Testing the Weak-Form Efficiency of the Nairobi Securities Exchange Market

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Abstract
The study aimed to test whether the Nairobi Securities Exchange Market is efficient in the weak form, specifically if stock prices movements are random or non-random. This study employed explanatory survey design on 20 firms sampled out of 68 listed firms. The parametric auto-correlation test and the non-parametric runs test were employed to test for serial independence in the daily prices. The data didn't follow random walk model which postulates a zero mean. The results, Durbin-Watson Coefficient = 0.169 indicates non-independent observations. The study rejected the null hypothesis and concluded that NSE firms' daily prices were non-random. It is possible that stock market prices are not informative and the market is inefficient in terms of resource allocation. The results is informative to investors and technical analysts to make use of historical data as they predict future prices. The market regulatory body should revise the markets information services and come up with innovative ways to increase free fair and equal dissemination of stock market information. Innovative and superior modeling of past daily prices needed to earn superior profits. Evaluation of factors that make the NSE weak-form inefficient is required implement policies to tackle the causes of inefficiency.
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1. Introduction

The most important theme in finance is that price must reflect the value because investors want value for their money to participate in a capital market. Capital markets channel surplus funds from savers to organizations with projects with a positive net present value but are experiencing a shortage of funds (Ogunrinola and Motilewa, 2015). In capital markets, issues of new stocks are in primary markets while dealing in existing securities or those previously issued in a secondary market, however, the two markets complement each other (Sornette, 2017). An efficient market mirror the organization's earning, growth and financial strength in a security's price, because that is the only way, investors will get value for their money (Cramton & Ockenfels, 2016).

In 1970, Fama came up with Efficient Market Hypothesis (EMH), a statement that will be tested in this study. Fama's statement was that prices react to new information, but that information is about the future not the past. Therefore, the EMH implies that trading on existing information, apart from not being profitable; tell us about the efficiency in pricing securities in a capital market. The EMH statement is that security's prices respond to new information and because new information arrives randomly it is difficult predicting security's price. No wonder it is Williams (2015) argument that changes in price of stocks must be random movement because there is no motivation to anticipate the new data to be non-arbitrary in appearance. That prices should follow a random walk is also found in Yang, Lee and Lee (2015) who describe the price series as random. Emenike (2017) distinguished three successively weaker versions of the Random Walk based on the distributional characteristics of the price (or return) increments: independently and identically distributed increments, independent increments and uncorrelated increments.

A standout among the most essential standards utilized as a part of estimating the market's efficiency is the capacity of costs to mirror all right now accessible data (Cramton and Ockenfels, 2016). The Efficient Market Hypothesis (EMH) proposes that present stock prices totally reflect every single open information about the firm, new or old. The EMH has gotten a plenitude of consideration since its initiation. Be that as it may, support for or against the EMH is the work in process, and various investigations have archived mixed results. This theory has additionally created extensive discussion (Rossi, 2015). All things considered, the EMH questions the capacity of financial specialists reliably recognizing mispriced securities.

With joined impact of data arriving in a random, autonomous and various contending investors altering stock costs quickly to reflect new data, one would anticipate that value changes will be independent and random. One way of establishing security's market efficiency is by examining the pattern inherent in security's prices,

specifically whether prices follow a random walk. In Brigham…it pointed out that 'Though the efficient market's hypothesis provides a framework for understanding what information is useful and what is not, we need to validate the hypothesis with real market data. This validation will go on until the results are not mixed. In all test on weak form efficiency seek answer to the question: Does today's stock prices reflect all the data of past prices?

The study tested the following hypotheses;

$H0_1$: Traded stock prices movements on the floor of the Nairobi Securities Exchange market are random;

$H0_2$: Traded stock prices movements on the floor of the Nairobi Securities Exchange market are non-random.

2. Literature Review

Levy (1967) first advanced the idea of EMH before (Fama, 1970) popularized it. EMH suggests that prices of stocks reflect all information that is available in the market. When prices reflect all information, no investor can benefit because everyone gets the same information. Maverick (2019) statement is that 'the market cannot be beaten because it incorporates all important determinative information into current share prices.

Levy (1967) proposed two forms of EMH – weak and strong forms, Professor Roberts (1959) suggested the three levels of market efficiency by adding strong form, but did not think it worth researching on. I t appears Eugene Fama furthered on Professor Roberts work. The three forms reflect a different set of information and level of efficiency. That is, market efficiency is about the degrees to which security's price reacts to information.

