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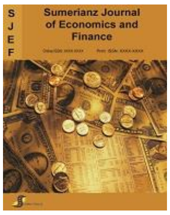

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Evaluation of Weak-Form Efficient Market Hypothesis in Zimbabwe Stock Exchange during Pandemic Period

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Abstract

Stock markets, just like other sectors of businesses have been impacted by the COVID-19 pandemic. COVID-19 has caused things to change in some sort; behavior, culture, and economy. Investors' behavior and expectations may have been shaken. Huge stock market dislocations may have occurred as individual and institutional investors react to bad economic news. This paper evaluated the Zimbabwe Stock Exchange (ZSE) for evidence of a weak-form efficient market hypothesis in the context of a random walk model for the pandemic period. The study used low-frequency data (monthly) from January 2020 to February 2022 for its analysis. The study employed autocorrelation tests, unit root test runs tests, and variance ratio tests. The study found that the autocorrelation tests run tests and the variance ratio tests failed to reject the random walk hypothesis, while the unit root test have opposite results. Given that the variance ratio test is more powerful than the unit root test and that unit root tests have very poor power properties, the study concludes that the ZSE followed a random walk during the pandemic period. The study, however, believes that the efficiency of the stock market may have been attributed to inflation problems during the period. As inflation sours, the revenue growth becomes of nominal terms not real terms, hence actual returns in real terms become meaningless in the financial trade. The study recommended further development of the stock market to resemble those of developed markets with various trading products, greater participation, automation, and capitalization.

Keywords: COVID-1; Efficient market hypothesi;, Random walk; Zimbabwe stock exchange.

1. Introduction

Market efficiency is a relatively broad term and is one topic in finance literature being controversial. In both developing and developed financial markets, academics and practitioners have extensively examined the efficient market hypothesis (EMH). EMH debates in empirical finance literature emanate from their significance and implications for investors' returns (Angelovska, 2018; Nurunnabi, 2012). The EMH concept came from Fama (1970), and affirms that prices fully reflect all available information in an efficient market. There are three levels of EMH; weak form, semi-strong form, and strong form. The weak-form version of EMH postulates that financial asset prices reflect all information contained in the past prices. Semi-strong version asserts that asset prices apart from reflecting all information content of historical prices also reflect all publicly available information. Strong-form version of EMH postulates that in addition to information on past prices and publicly available information, stock prices also reflect inside information.

The major focus of this research paper is to examine the weak-form version of the EMH (WF-EMH). An empirical investigation of the EMH is very necessary for lesser-known stock markets, like the ZSE, where research has been less extensive, as there is no real consensus on whether EMH truly holds. The EMH concept, because of globalization, investments free movement across nations, and huge inflows of capital from advanced economies, have become more important (Nurunnabi, 2012). The WF-EMH asserts that past price movements, volume, and earnings data do not affect the price of an asset and can never be used to predict its future direction. The WF-EMH is also termed the Random walk theory. The random walk theory states that future asset prices are random and are not influenced by past events. All current information is believed to be reflected in stock prices, but past information has no association with current market prices. Due to the randomness of the stock prices claimed by the WF-EMH, it implies that price patterns are impossible to be found. In support, Alsayed (2016) narrated that, inefficient markets, short-term movements, and market returns display no noticeable pattern. Fluctuations in periodic stock prices are entirely independent of each other. Current and future earnings growth are unpredictable using past earnings growth. Summing up the facts, WF-EMH indicates that technical analysis is not accurate and that fundamental analysis can be flawed at times. Technical analysis, however, is the most widely used trading strategy in the foreign exchange market (Bonga, 2015). EMH indicates that it is very hard to outperform the financial market, more so in the short run. According to the WF-EMH, it is pointless to have a financial advisor or an active portfolio manager.

The Zimbabwe Stock Exchange (ZSE) is a stock market for a developing nation. The efficiency of stock markets in developing nations has always been questioned, however notable reforms have since been carried out which might change the then status quo. An efficient market has to be large and liquid, with low transaction costs (Angelovska, 2018). Developing markets have different characteristics from developed markets. African stock markets suffer from the problem of low liquidity (Bonga and Sithole, 2019). The Zimbabwe stock market, just like other developing nations, has low liquidity, shallow trading, large price fluctuations, uninformed investors with access to unreliable information, and significant instability. A financial system that is strong and stable depends on the capability of its users to make informed decisions, particularly when managing the risk associated with credit use (Bonga and Mlambo, 2016). The stock market has few financial products, for example, no derivatives. Without a derivatives market, institutions are still exposed and hence there is no stability for development (Bonga *et al.*, 2015). The efficiency of markets in developing countries, though now existing, has been less under investigation compared to developed markets. The ZSE is with a short history of its efficiency and hence efficiency issues lack comprehensive research. The WF-EMH in the context of the ZSE is examined.

