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TESTING THE WEAK-FORM EFFICIENCY OF THE MALAWI STOCK EXCHANGE

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Abstract: This research study tests the validity of the weak form of the efficient market hypothesis in the Malawi Stock Exchange. The period covered by this study spans January 01, 2016, to December 31, 2019. Parametric and non-parametric statistical tests including the Augmented Dickey-Fuller test, the Kolmogorov-Smirnov (K-S) test, the Shapiro–Wilk test, and the runs test are applied to the daily return series of three market indices of the MSE, viz, the MASI, the DSI, and the FSI, over the study period. The results of the tests of normality indicate that the return series of all the market indices are not normally distributed. The return series are found to be leptokurtic and negatively skewed. Furthermore, the results of the Augmented Dickey-Fuller test show that the return series of the MASI, the DSI, and the FSI are stationary. More, the runs test rejects the hypothesis that the return series are random. It is therefore concluded that the random walk hypothesis does not hold for the Malawi Stock Exchange since successive price changes are not random. Hence, the Malawi Stock Exchange is not weak-form efficient.

***Index Terms* - African stock markets, market indices random walk, return series, weak-form efficiency.**

I. INTRODUCTION

Previous studies on market efficiency tend to be focus on developed countries (See Fama, 1970; Summers, 1986; Lo & MacKinlay, 1988; Borges, 2010). As a result, there is little empirical evidence on the efficiency of emerging stock markets in developing countries, especially those in Africa. The researchers note the studies conducted by Mecagni and Sourial (1999) on the Egyptian stock market; Osei (2002) on the Ghanaian stock market; Chiwira and Muyambiri (2012) on the Botswana stock market; and Kelikume, Olaniyi, and Iyoha (2020) on fifteen select African stock markets. The insufficiency or unavailability of relevant data is often at the root of the paucity of empirical evidence on the efficiency of African stock markets.

This section consists of an overview of the Malawi Stock Exchange (MSE) and the efficient market hypothesis.

1.1 Overview of the MSE

The Malawi Stock Exchange (MSE) is the regulated stock market of Malawi, a landlocked country in southeastern Africa. The MSE came into existence in 1994. It is based in Malawi's commercial and industrial capital, Blantyre. Initially, the MSE was engaged in the provision of a facility for secondary market trading of government securities including Treasury Notes and Local Registered Stock. However, it began equity trading in November, 1996, when National Insurance Company Limited (NICO), Malawi's largest insurance provider, was first listed. The MSE is licensed under the Financial Services Act 2010 and operates under the Securities Act 2010 and the Companies Act 2013. The MSE has three (3) platforms. These are the Main Board, the Debt Market, the Alternative Capital Market. First, the Main Board is intended to serve the needs of larger and well-established companies. Second, the Alternative Capital Market is meant to provide opportunities to the Small and Medium-sized Enterprises (SME) to procure capital at a lower cost. Lastly, the Debt Market serves the needs of issuers of debt capital. At present, there are sixteen (16) companies listed on the Main Board of the MSE.

The market indices of the MSE used for this study are the Malawi All Share Index (MASI), the Malawi Domestic Share Index (DSI), and Malawi Foreign Share Index (FSI). The MASI is the benchmark index of the MSE. It tracks the performance of all the stocks listed on the MSE. While the DSI is composed of stock of listed domestic companies, the FSI is made up of stocks of foreign companies listed on the MSE. This research study uses the daily return series of the MASI, the DSI, and the FSI to assess the weak-form efficiency of the MSE.

1.2 The Efficient Market Hypothesis

The efficient market hypothesis states that the prices of securities in an efficient market always "fully reflect all available information" (Fama, 1970, p. 383). This suggests that the prices of securities in an efficient market are neither over-valued nor under-valued. Thus, security prices in an efficient reflect their intrinsic values. As a result of the fact that security prices reflect all available relevant information, market participants cannot profit from privileged information or sophisticated investment strategies based on such information. Tiwari and Kyophilavong (2014) argue that, under competitive market conditions, stock prices are supposed to rapidly incorporate available market information in order that arbitragers cannot make price predictions, and extra earnings, from the use of past information. According to Fama (1970), the efficient market hypothesis depends on three conditions, which are considered as sufficient but not necessary. These conditions are the existence of free and public information, the absence of transaction costs, and the incorporation of all available relevant information in security prices. Kim and Shamsuddin (2008) further contend that the level of equity market development and the regulatory framework exert some influence on the pricing efficiency of stock markets.