The weak form mirrors a random walk model of short-term price movements and upholds that there should be no patterns in the security's prices because the stock value captures all historical data about securities, such as daily prices and trading volume. (Nwachukwu & Shitta, 2015). Therefore, no investor can gain excessive profits by predicting the stock prices based on such past information, because that information is already incorporated into share prices (Fama, 1970). A market that fails to discount existing information in the share price is by all definitions inefficient in pricing securities in that market. Relevant information for purpose of security valuation is about the future. Semi-strong form assumes that stock prices adjust rapidly to reflect all public information received (Nwachukwu & Shitta, semi-strong predict that the stock prices completely reflect all data from open and private sources (Nwachukwu & Shitta, 2015). The strong form also assumes that markets are efficient to an extent that the information impacts on price occur before the information is published.

The simple random walk theory suggests that because information arrives randomly, the share price changes are unpredictable. Samuelson (1965) formalized the belief among that security market prices are unbiased and are a reflection of supply and demand, and is random. The Random Walk model accept that progressive value changes (or daily prices) are independently and identically distributed random variables, ruling out predictability of future price changes from previous price changes (Fama, 1965). In a weak form efficient market, i.e. where stock market prices fully reflect all past market historical market data to predict share prices. It is not possible relying on historical data to select stocks and earn excess profits from those stocks (Cleary, et al., 2011). Thus, researchers use the random walk hypothesis (RWH) to study EMH. The assumption is that stocks that follow a random walk are efficient in the weak form. Indeed, studies that test EMH assumes the RWH, and then proceed to prove otherwise. This study adopted RWH as a basis for testing EMH for stocks listed on the Nairobi Securities Exchange.

Al-Loughani & Chappell (1997) studied the validity of weak form EMH for London's stocks and found no evidence that the series followed RWH hence no weak-form efficiency of the market. Narayan et al., (2015) tested whether EMH is day-of-the-week-dependent using stocks from banks listed in NYSE. The study found no evidence of EMH for individual bank stocks. Al-Khazali & Mirzaei (2017) using Dow Jones Islamic Market Index (DJIMI) used both AMH and EMH frameworks and found that AMH better explained calendar anomalies affecting market efficiency of Islamic stocks than the EMH.

Omran & Farrar (2006) investigated the RWH in Middle Eastern countries and rejected the RWH for all the markets examined. Jarrett (2010) studied the Asian market in a bid to test EMH and revealed that the weak form EMH did not hold for the four markets (Singapore, Malaysia, Korea and Indonesia) examined. Mishra et al. (2015) showed that Indian stocks were means reverting thus no evidence of weak form efficiency. Malafeyev et al. (2017) studying China and India to test the effect of global financial crisis on the efficiency of stock markets revealed that both markets did not exhibit weak form efficiency and that the crisis did not affect the market efficiency. A study in Bangladesh by Feige (2016) investigated the independent movements in the prices and volumes of stocks and concluded that cost and volume responses are autonomous and firmly related.

OpokuOpoku (2016) studied the weak form efficiency of African stock markets by selecting 24 stocks indexes and eight individual national stocks and found that the stocks were weak form efficient; and that the continent-wide indexes were more weak-form efficient than the national stocks. Using 30 stocks from Kenya, Kelikume (2016) found that the stocks were efficient in the weak form. In Ethiopia, the Independent movement in the prices of stocks traded is influenced by malpractices where an investment bank oversees an issue while a business department of the same bank trades in those shares prior to an issue of the company. There are circumstances where analyst compensations for research work and investment banking businesses are connected.

Murithi (2013) studied the weak-form efficiency of NSE and found that the stocks did not follow a random walk. Kamau (2013) also found that NSE stocks were not weak form efficient. Chesire (2014) also found no evidence for weak form EMH when she examined weak form EMH for KenGen and KPLC shares prices.

3. Research Methodology

The target population for this study will be all 68 listed firms in the NSE for the period 2002-2017 (NSE handbook, 2017). The study selected 20 firms that constitute the NSE twenty share index and represent over 60 percent of market capitalization in that market. The test is to establish whether the daily price dynamic at the NSE follows a random walk process. The researcher used inferential statistics to try to infer from the daily price data how the population of stocks in the NSE behaves. Kolmogorov-Smirnov goodness of fit test was used together with the descriptive statistics obtained to test the distribution of the return series. In addition, parametric auto-correlation test and the non-parametric run's test were employed to test for serial independence in the daily prices.

4. Findings and Discussions

Findings on descriptive analysis were as presented in table 1 below. The (missing observations in table 1 for some firms was because the observed data started from 2002 when some firms had not been started).