The paper is organized as follows; introductory section, section 2 with brief information about the Zimbabwe stock market, section 3 where literature on market efficiency is reviewed, section 4 discussing methodology, section 5 rich in data analysis and commenting on results, and finally section 6 with the study conclusions and policy implications.

2. An Overview of the Zimbabwe Stock Market

The Zimbabwean economy has been suppressed for over two decades (Chirisa, 2021). The economy has many of its economic sectors, including the financial sector, are not in good shape. Various policies have been developed and implemented to pull the economy from the doldrums. One way has been noticed in the developments in the stock market. Just following Massa (2009), if supported by adequate policies and reforms, stock markets could well play a key role in fostering economic growth in African countries. Two stock exchanges are found in Zimbabwe; the Zimbabwe Stock Exchange (ZSE) (63 listings) and the Victoria Falls Stock Exchange (VFEX) (1 listing).

Added pressure on economic recovery came with the coming of the deadly virus (COVID-19) declared a pandemic by World Health Organisation (WHO). To weaken the impact of COVID-19 on economies, countries resorted to lockdowns. Zimbabwe just like many nations started with a 21-day lockdown starting March 30, 2020, later followed by a series of lockdowns effected through statutory instruments. COVID-19 strike caused various sectors of the economy - health, education, livelihoods, human rights, and trade among others – to further suffer.

For the financial sector, despite the threatening economic environment, many listed companies on the stock exchange enjoyed growth in revenue that was supported by high levels of inflation (Portfolio Manager's Digest Q3, 2021). There was cost-push inflation, thereby the rise in revenues was in synchronization with inflationary trends. As inflation sours, the revenue growth becomes of nominal terms not real terms, hence actual returns in real terms become meaningless in the financial trade. The ZSE Market Capitalisation during the pandemic times steadily grew due to buying pressure from disinvesting investors moving from near cash assets to equity as a response to growing currency uncertainty and inflation (Portfolio Manager's Digest Q3, 2021). Despite the COVID-19 impact, exchange rate distortions and persisting foreign currency shortages have been constant complaints from ZSE-listed companies.

Zimbabwean stock markets in their operations include foreign portfolio investment – any willing foreign investors are limited to up to 49 percent of any locally listed company. Foreign participation remained sluggish in 2021, having 19 percent of turnover as disposals due to foreigners shying away caused international payments movement delays (Mapakame, 2022).

The Zimbabwe Stock Exchange is listed as one of the top gainers in Africa for the period 2020 – 2021. Table 1 below shows the Top 10 gainers in Africa using the stock market indices;

Table-1. Top 10 Africa Stock Exchanges by Indices Growth

Rank	Country	Indices	31-Dec-20	31-Dec-21	% Change
1	Zimbabwe	All Shares Index	2636.34	10822.36	310.51%
2	Zambia	All Shares Index	3912.33	6059.68	54.89%
3	Ghana	GSE Composite Index	1941.59	2789.34	43.66%
4	Malawi	All Shares Index	32392.84	45367.68	40.05%
5	BRVM	BRV-C	145.37	202.28	39.15%
6	Namibia	NSX	1237.80	1571.65	26.97%
7	South Africa	JSE ASI	59960.07	73709.39	22.93%
8	Morocco	Casablanca	11287.38	13358.32	18.35%
9	Mauritius	SEMDEX	1645.65	1935.51	17.61%
10	Egypt	EGX 30	10845.26	11949.18	10.18%

Source: https://businessmetricsng.com/2021-zimbabwe-led-african-stock-market-performance-with-310-5-growth/

Table 1 shows that the Zimbabwe stock market index registered a 310.51% increase from December 2020 to December 2021, which is far greater than Zambia, which registered the second increase of 54.89% for the same period. This simply meant that the Zimbabwe stock market has its own experience far more than the other African countries including the Top 10 gainers. The statistics observed for the Zimbabwe stock market are a motivation for the study to examine the efficiency as proposed by the Random walk theory. The study, next, dwells on a literature review.

3. Literature Review

There has been a great piling of literature globally against market efficiency. However, in developing and emerging markets no strong evidence exists to support the hypothesis of efficiency. The existing theory as well as empirics are based on the assumption of stock prices following a random walk behavior. To that end, it entails that stock prices cannot be predicted, and that is what the Random Walk Hypothesis (RWH) posits. There have been improvements in the way researchers have tried modeling the concept of market efficiency, thereby improving the conclusions on the efficiency of the stock market under investigation. There is a greater need not to rely on one test for study conclusions, but on various possible procedures to increase confidence in retrieving information from stock market data. The current study has considered various empirics around the globe, obtaining various techniques and tools used to evaluate stock markets efficiency, with the hope of correctly evacuating the ZSE. More current and accessible studies have been considered to strengthen the current study.