Fama (1970) classified the efficient market hypothesis into three forms. The three forms are the strong-form efficient market hypothesis, the semi-strong form efficient market hypothesis, and the weak-form efficient market hypothesis. According to the strong form of the efficient market hypothesis, security prices reflect all relevant public and private information. Thus, investors and arbitragers cannot beat the market using any piece of information. Second, the semi-strong form of the efficient market hypothesis postulates that the prices of securities reflect all publicly available information. The weak form of the efficient market hypothesis asserts that prices of securities reflect only historical volume and price information of securities.

This study focuses on the weak form of the efficient market hypothesis. If the Malawi Stock Exchange is weak-form efficient, then market participants are not expected to have the capacity to earn above-average returns by predicting future stock prices based on information on past stock prices.

II. Empirical review

Major A number of research studies have been performed to ascertain the efficiency or inefficiency of African stock markets. Mecagni and Sourial (1999) examined the behaviour of stock returns on the Egyptian stock market as well as the efficiency of the market in pricing securities. The GARCH modelling framework was employed in the analysis of the market's four best known daily aggregate indices (the CMAI, the EFGI, the HFI, and the PIPO). The findings indicate significant departures from the efficient market hypothesis. Additionally, Osei (2002) assessed the asset pricing and information efficiency of the Ghana Stock Market. This was done by testing the response of the Ghana Stock Exchange to annual earnings announcements. The study found that the Ghana Stock Exchange is inefficient with regard to the information on annual earnings releases of listed companies. Again, Chiwira and Muyambiri (2012) investigated whether or not the Botswana Stock Exchange is weak-form efficient. Statistical techniques including the Augmented Dickey Fuller test and the Phillips-Perron test as well as the runs test and the autocorrelation test were applied to stock price data covering the period 2004-2008. The results of the tests provide evidence that the Botswana Stock Exchange is not weak-form efficient.

Furthermore, Ramsohok, Jaunky, and Ramesh (2017) assessed the validity of the random walk hypothesis in the Stock Exchange of Mauritius using the returns data of four stock market indices (the SEMDEX, the SEMTRI, the DEMEX and the DEMTRI) spanning the period of August, 2006, to May, 2014. Unit root tests, including the Augmented Dickey-Fuller (ADF), the Kwiatkowski-Phillips-Schmidt-Shin (KPSS), were employed in the analysis of the daily returns of these stock market indices over the period. It was found that the return series of the SEMTRI, the DEMEX and the DEMTRI are non-stationary. However, the return series of the SEMDEX was found to be stationary over the period. Also, Kelikume, Olaniyi, and Iyoha (2020) investigated the weak form of the efficient market hypothesis in fifteen (15) foremost African stock markets (the BRVM, the BSE, the BVC, the DSE, the EGX, the GSE, the LuSE, the MSE, the NGSE, the SEM, the USE, the ZSE, the BVMT, the JSE, and the NSE). In the study, the wavelet unit root technique was used to analyze the monthly stock returns data from the sampled stock markets covering the period of January, 2010, to June, 2018. Based on the results of the analysis, the hypothesis of stationarity is accepted at 1 percent, 5 percent and 10 percent significance level. Hence, stock return series are not random.