Table 1: Descriptive Statistics of the NSE Firms

	ARM	BAMBURI	BBK	BAT	ICDCI	CFC	EABL	KCB	KENOL	KQ	KPLC
Observation	3811	3321	3818	3311	3818	3825	3815	3818	3818	3818	3818
Mean	75.1	147.2	85.3	284.6	43.5	68.7	219.0	47.3	67.5	29.8	79.37
Median	72.5	158	57.25	205	32	65.5	194	32.5	49	14	25
Mode	91	200	17	200	60	9	145	23	100	6	9
Std. Dev	56.24	54.64	93.37	207.4	49.64	36.84	98.07	43.14	80.47	30.87	80.43
Min	0	0	7	0	9	0	74	8	0	3	6
Max	235	240	602	999	553	368	552	271	423	146	335

	NMG	SASINI	SCBK	BRITAM	COOP	EQTY	KENGEN	SAFCOM	SCAN
Observation	3813	3803	3815	1363	2144	2711	2766	2279	2685
Missing	0	0	0	97	3628	3628	3628	3628	3640
Mean	187.5	19.02	192.7	12.93	15.18	62.22	14.68	9.16	38.09
Median	178	15.55	189	10.40	15.70	33.75	12.30	5.85	32.75
Mode	180	20	140	10	20	24	7	4	26
Std. Dev	78.3	17.169	72.75	7.461	4.058	65.83	7.651	6.008	15.63
Min	0	3	46	4	6	12	5	3	10
Max	398	177	355	37	24	324	40	25	76

The values of Skewness and kurtosis coefficients (see table 2) were all above 5% level of significance suggesting the absence of normally distributed.

Table 2 Skewness and Kurtosis

Category	ARM	BAMBURI	BBK	BAT	ICDCI	CFC	EABL	KCB	KENOL	KQ
Skewness	0.574	-0.901	1.445	1.47	4.91	1.15	1.169	2.534	2.057	1.36
Kurtosis	-0.383	0.019	2.127	1.49	28.711	5.79	0.778	6.732	4.611	0.98

Category	KPLC	NMG	SASINI	SCBK	BRITAM	COOP	EQTY	KENGEN	SAFCOM	SCAN
Skewness	0.672	0.116	5.202	0.211	0.943	-0.245	1.976	1.152	0.637	0.49
Kurtosis	-0.819	-0.721	30.403	-0.629	-0.069	-0.817	3.305	0.603	-1.041	-0.95

The study finding also indicated that majority of data were positively skewed. These study findings of positive skewness for the daily data in NSE concur with study findings of Vitali and Mollah (2010), in Tunisia, Kenya and Mauritius. However, Borges (2007), noted negative values for all the daily samples in the Pakistan market. As per Elbarghouthi, et al. (2012), skewness is a measure of asymmetry of the distribution of the series around its mean. The significant positive skewness in NSE firm daily prices give an implication that large positive daily prices tend to be larger than the higher negative daily prices hence data are not symmetrical distribution.

The study results for Kolmogorov-Smirnov Goodness of Fit Tests were presented in table 3.

Table 3 Kolmogorov-Smirnov Goodness of Fit Tests

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
ARM	0.124	3311	0.000	0.929	3311	0.000
BAMBURI	0.111	3311	0.000	0.912	3311	0.000
BBK	0.239	3311	0.000	0.801	3311	0.000
BAT	0.235	3311	0.000	0.816	3311	0.000
ICDCI	0.256	3311	0.000	0.494	3311	0.000
CFC	0.079	3311	0.000	0.917	3311	0.000
EABL	0.16	3311	0.000	0.882	3311	0.000
KCB	0.198	3311	0.000	0.684	3311	0.000
KENOL	0.206	3311	0.000	0.746	3311	0.000
KQ	0.188	3311	0.000	0.807	3311	0.000
KPLC	0.22	3311	0.000	0.852	3311	0.000
NMG	0.098	3311	0.000	0.966	3311	0.000
SASINI	0.279	3311	0.000	0.454	3311	0.000
SCBK	0.067	3311	0.000	0.966	3311	0.000
BRITAM	0.147	1363	0.000	0.894	1363	0.000
COOP	0.073	2144	0.000	0.975	2144	0.000
EQTY	0.315	2711	0.000	0.689	2711	0.000
KENGEN	0.131	2766	0.000	0.879	2766	0.000
SAFCOM	0.214	2279	0.000	0.858	2279	0.000
SCAN	0.151	2685	0.000	0.929	2685	0.000

The Kolmogorov-Smirnov value less than 0.05 is considered not normal at sig. <0.05. The value for Shapiro-Wilk less than 0.05 indicate non-normality (Sig. <0.05). This implies that data was considered not to come from a normal distribution. Therefore, distribution of the NSE firms daily prices are not coming from normally distributed population. The study findings concur with study finding of Elbarghouthi, et al., (2012); Mlambo and Biekpe (2003); Mollah (2007); Simons and Laryea (2005); Vitali and Mollah (2010) who found out that return from emerging markets are not normally distributed. Auto-Correlation Tests gave the results presented in table 4.