Global empirical literature considered by the current study is Tang (2020), Angelovska (2018), Hawaldar *et al.* (2017), Alsayed (2016), Bolotova (2016), Degutis and Novickytė (2014), Nurunnabi (2012), Hameed and Ashraf (2009) and Kelikume *et al.* (2020). The study also reviewed some studies that explored the Zimbabwean stock market, and they are namely; Siavhundu and Nyabunze (2020), Mazviona and Nyangara (2013), and Jecheche (2011). The reviewed study was tactically picked to aid the study to attain its objectives.

Tang (2020), investigated China's stock market efficiency. The study used data after the period after the implementation of the non-tradable reform, from 2005, praised for positively influencing China's stock market efficiency. To test the WF-EMH, the study a variety of unit root tests. Among them, the study boast of applying a panel unit root test accommodating the smooth structural breaks thereby accounting for cross-sectional dependence. The stock market of China displayed nonlinearity and was found to be weak-form efficient. Further development of the market was recommended to policymakers.

Angelovska (2018), investigated the emerging Macedonian Stock Exchange (MSE) and tested the weak form of efficiency using high-frequency data from January 2005 to April 2018. The Macedonian Stock Market was found to be not weak form efficient using the random walk application and the GARCH (1, 1) model. The study indicated that the inefficiency of the stock market disturbs national resource allocation for development projects. However, it acts as an incentive for the creation of new products.

The study by Hawaldar *et al.* (2017) was motivated to test the weak form of market efficiency for the Bahrain Bourse-listed individual stocks using data from 2011 to 2015. The Kolmogorov-Smirnov (K-S) goodness of fit test, run test, and autocorrelation test were used to test the EMH. The random walk was not supported by the K-S test and the runs test. The autocorrelation tests revealed that low to moderate correlation both negative and positive was shown by the share prices. The study failed to have a concrete conclusion due to the mixed results obtained.

Alsayed (2016), examined the WF-EMH in four Dow Jones Islamic market indices from 1996 to 2012 as well as three sub-periods (1996-2000, 2001-2006, and 2007-2012). The study used in its examination was; Autocorrelation test, Run test, and Variance Ratio test. From the study findings, four Islamic indices were found to be inefficient in the weak form for all the periods, except the Asian/Pacific for the last two periods. The study concluded that the stock indices do not conform to the posit of the random walk theory and for the entire period 1996-2012, they are inefficient in the weak form. The study, however, noted that the four stock indices were moving toward efficiency. To attain market efficiency, the study recommended new products and services be introduced to increase market size, trading volume, and liquidity boosting.

Bolotova (2016), empirically researched the efficiency of the Ukrainian stock market. The study concentrated on testing the WF-EMH for years after the global financial crisis (2009 – 2015). The study employed the ARMA and

GARCH models, claiming them to be suitable for highly volatile markets. The study obtained that the Ukrainian stock market was inefficient. The results were praised to aid in reforms implementation in the financial sector.

Degutis and Novickytė (2014) analyzed, using the critical literature review approach, the EMH development and the current status of the Baltic stock market. Their study indicated that stock market anomalies have been observable and stock prices deviated from their intrinsic values, but investors failed to make an excess profit. The study apart from the analysis the EMH concept also reviewed the methods for testing the weak-form efficiency in developing markets.

Nurunnabi (2012), undertook a critical review of the literature on emerging economies testing the weak-form efficiency of the markets. The study collated and examined broader and most bubbling literature including their findings. The study also explored the various aspects of the WF-EMH in emerging economies. However, as a limitation of the study, which the author also acknowledges, the findings of the study cannot be generalized to various economies due to different socio-cultural and political settings including investor behavior and capital market strengths.

Hameed and Ashraf (2009), in their study for Pakistani modeled weak-form efficiency tests and volatility effects. Their study used high-frequency data and found that returns series exhibit persistence and volatility clustering. Their study rejected the weak-form efficiency and mean-variance hypothesis. The study concluded that various reforms by the Securities and Exchange Commission of Pakistan (SECP) failed to bring a significant effect on return volatility as witnessed by a small increase.

Kelikume *et al.* (2020), investigated the WF-EMH for the top fifteen stock markets in Africa. The study noted that the twenty-nine existing stock markets in Africa vary greatly in terms of market size, the volume traded, the number of listed companies, funds and information access, and market standardization among other attributes. The study employed a wavelet unit root analysis tool. Institutional constraints were found to have implications for the EMH and investment. The study concluded that the relevance of using previous historical stock prices to forecast the current earnings for African stock markets is a denial of the EMH. The EMH is not supported by the performance of African stock markets.

The relevant studies that focused on the Zimbabwe stock market reviewed by the study are; Siavhundu and Nyabunze (2020), Mazviona and Nyangara (2013), and Jecheche (2011).