Other studies test the efficiency of stock markets in Asian-Pacific region of the world. Kim and Shamsuddin (2008) tested the martingale hypothesis in the stock prices of a group of Asian stock markets. New multiple variance ratio tests based on the wild bootstrap and signs were applied to daily and weekly data from 1990. It was found that the stock markets of Hong Kong, Japan, Korea, Singapore, Thailand and Taiwan are weak-form efficient. However, the stock markets of Indonesia, Malaysia and Philippines are found not to be inefficient in spite of the implementation of financial liberalization measures decades ago. Moreover, Srinivasan (2010) assessed the random walk hypothesis to ascertain the validity of the weak-form efficiency for two major stock exchanges in India. The Augmented Dickey-Fuller (1979) test and the Phillips-Perron (1988) test were used to analyze daily observations of two major market indices (the Nifty and the Sensex) over the period July 01, 1997, to August 31, 2010. The results of both unit root tests reject the random walk hypothesis in the two exchanges. Thus, the study found no evidence to support the validity of the weak-form efficiency of the Indian stock market.

In addition, Al-Jafari (2013) examined the market efficiency of the Istanbul Stock Exchange using the daily values of the Istanbul Xu030 index spanning the period 1997-2011. The runs test and unit root tests were applied to the return series of the market index. Al-Jafari (2013) found that the Turkish stock market is not weak-form efficient. In another study in the region, Kanojia and Mahajan (2017) examined the efficient market hypothesis in five stock markets in Asia over a period 2000-2014, which includes the time of the financial crisis. The research data consists of monthly closing prices of individual indices of the Bombay Stock Exchange of India, the Tokyo Stock Exchange of Japan, the Shenzhen Stock Exchange of China, the Karachi Stock Exchange of Pakistan and the Kuala Lumpur Stock Exchange (now the Bursa Malaysia) of Malaysia. After conducting the analysis of the data using the general regression model, Kanojia and Mahajan (2017) found that all the five sampled Asian markets are not weak-form efficient. These findings for Malaysia are consistent with those of Kim and Shamsuddin (2008), but the results are mixed for the Japanese stock market.

Some studies have also been conducted on stock markets of Europe and the Americas. Seiler and Rom (1997) examined the validity of the random walk hypothesis in the New York Stock Exchange using daily stock prices of all listed stocks from February, 1885, to July, 1962. It was found that stock prices follow a random walk and, thus, the American stock market is weak-form efficient. As well, Urrutia (2004) employed the variance-ratio in testing the random walk hypothesis in emerging equity markets of Latin America, namely, Argentina, Brazil, Chile, and Mexico. The research data comprised monthly index values in local currency from December, 1975, to March, 1991. The results of the runs test indicate that the sampled Latin American equity markets are weak-form efficient even though the variance ratio test reject the random walk hypothesis. Nisar and Hanif (2012) examined the weak-form efficiency of six stock exchanges in North America and Europe. The runs test and the variance ratio test were applied to the monthly, weekly and daily historical values of the indices of the sampled stock markets, including the NYSE Composite of the United States of America (USA), the S&P TSX Composite of Canada, the

FTSE 100 Index of the United Kingdom (UK), the CAC 40 of France, the DAX 30 of Germany, and the IBEX 35 of Spain. The study spanned July, 1997, to June, 2011. The results of the tests indicate that only the stock markets of the USA, Canada, Germany, and Spain are weak-form efficient. In addition, Duarte and Pérez-Iñigo (2014) tested the weak-form efficiency in the five foremost Latin American stock markets. The normality of the series was evaluated using basic statistics as well as the Jarque-Bera test and the Chi-Square goodness-of-fit test. The analysis proceeded by contrasting the Random Walk 1 (Runs test and BDS test), Random Walk 2 (Alexander filters with genetic algorithms) and Random Walk 3 (Ljung-Box test and Bartlett Interval) of the random walk of the assets. The findings evidence that the sampled stock markets have recently evolved from inefficiency to market efficiency. The change to efficiency began in Mexico in 2007, followed by Brazil in 2008, Colombia in 2008, Chile in 2011, and then Peru in 2012.

