2000 – 2009.
iii) The same study may also be done but with changes in the techniques of analysis to improve on these results.

REFERENCES

[1] Fama, E.F (1970). Efficient Capital Markets: A review of theory and empirical work. Journal of finance, 25 (2), 383-417.

[2] Fischer, D.E & Jordan, R. J (2006). Security analysis and portfolio management. 6th Ed. Prentice Hall. New Delhi.

[3] Jensen, M.C (1978). Some analogous evidence regarding market efficiency. Journal of financial economics, 6 2/3, 95-101.

[4] Rahman, S. & Hossain, M.H (2006). Weak form efficiency: Testimony of Dhaka stock exchange. Journal of Business Research, 8, 1-12.

[5] Mlambo, C. & Biekpe, N. (2007). The efficient market hypothesis: Evidence from ten African

stock markets. Investment Analysts Journal, 66, 5-18.

[6] Simons, D. & Laryea, S.A (2005). Testing the efficiency of selected African stock markets. SSRN [online], Retrieved from www.papers.ssrn.com/sol3/papers.cfm? Abstract id= 874808.

[7] Dickson, J. P & Muragu, K. (1994). Market efficiency in developing countries: A case study of the Nairobi stock exchange. Journal of Business finance & Accounting, 21 (1).

[8] Magnusson, M.A & Wydick, B. (2007). How efficient are Africa's emerging stock markets? Journal of development Studies. Available at www.accesmylibrary.com/summary 0286-25421091.

[9] Odera, O. (n.d). Determining the accuracy of the Nairobi stock exchange 20- share index. University of Nairobi.

[10] Kendal, M.G.(1953). The analysis of economic time series-part 1: Prices. Journal of the royal statistical society, Series A (General), 116 (1), 11-25.

[11] Jefferis, K. & Smith, G. (2005). The changing efficiency of African stock markets. South African Journal of Economics, 73.

[12] Opong, K.K., & Danbolt, J. (2007). An empirical re-examination of weak form efficient markets hypothesis of the Ghana stock market using variance ratio tests. African Finance Journal, 9 (2), 1-25.

[13] Dimson, E., & Mussavian, M. (1998) A brief history of market efficiency. European financial management, 4 (1), 91-193.

[14] Ball, R. (1994). The development, accomplishment and limitation of the theory of stock market efficiency. William E. Simon Graduate School of Business Administration, University of Rochester.

[15] Granger, C.W. & Morgenstein, O. (1962). A spectral analysis of New York stock market prices. Percent on University. New Jersey.

[16] Roberts, H. V. (1959). Stock market patterns and financial analysis: Methodological suggestions. Journal of Finance, 14 (1), 1-10.

[17] Brealey, R.A., Myers, C.S & Mercus, J. A (2001). Foundation of corporate finance. 3rd Edition. Mc Graw -Hill Irwin. Boston.

[18] Malkiel, G.B. (2002). The efficient market hypothesis and its critics. Journal of Economic Perspectives, 17 (1), 59- 82.

[19] Fama, E.F (1965). Random walk in stock market prices. Financial analyst journal, 76-80

[20] Grossman, S.J. & Stiglitz, J.E. (1980). On the impossibility of informationally efficient markets. The African Economic Review, 70 (3), 393- 408.

[21] Fama, E.F (1991). Capital market II. The Journal of finance. 46 (5), 1575-1617.

[22] Fama, E.F, Fischer, L., Jensen, M.C, Roll, R (1969). Adjustment of stock to new information. International Economic Review, 10, 1-21

[23] Elango, R. & Hussein, M. I. (2008). An empirical analysis on the weak form efficiency of the GCC markets applying selected statistical tests. International Review of Business research papers, 4 (1). www.papers.ssrn.com/sol3/papers.cfm?abstract id= 1026569.

[24] Moustafa, M.A (2004). Testing the weak form efficiency of United Arab Emirates stock market. International Journal of Business, 9 (3), 309-325.