A study by Siavhundu and Nyabunze (2020), for the ZSE aimed at ascertaining empirically whether or not the ZSE followed a random walk. The study used low-frequency data (monthly) for the period from February 2009 to September 2017. Normality and unit root tests were the statistical tools used to evaluate the ZSE whether follows the random walk. Micro-inefficiency was observed for the stock market from the results obtained from the Jarque-Bera, Augmented Dickey-Fuller Test, normality test, and unit root test. From the study findings, the authors recommended the establishment of strong institutions to enhance information flow. The study recommended the establishment of strong institutions aimed at improving information flow and its obtainability to all interested economic agents.

Mazviona and Nyangara (2013), considered the period after the introduction of the multi-currency system in Zimbabwe (19 February 2009 to 28 June 2012) and investigated the weak form efficiency of the ZSE. The main concern of the study was to test whether the ZSE exhibits weak form market efficiency. Daily closing prices were used, employing conventional tests namely autocorrelation, the runs test, and the Q-statistic test. The study results indicated that the ZSE is not weak form efficient.

A study by Jecheche (2011), was driven by concerns over the robustness of the EMH, hence testing the weak form of the ZSE. The study used the weekly closing prices from 08 January 2010 to 29 July 2011 for both the Industrial index and the Mining index. Control for thin trading was done for the returns used by the study, hence independent of each other across time. The ZSE was found to be efficient in the weak form for the study period. However, the study insisted that achieving efficiency should not take away the roles of investment managers, considering them unworthy.

The section explored various empirical literature on EMH for many world countries including developing nations. The section also reviewed some studies that focused on the Zimbabwe stock market for various periods. The review has aided the current study in determining the correct methods to apply for a proper diagnostic of market efficiency. The empirical literature also guides policy suggestions for results obtained. Next, the study presents the methodology.

4. Methodology

To examine the WF-EMH, some appropriate tests have been identified by the study with the help of a literature review. The study employed the Autocorrelation test, Unit root tests (Augmented Dickey-Fuller (ADF) (1979), Phillips and Perron (1988) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) (1992)), Run test (Bradley, 1968), and Variance Ratio tests.

The above tests have been selected due to their linkage to the explanation of the weak form efficiency. According to the weak form efficiency, there is no correlation of price trends over time, hence this fact is examinable using autocorrelation (Ljung and Box, 1978) test). Another fact stated by the weak form efficiency is the stationary of the return series, and this can be checked by performing a unit root test. The third fact is that testing EMH becomes difficult to test using autocorrelation, as markets in emerging markets are characterized by infrequent trading, hence the Run test becomes a better alternative option. The fourth fact of the weak form efficiency indicates that stock prices follow a random walk, and this can be statistically verified using the Variance Ratio test; conventionally (Lo and Mackinlay, 1988;1989), or robustly (Wright, 2000).

4.1. Autocorrelation Test

Autocorrelation refers to a situation where a data set is correlated with itself (Frey, 2018). Data is autocorrelated when successive values ordered over time or space exhibit nonzero covariance. Adding facts from Asthana (2020), autocorrelation is said to be present when the error term of a time series variable in a linear regression depends upon its past (previous) values. Common methods to check autocorrelation are Graphical Method, Run Test, and Durbin–Watson test. When residuals are plotted against time and exhibit some pattern it implies the presence of autocorrelation. The number of runs (R) formed by positive and negative signs is counted, and when it surpasses the tabulated value it is an indication of the absence of autocorrelation. For the D-W test, *the d* statistic lies between 0 and 4, and the value near 2 is ideal for no autocorrelation. The autocorrelation test developed by Ljung and Box (1978), is used in the current study. The Ljung and Box test is ideal for small samples; it introduced the finite-sample correction that yields a better fit to the Chi-square distribution (Alsayed, 2016).

4.2. Unit Root Test

Unit root tests are statistical tests for stationarity in time series data. A unit root refers to a stochastic trend in a time series (Stephanie, 2016). The stochastic trend is sometimes known as a “random walk with drift”. When time series has a unit root (not stationary) it displays a systematic pattern not predictable. As indicated by Stephanie (2016) time series data has stationarity when a shift in time doesn't cause an alteration of the data distribution. Mathematical transformations are often made to stationary non-stationary time series. One crucial reason for rationalizing a time series is meaningful sample statistics. The Random Walk theory entails that the time series have a unit root. The study applied the ADF tests, PP test, and KPSS test to check for a unit root in the return series.