In another study on European stock markets, Dutta (2015) employed the runs test, the variance ratio test and unit root tests (the Augmented Dickey-Fuller test and the Phillips- Perron test) for investigating the weak-form efficiency of France, Germany, Italy, and the United Kingdom. The tests were applied to monthly price index data spanning the period 1998-2014. The findings of the analysis provide evidence that stock prices in the sampled European stock markets do not follow a random walk, which is an indication of weak-form inefficiency. Likewise, Erdas (2019) examined the weekly closing values of the market indices from the stock markets of Lithuania, Hungary, Romania, Croatia, Slovenia, Poland, Bulgaria, the Slovak Republic, Latvia, Estonia, and the Czech Republic in search for evidence of weak-form market efficiency. The Harvey et al. (2008) linearity test was used to determine the characteristics of the series. Then the DF-GLS (1996), the Phillips-Perron (1988) and the Lee-Strazicich (2003) unit root tests were applied to linear series while the Kapetanios et al. (2003) and Kruse (2011) tests were applied to nonlinear series. The results of all the linear and nonlinear unit root tests indicate that the all the sampled central and eastern European stock markets have a unit root. Accordingly, the findings evidence that the sampled stock markets are weak-form efficient over the study period. Similarly, the findings support the validity of the random walk hypothesis in all the selected central and eastern European stock markets.

In summary, there is still no agreement in extant literature on the efficiency or inefficiency of stock markets. The empirical evidence on certain markets remains mixed and inconclusive. As noted by Senthilnathan (2015), evidence "in the literature seem not consistent about market efficiency, even for the same market." Such disparities in extant literature may be due, in part, to the nature of research data used, the statistical techniques employed for analysis, or the period of study.

III. RESEARCH METHODOLOGY

This research study examines the weak-form efficiency of the Malawi Stock Exchange using a number of statistical tests of normality, stationarity, and randomness. These include Kolmogorov-Smirnov (K-S) test, the Shapiro–Wilk test, the Augmented Dickey-Fuller unit root test, and the runs test. This section is divided into two parts. The first part is about the research data and hypothesis employed in this study. The second part gives a description of the various parametric and non-parametric tests used.

3.1 Research Data and Hypothesis

The data used for this study is obtained from the official website of the Malawi Stock Exchange. It comprises the daily values of the three sampled market indices of the MSE (namely, the MASI, the DSI, and the FSI). The return series of each of the sampled indices is then generated by applying the natural logarithm to its daily values as shown in the formula below:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

Where,

r_t is the return at time t, P_t is the price at time t, and P_{t-1} is the price at time t – 1.

After undertaking the literature review, the following null and alternative hypotheses are formulated for this research study.

H_0: The indices of the Malawi Stock Exchange follow a random walk.

H_1: The indices of the Malawi Stock Exchange do not follow a random walk.

This study adopts the quantitative research approach.

3.2 Statistical Tests

In this section, the various parametric and non-parametric tests used in this study are described. To suit the purpose of this study, these tests are generally grouped as tests of normality, stationarity, and randomness. In this study, only the Augmented Dickey-Fuller (1979) test is conducted with the EViews statistical package. The rest of the tests are carried out using the SPSS statistical packages.

3.2.1 Tests of Normality

The Kolmogorov-Smirnov (K-S) test and the Shapiro–Wilk test are used to assess the normality of the distribution of the return series of the MASI, the DSI, and the FSI. The Kolmogorov-Smirnov (K-S) test is a non-parametric test that is used to examine the normality of each return series by standardizing the return series and comparing it to the standard normal distribution. The hypothesis of the K-S test is given below:

H_0: The return series is normally distributed.

H_1: The return series is not normally distributed.

The decision rule is to reject the null hypothesis if the p-value of the test statistic is less than the level of significance. On the other hand, if the p-value if greater than the level of significance, retain the null hypothesis of normality. Similarly, the Shapiro–Wilk test is used to test the normality of each return series. The Shapiro–Wilk test is usually deemed to possess more statistical power than the Kolmogorov-Smirnov test because the former has stricter requirements. The decision rule for the Shapiro–Wilk test is the same as that of the Kolmogorov-Smirnov test. Reject the null hypothesis that the return series is normal, if the critical value is less than the level of significance. Otherwise, retain it.