Table 4: Auto-Correlation Coefficients

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.978a	.956	.955	.589	.169

Autocorrelation also known as lagged correlation or serial correlation, measures the relationship between a variable's current value and its past values. Autocorrelation occurs when residuals are not independent of each other. The assumption of independence of residuals implies that successive observations of the dependent variable are not correlated. This means that successive residuals have no pattern and there are no long runs of positive or negative residuals. Durbin-Watson statistic was used to test for autocorrelation. The value of the Durbin-Watson statistic can range from 0 to 4. The value of Durbin-Watson statistic is 2.0 when there is no autocorrelation among the residuals. It gets close to 0 when there is positive autocorrelation and is beyond 2 when there is negative autocorrelation (Lind, Marchal & Wathen, 2012). The value of Durbin-Watson coefficient in this study was found to be 0.169 indicating non independent observations and absence of random walk in share prices.

Run test was done in order to test independence of data. Findings were as presented in table 5.

Table 5 Runs Test Results

	Test Value	Total Cases	Number of Runs	Z	Sig. (2-tailed)
ARM	75.1	3811	45	-60.314	0.000
BAMBURI	147	3321	54	-55.715	0.000
BBK	85.37	3818	19	-61.066	0.000
BAT	284.66	3311	10	-57.159	0.000
ICDCI	43.58	3818	33	-60.66	0.000
CFC	69.35	3794	50	-60.007	0.000
EABL	219.09	3815	26	-60.947	0.000
KCB	47.3	3818	35	-60.548	0.000
KENOL	67.52	3818	14	-61.36	0.000
KQ	29.81	3818	11	-61.435	0.000
KPLC	79.37	3818	5	-61.667	0.000
NMG	187.56	3813	49	-60.168	0.000
SASINI	19.02	3803	80	-58.466	0.000
SCBK	192.17	3815	64	-59.727	0.000
SCAN	38.09	2685	25	-50.895	0.000
SAFCOM	9.16	2279	4	-47.62	0.000
KENGEN	14.68	2766	30	-51.46	0.000
EQTY	62.22	2711	2	-52.031	0.000
COOP	15.18	2144	22	-45.406	0.000
BRITAM	12.93	1363	18	-35.957	0.000

The finding is Z statistics value for all firms have negative signs, giving an indication that the run numbers observed were less than the expected numbers of runs for daily price data for NSE selected firms, except for Sasini, Kengen, Co-operative and Britam, which had observed number of runs more than expected numbers of runs. Negative Z values indicate positive serial correlation in the return series (Elbarghouthi,et al., 2012).

The observed differences between the actual and the expected number of runs, expressed as a two-tailed is significant. Therefore, the study data rejected the null hypothesis that the traded stock prices movements in NSE firms are completely random. The data reject the null hypothesis that the successive return changes are not independent, hence traded prices movements in NSE firms market exhibit a pattern for some firms, weak form efficient. However, the daily prices Sasini, Kengen, Co-operative and Britam which had observed number of runs more than expected numbers of runs follow a random walk.

The study findings agreed with the study results of Waweru, Munyoki and Uliana (2008) on the NSE, Emenike (2008) on the Nigeria Stock Exchange and Elbarghouthi, et al. (2012), on the Amman Stock Exchange, when the expected number of runs were significantly higher than the observed number of runs in the respective markets. The study findings also agreed with study findings of Vitali and Mollah (2010) who rejected the null hypothesis of the return series being a random. However, the study findings fail to agree with study findings of Dickinson and Muragu (1994) who failed to reject the null hypothesis of independence at the 5% level for the NSE daily prices.

5 Conclusions and Recommendations

The study concluded that in 16 out of the 20 firms sampled, the run numbers observed in the majority of the firms were less than the expected numbers of runs for daily price data for NSE firm. Therefore, the study rejected the null hypothesis and concluded that NSE firm's daily price data were non-random. The successive return changes are not independent, hence traded stock price's movement in NSE is not a weak form efficient. This implies that investors and technical analysts are in a position to make use of historical data as they will be able to predict future prices. In all, NSE is not informatio efficient. The market regulatory body should revise the markets information services and come up with innovative ways to increase free fair and equal dissemination of stock market information to all participants.

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