4.3. Runs Test

A run is a series of increasing values or a series of decreasing values. The Runs test is used to test for dependence in successive price changes. It is a non-parametric statistical test that does not consider the distribution of returns (whether normally or identically distributed). The run test is often attributed to Wald and Wolfowitz (1940). Runs test is sometimes called the Geary test. For the Runs test, the null hypothesis is that there is no serial dependence (i.e. random stock price fluctuations). The test statistic for the Runs test is as follows;

$$Z = \frac{R - E(R)}{s_R} ----------------- (Eqn\ 1)$$

Where; R – is the observed number of runs, E(R) – is the expected number of runs, and s_R – the standard deviation of the number of runs. Other parameters are calculated as follows;

$$E(R) = \frac{2n_1n_2}{n_1 + n_2} + 1 -------------- (Eqn\ 2)$$

and

$$s_R = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}} ---------- (Eqn\ 3)$$

Where; n_1 and n_2 are the numbers of positive values in a series and the number of negative values in a series respectively. For large samples, where n_1 and n_2 are greater than 10, the test statistic (|Z|) is compared with $Z_{1-\alpha/2}$, and if it is greater it indicates non-randomness. Symbol α is the significance level, and at a 5 percent significance level (rule of thumb), Z = 1.96. As done by Lönnquist (2018), the run test has been applied to the stock returns series.

4.4. Variance Ratio Test

The pioneers of the variance ratio test were Lo and Mackinlay (1988) and Cochrane (1988). Weekly stock market prices from the US market, were used to test the Random Walk by Lo and Mackinlay (1988), and they were unable to accept the Random Walk Hypothesis. The test is robust concerning many heteroskedasticity forms and the non-normality of the stochastic disturbance term. An important assumption used by the variance ratio by Lo and Mackinlay (1988) is that if the natural logarithm of a time series Pt is a pure RW, then the variance of its kth difference grows proportionally with the difference k (Alsayed, 2016). The test is based on the idea that stock prices follow a martingale process; it submits that the variance of returns should be linearly increasing and directly proportional to the length of the time interval (Lönnquist, 2018). Kim (2006) offers a wild bootstrap approach to refining the small sample properties of variance ratio tests. The wild bootstrap approach is related to Lo and Mackinlay (1988) in an improved form for small samples. The test of Lo and Mackinlay (1988) has been criticized by Wright (2000), who indicated that when data are correlated (positively or negatively) as well as when the tests are asymptotic and biased in finite samples the test does not hold. To solve this weakness, a non-parametric test was proposed by Wright (2000) that uses ranks and signs. It is argued that the ranks and signs tests are more powerful.

4.5. Data Analysis

Data for the study was obtained from the Zimbabwe Stock Exchange website and Reserve Bank of Zimbabwe (RBZ) publications. The study used the Eviews statistical software to analyze data. To calculate stock returns, the following formula has been used;

$$RETURNS_t = Ln\left(\frac{ASI_t}{ASI_{t-1}}\right) ----------- (Eqn\ 4)$$

Where RETURNS – stock returns at time t, ASI – All shares index, t – denotes time.

The following graph presents the ASI and the subsequent returns for the pandemic period, January 2020 to February 2022. The monthly stock return data have been plotted to observe the volatility of the ZSE.

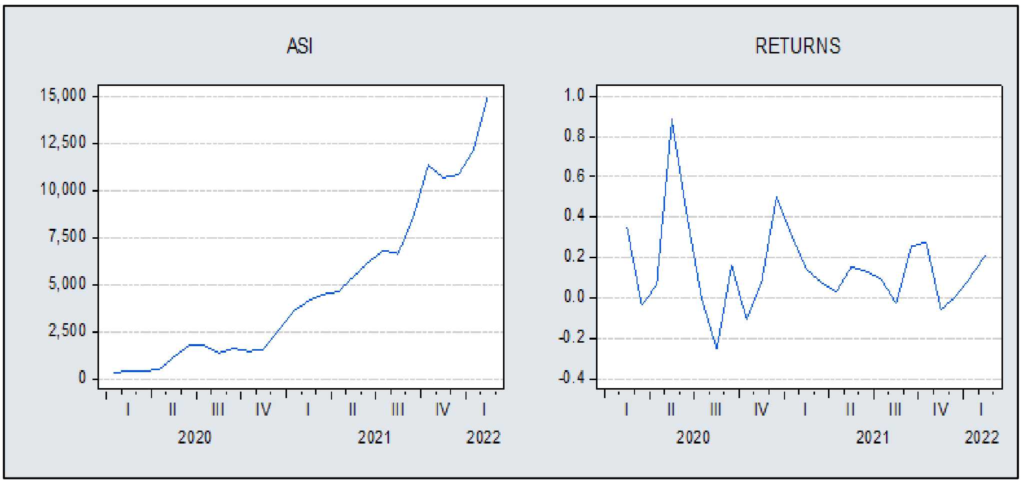

Figure-1. ZSE ASI and RETURNS (Jan 2020 to Feb 2022)

Source: Eviews Output

A look at Figure 1 suggests that the levels of the ASI series are stationary: the series appears to have an upward trend. The time plot of the returns series shows that the series fluctuate around the mean value. The mean reversion tendency is being observed and is one indication of stationarity. However, more appropriate statistical tests are employed by the study for a solid conclusion.