3.2.2 Test of Stationarity

The Augmented Dickey-Fuller (1979) unit root test is employed in this study to determine the stationarity of the return series of the MASI, the DSI, and the FSI. A time series is said to be stationary if its characteristics such as the mean and variance are time-invariant. A stationary time series does not have a unit root. However, a non-stationary time series does not have a unit root. A common example of a non-stationary time series is the random walk.

The model of the Augmented Dickey-Fuller (1979) test is as follows:

$$\Delta y_t = \phi + \beta t + \alpha y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \cdots + \delta_p \Delta y_{t-p} + \varepsilon_t$$

Where,

ϕ = constant term, y_{t-1} = lag p of the return series, Δy_{t-p}= pth order difference of the return series, and ε_t = random disturbance term.

The following are null and alternative hypotheses of the Augmented Dickey-Fuller (1979) test:

H_0: The return series has a unit root.

H_1: The return series does not have a unit root.

As a decision rule, the null hypothesis is rejected if the p-value of the test statistic is less than the level of significance. Otherwise, the null hypothesis is retained.

3.2.3 Test of Randomness

The runs test is a non-parametric test that used to determine for randomness of runs in a data set. It does not depend on the normality of returns. In this study, the runs test is used to assess the randomness of the return series of each of the three market indices. That is to say, it the runs test is used to find out if each return series is from a random process. The null and alternative hypotheses of the runs test are given below:

H_0 : The sequence of each return series is random.

H_1 : The sequence of each return series is not random.

The test statistic of the runs test, Z, is given by:

$$Z = \frac{R - \bar{R}}{S_R}$$

Where, $\bar{R} = \frac{2N_1N_2}{N} + 1$ and $S_R = \sqrt{\frac{2N_1N_2\,(2N_1N - N_1 - N_2)}{(N)^2(N-1)}}$, N_1= Number of positive residuals, N_2= Number of negative residuals, and N= Total number of observations.

The decision rule of the runs test is that the null hypothesis is rejected if the p-value of the test statistic is less than the level of significance of the test. Otherwise, the null hypothesis of randomness is retained.

IV. RESULTS AND DISCUSSION

This section provides the results of the tests of normality, stationarity and randomness.

4.1 Tests of Normality

The following are the results of the normality tests, comprising the descriptive statistics of the return series as well as results of the Kolmogorov-Smirnov (K-S) test and the Shapiro-Wilk (S-W) test.

Table 4.1: Descriptive Statistics of the Return Series of the MASI, the DSI, and the FSI.

	N	Mean	Std. Dev.	Skewness		Kurtosis	
				Stat.	Std. Error	Stat	Std. Error
MASI	980	.00074603	.009401561	-.066	.078	120.796	.156
DSI	980	.00073686	.014089851	-.228	.078	192.141	.156
FSI	980	.00084282	.315795850	-.008	.078	485.791	.156
Valid N (listwise)	980						

Table 4.1 shows that the return series of the MASI, the DSI, and the FSI have a skewness value of -0.066, -0.228, and -0.008 in that order. All the values of skewness are less than zero, indicating that the return series of each index is negatively distributed. In addition, Table 4.1 gives that kurtosis values of the return series of the MASI, the DSI, and the FSI as 120.796, 192.141, and 485.791 respectively. These values, which are all greater than three (3), imply that the distributions of returns on the MSE are all leptokurtic.

Table 4.2 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
MASI	.321	980	.000	.464	980	.000
DSI	.345	980	.000	.275	980	.000
FSI	.480	980	.000	.033	980	.000

a. Lilliefors Significance Correction

Next, Table 4.2 displays the results of the Kolmogorov-Smirnov test and the Shapiro-Wilk test. First, the Kolmogorov-Smirnov test records a p-value of 0.000 for the return series of the MASI, the DSI, and the FSI alike. Since the p-value of 0.000 is less than the level of significance of 0.05 for each index, the p-value is statistically significant for each index returns. Thus, the null hypothesis of normality if rejected. Second, the Shapiro-Wilk test also records a p-value of 0.000 of each return series. This is an indication that none of the return series is normally distributed, according to the Shapiro-Wilk test. Hence, both the Kolmogorov-Smirnov test and the Shapiro-Wilk test reject the null hypothesis of normality of the returns of the MASI, the DSI, and the FSI.