The descriptive statistics for the returns series are presented in Table 2 below;

Table-2. Descriptive Statistics (ASI)

Statistic	Statistic Value
Mean	0.152293
Maximum	0.881844
Minimum	-0.25282
Std. Dev.	0.227405
Skewness	1.266705
Kurtosis	5.556558
Jarque-Bera (Prob.)	13.49391 (0.001174)

Source: Eviews Computations

Table 2 statistics indicate that the average return on the ZSE ASI is 15.2% on any trading month. The variation of the returns is 22.7% reflecting a high-risk market. Kurtosis is 5.56, implying that the ASI return series is leptokurtic, the returns have heavy tails and are peaked. This scenario indicates the possibility that investors in the stock market may make very high returns and may also lose large amounts of their investments. The skewness statistic is 1.27, indicating that ASI returns are positively skewed. Skewness is a certain feature of returns in developing markets (Angelovska, 2018). A positive skewness of 1.27 implies that there is a higher probability of large positive returns than negative returns in the stock market. However, the statistics show that the data is not normally distributed. The results are further confirmed by the significance of the Jarque-Bera statistic 13.49 (0.001174). A study by Bonga (2019) using monthly data for the period January 2010 to January 2019 also found that stock market data was not normally distributed. However, real-life data rarely follow a perfect normal distribution, but is only near normal, with skewness and kurtosis coefficients explaining the dissimilar components.

To examine persistence in volatility we examine squared ASI returns. Based on the EMH, volatility should be persistent rather than persistent (Muguto and Muzindutsi, 2022). In general, volatility persistence entails a sluggish reaction of prices to information entering the market. The autocorrelations coefficients of squared returns are presented in Table 3.

Table-3. Autocorrelations: Squared Returns

	AC	**PAC**	**Q-Stat**	**Prob**
1	0.081	0.081	0.1859	0.666
2	-0.173	-0.18	1.0603	0.589
3	0.048	0.083	1.1323	0.769
4	-0.015	-0.062	1.1395	0.888
5	-0.067	-0.037	1.2905	0.936
6	-0.012	-0.019	1.2952	0.972
7	0.247	0.247	3.5796	0.827
8	0.029	-0.029	3.6128	0.89
9	-0.052	0.04	3.7273	0.928
10	-0.037	-0.081	3.7891	0.956

Source: Eviews Computations.

From Table 3 there are no significant autocorrelations for all the lags 1 to 10 as indicated by the probability of the Q-statistic. The insignificant autocorrelations coefficients reflect the absence of volatility clustering in the ASI returns. With the results pointing out that returns do not exhibit volatility clustering, it, therefore, implies that the weak-form efficiency hypothesis is not rejected since past information does not help in predicting future prices (Hameed *et al.*, 2006).

In line with the methodology above, autocorrelation was tested. The autocorrelation functions (ACF) of the ASI returns series and the Ljung-Box Q-statistic are presented in Table 4 below. 5 lags have been considered. The ACF test helps check if the return series are serially correlated, and the information is necessary for the specification of the correct random walk model.

Table-4. Autocorrelations: ASI Returns

Lags	AC	PAC	Q-Stat	Prob
1	0.154	0.154	0.6678	0.414
2	-0.379	-0.413	4.8913	0.087
3	-0.156	-0.012	5.634	0.131
4	-0.033	-0.19	5.6685	0.225
5	-0.181	-0.269	6.7749	0.238

Source: Eviews Computations

The ACF and Q-statistic indicate that ASI return series are not serially correlated at all other lags, except on lag 2 at a 10% significance level. The coefficient of some lags is not different from zero. The study fails to reject the null hypothesis of RW during the pandemic period. According to the weak form efficiency, there is no correlation between price trends over time. The autocorrelation observed on lag 2 implies that an autoregressive (AR) random walk model should be estimated and erase the serial dependence in the residuals.

Lag analysis for the AR random walk model was checked using the Bayesian information criterion (BIC) and Akaike information criterion (AIC). Results are presented in Table 5.

Table-5. BIC and AIC Statistics for AR Random walk models

Lag	**BIC**	**AIC**
1	0.081968	-0.016204
2	0.014507*	-0.133601*

Source: Eviews Computations

From Table 5, the best model is the one with the smallest BIC or AIC. Therefore an AR Random walk model considering 2 lags is the best model.

Regression results of the random walk model are presented in Table 6 below;

Table-6 Random Walk Model Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.179087	0.057879	3.094146	0.0057
RETURNS(-1)	0.259933	0.197460	1.316386	0.2029
RETURNS(-2)	-0.421925	0.194164	-2.173030	0.0420
R-squared	0.221402	Mean dependent var		0.151835
Adjusted R-squared	0.143542	S.D. dependent var		0.230198
S.E. of regression	0.213036	Akaike info criterion		-0.133601
Sum squared resid	0.907689	Schwarz criterion		0.014507
Log-likelihood	4.536407	Hannan-Quinn criter.		-0.096352
F-statistic	2.843603	Durbin-Watson stat		1.966450
Prob(F-statistic)	0.081871			

Source: Eviews Output

The drift parameter is positive and significant, indicating that the expected price change may be predictable. The AR term at lag 1 is insignificant, however, the AR term at lag 2 is negative and significant at a 5% level supporting indication of serial dependence.

The study undertook a stationarity test of the returns series and the results are presented in Table 7 below;

Table-7. Unit Root Test

Test	Intercept	Critical Values 1%, 5% & 10%	Trend and Intercept	Critical Values 1%, 5% & 10%	Implication
ADF	-4.991401 (0.0008)	-3.808546 -3.020686 -2.650413	-5.021792 (0.0039)	-4.532598 -3.673616 -3.277364	Stationary
PP	-4.684918 (0.0011)	-3.737853 -2.991878 -2.635542	-4.720656 (0.0049)	-4.394309 -3.612199 -3.243079	Stationary
KPSS	0.238334	0.739000 0.463000 0.347000	0.191540	0.216000 0.146000 0.119000	Stationary

Source: Eviews Computations

The ADF, PP, and KPSS test statistics (-4.991401; -4.684918; 0.238344) are all less than their critical values at 1%, 5%, and 10% levels of significance. Therefore, the null hypothesis of unit root (non-stationarity) is rejected. The series is stationary. It is, therefore, obtained that the ZSE is not weak-form efficient, hence it does not follow a random walk. With such evidence, it implies that there is a possibility that stock market players on the stock market can make a profit through arbitration activities by technical analysis. The results are similar to what was obtained by Siavhundu and Nyabunze (2020) for the period before the pandemic (2009 – 2017).

The **Runs Test** was also conducted on the returns series data. The threshold value was set to 0.1523 and 0.1099, which corresponded to the mean and median for stock returns respectively. Results for the calculated statistics are presented in Table 8 below;

Table-8. The Runs Test Results

Parameter	Mean	Median
n_1	10	12
n_2	15	12
R	13	13
E(R)	13	13
s_R	2.345	2.396
Z	0	0
$Z_{1-\alpha/2}$	1.96	1.96

Source: Author(s) Calculations

From Table 8 above, the results of the run test indicate randomness. The Z-statistic calculated for both thresholds is less than the Z-critical (1.96). The study failed to reject the null hypothesis of randomness. Failure to reject the null hypothesis corresponds to the equivalence of accepting the EMH. The results differ with Mazviona and Nyangara (2013) who obtained that the ZSE is weak from inefficient using the runs test. The difference in results might be due to different periods of study having different economic climates.

The study performed the **Variance Ratio Tests.** The variance ratio test was used to examine the predictability of the returns time series by comparing variances of differences of the data (returns) calculated over different intervals (2, 4, 8, and 16). The Lo and MacKinlay variance ratio test for homoskedastic and heteroskedastic random walks results are presented in Table 9 below.

Table-9. The Lo and MacKinlay variance ratio test

Joint Tests		**Value**	**df**	**Probability**
Max |z| (at period 4)*		1.546919	24	0.4054
Individual Tests				
Period	**Var. Ratio**	**Std. Error**	**z-Statistic**	**Probability**
2	0.888004	0.23817	-0.47024	0.6382
4	0.29505	0.455712	-1.54692	0.1219
8	0.154158	0.678639	-1.24638	0.2126
16	0.152309	0.884324	-0.95858	0.3378

Source: Eviews Computations

From Table 9 above, the Chow-Denning maximum statistic of 1.546 is associated with the period 4 individual test. The approximate p-value of 0.4054 is obtained using the studentized maximum modulus with infinite degrees of freedom so that we strongly fail to reject the null of a random walk. The individual statistics generally fail to reject the null hypothesis, as the variance ratio statistic p-values are greater than 0.01, 0.05, and 0.1 for 1%, 5%, and 10%

significance levels respectively. From these results, it means that the data follow a random walk. The results of the wild bootstrap show similar statistical properties (Joint test, 1.546919 (0.3260)), and hence carry the same conclusion.