4.2 Test of Stationarity

Below are the results of the Augmented Dickey-Fuller test of stationarity, including the test statistic, probability value, and decision of each return series.

Table 4.3: Results of the Augmented Dickey-Fuller test (at Level)

Index	Test Statistic	Prob.	Decision
MASI	-38.85590	0.0000	Reject the null hypothesis
DSI	-32.13360	0.0000	Reject the null hypothesis
FSI	-18.01133	0.0000	Reject the null hypothesis

From Table 4.3, the Augmented Dickey-Fuller test gives a p-value of 0.0000 for the return series of the MASI, the DSI, and the FSI. Since the p-value of 0.0000 is less than the alpha value of 0.05, the null hypothesis of non-stationarity is rejected for all the indices. Thus, returns series of the MASI, the DSI, and the FSI are stationary, and not random.

4.3 Test of Randomness

This section provides the results of the runs test for the randomness of the returns series of the three sampled stock market indices.

Table 4.4: Results of the Runs Test

Index	**Null Hypothesis**	**Sig.**	**Decision**
MASI	The sequence of values defined by MASI is random.	0.006	Reject the null hypothesis
DSI	The sequence of values defined by DSI is random.	0.044	Reject the null hypothesis
FSI	The sequence of values defined by FSI is random.	0.001	Reject the null hypothesis

Asymptotic significances are displayed. The significance level is 0.05.

In Table 4.4, the p-values of the runs test for the return series of the MASI, the DSI, and the FSI are 0.006, 0.044, and 0.001 correspondingly. Each p-value is less than the level of significance of 0.05 so the null hypothesis of randomness is rejected for each return series. Thus, the daily returns on the MASI, the DSI, and the FSI are each not random, and hence, the Exchange is weak-form inefficient.

V. CONCLUSION AND RECOMMENDATIONS

This section documents the conclusions based on the findings of the study as well as the recommendations to relevant stakeholders.

5.1 Conclusion

This research study seeks to test the weak-form efficiency of the Malawi Stock Exchange (MSE). Statistical tests of normality, stationarity, and randomness are employed for the analysis of daily return series of three stock market indices spanning the period January 01, 2016, to December 31, 2019.

The tests of normality, the Kolmogorov-Smirnov test and the Shapiro-Wilk test, reject the hypothesis of normality of the return series of each market index. The values of skewness indicate that the index returns are negatively skewed. Further, the kurtosis values show that the distribution of each return series is more peaked relative to a normal distribution. It is therefore concluded that the returns of the Malawi Stock Exchange are not normally distributed over the study period.

The results of the Augmented Dickey-Fuller test for stationary record a significant p-value for all the three market indices. Thus, the hypothesis that a given return series has a unit root is rejected for each return series. This implies that the returns on the three indices are each stationary and not random. This is because the presence of a unit root is an essential feature of a random process.

Lastly, the runs test results indicate that each return series has a significant p-value. Hence, each return series is not random and successive price changes are not independent of each other. Based on all the findings, the researchers conclude that the Malawi Stock Exchange is not weak-form efficient and the random walk hypothesis is rejected. These findings are consistent with those of Kelikume, Olaniyi, and Iyoha (2020). The findings imply that investors and other market participants in possession of significant market information, including information on past price movements, can predict future stock prices and make abnormal returns.

5.2 Recommendations

The researchers make a number of recommendations. First, it is recommended that the market regulators devise a conducive regulatory and policy framework to attract both Malawian and foreign companies for listing on the Malawi Stock Exchange, as a way of boosting market efficiency. Second, the relevant government or public sector entities may review the taxes and charges which apply to market participant including investors and companies. Lastly, the researchers recommend further research on the efficiency of the Malawi Stock Exchange, using alternative statistical techniques or different time series data such as weekly returns on stock indices or actual stock prices.

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