The non-parametric test results proposed by Wright (2000) that use ranks and signs are shown in Table 10 below;

Table-10. Non-parametric test: Rank, Rank Scores, and Signs

	Joint Test	Individual Test			
		k=2	k=4	k=8	K=16
Rank	1.609 (0.1740)	0.868696 (0.5500)	0.385217 (0.0980)*	0.130978 (0.0440)**	0.049130 (0.1910)
Rank Scores	1.602 (0.1730)	0.877445 (0.5790)	0.388045 (0.1060)	0.130712 (0.0570)*	0.050545 (0.2160)
Signs	0.764 (0.9560)	1.000000 (0.8390)	0.708333 (0.5130)	0.562500 (0.6330)	0.375000 (0.9130)

Significance: **5%, *10%; Source: Eviews Computations

From Table 10 above, the results of the joint test for rank, rank scores, and signs test are all insignificant, thereby confirming that the random walk hypothesis cannot be rejected. However, a different behavior has been observed for the rank test period four which shows significance at 10%, and period 8 showing significance at 5%. Also, the rank scores test reported significance at a 10% level for period 8. Overall, the test results indicate that the study failed to reject the null hypothesis of random walking.

The summary of all tests done by the study and their main findings about the WF-EMH are presented in Table 11 below;

Table-11. Summary of Statistical Tests

Test		Stock Market is Efficient in the Weak Form (Random Walk)	Stock Market is not Efficient in the Weak Form (Not Random Walk)
Autocorrelation	Squared Residuals	✓	×
	ASI Returns	✓	×
Unit Root	ADF	×	✓
	PP	×	✓
	KPSS	×	✓
Runs	Mean Threshold	✓	×
	Median Threshold	✓	×
Variance Ratio	Lo and MacKinlay	✓	×
	Wild bootstrap	✓	×
	Rank	✓	×
	Rank Scores	✓	×
	Signs	✓	×

Source: Author(s) Design

From Table 11 above it can be observed that the autocorrelation tests, run tests, and variance ratio tests have failed to reject the random walk hypothesis, while the unit root test has opposite results. Given that the variance ratio test is more powerful than the unit root test and that unit root tests have very poor power properties (Alsayed, 2016), the study concludes that the ZSE follows a random walk. The findings of this study differ from that of Kelikume *et al.* (2020) who from their findings indicated that it is possible for market participants in African stock markets to constantly pick stocks that will beat the returns of the overall market. A study of the ZSE by Siavhundu and Nyabunze (2020) that relied on normality and unit root tests (poor power properties) concluded different results from this study. According to Jecheche (2011), emerging markets are expected to show significant departures from market efficiency due to the thin trading prevalent in these markets. The study, therefore, concludes that the ZSE was efficient during the pandemic period. However, for a policy it calls for further investigation as the efficiency of the stock market may have been attributed to inflation problems during the period. According to Portfolio Manager's Digest Q3 (2021) many listed companies on the stock exchange enjoyed growth in revenue that was supported by high levels of inflation. There was cost-push inflation, thereby the rise in revenues was in sync with inflationary trends. As inflation sours, the revenue growth becomes of nominal terms not real terms, hence actual returns in real terms become meaningless in the financial trade. Therefore, the ZSE just like other developing markets has to work to improve the development of its stock markets to guarantee improved permanent growth and development.

5. Conclusion and Policy Recommendations

Market efficiency is linked to economic development. For funds to be allocated to the highest value projects, it is a pre-requisite that markets are efficient and stock prices are efficiently priced. When the market performs a price discovery process, firms can easily raise capital without heavy challenges. Having an efficient market has the capacity of encouraging local and foreign investors to invest more and save more in the local market. The purpose of this study has been to primarily evaluate the ZSE for evidence of a weak-form efficient market hypothesis in the context of a random walk model for the pandemic period. The study undertook various tests that enabled the evaluation of the ZSE. Tests undertaken include autocorrelation, unit root, runs test, and variance ratio tests. Through the tests performed it is observed that the autocorrelation tests, run tests, and variance ratio tests have failed to reject the random walk hypothesis, while the unit root test has opposite results.

The study suggests that policymakers perform or adopt strategies that include;

- The attraction of more individual and institutional investors. Stock market participation is low in the ZSE.
- Financial literacy enhancement. There is a greater need to promote the financial literacy of the populace. Financial literacy aid in improving the efficiency and quality of financial services (Bonga and Mlambo, 2016).
- Bringing in new products into the stock market. To date, not all stock market products are traded in the country. There are no derivatives in Zimbabwe since the closure of the Barbican Bank. Investors generally use derivatives for three purposes: risk management, price discovery, and reduction of transaction costs (Bonga *et al.*, 2015). New products increase market size, and trading volume and improve liquidity.
- Access to information for investors should be enhanced. Avoid restricting commonly obtainable information.
- Strong institutions are established aimed at improving the flow of information and its availability.
- Costs of trading should be kept low. High transaction costs impact expected profits.
- Further, promote using computerized automated trading systems in the stock markets. This move helped improve speed in trade and the matching of orders.
- Create a political and social climate that enables macroeconomic stability through business growth strategies.

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