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EDITORIAL COMMENT

The Ilorin Journal of Finance is a bi-annual publication of the Department of Finance, Faculty of Management Sciences, University of Ilorin, Ilorin, Nigeria. This maiden edition of the journal has nine articles focusing on several topical issues in finance, banking, and related areas in economics.

Specifically, the authors in this edition focus on issues such as institutional shareholding and deposit money banks; investors herding tendency in equity markets; technical efficiency of deposit money banks; stock market efficiency; convergence of stock prices in the banking industry; banking sector development and economic growth; financial inclusion and small and medium enterprises performance; financial sector development and capital market development; and lastly, effectiveness of monetary policy instruments in the Nigerian capital market. The different issues presented in this edition reflect the aim of the journal.

I wish to thank the various anonymous reviewers whose constructive reviews and criticisms ensured the success of the first edition. The unflinching support and efforts of the editorial members of the journal are also acknowledged.

I wish the readers a happy reading.

Dr. I. B. Abdullahi

Editor-in-Chief

Ilorin Journal of Finance

ILORIN JOURNAL OF FINANCE

Aim and Scope: The aim of the journal is to publish original and quality research targeted at contributing to the development of theory and practice of finance, and growth of economies across the world. The scope covers areas in banking, finance, economics, accounting, business administration and other related fields in management sciences.

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Testing the Validity of the Weak Form Market Efficiency in the UK Stock Exchange: Evidence from London Stock Market

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Abstract

The mixed results from a wide range of research and a new concern raised by Moore (2016) that United Kingdom market participants did not display a rational behaviour in the lead up to and aftermath of the British referendum to leave the European union motivated a new research into market efficiency of the London stock exchange using larger sample size that reflects more recent trading. Therefore, this research work examined whether the London stock exchange is weak form efficient using the random walk theory. Three objectives were formulated based on three different statistical methods of testing for randomness in price series. The log returns of Financial Times Stock Exchange 250 Share index between 1986 and 2016 were examined using serial correlation test, variance ratio test and unit root test. The three statistical tests agree that the randomness of successive stock prices do not hold in the London stock exchange. Therefore, the result of this research work suggests that London stock exchange is not informationally efficient in the weak form. This implies that prices of stocks listed on the London stock exchange may not be a true reflection of asset value and opportunities exist for technical and fundamental analysts to study stock trend and predict future prices. Based on the conclusion, the study recommends that: firms should ensure good information management and a very cautious investment strategy that put into consideration the possibility of overreaction from investors.

Keywords: Efficient market hypothesis, Random walk theory, Price series

JEL Classification: G 14

1.0 Introduction

The stock exchange is expected to help the economy in attracting foreign direct investment, growing local savings, improving pricing, and making long-term capital available. Effective performance of these roles of the stock market is a function of the extent to which it can be deemed efficient (Phiri, 2015). Academics, investors, and businessmen have been engrossed by the need to

discover whether the stock market is efficient in pricing securities or not. High interest and research on stock price behaviour are understandable because of the possibility of exploring the market and making a profit above the market expectation (Arnold, 2012:563). Chung (2006) described the efficient market as a market where there is in existence independent and identical distribution of stock price changes leading to the

eradication of the predictive content of historical prices. Fama (1995) stated that efficient markets consist of a lot of intelligent and rational investors attempting to predict future behaviour of individual security where information is almost freely and publicly available. (Titan, 2015) Consequently, competition among market participants will ensure that actual price of a stock reflects events that already occurred and events expected to occur in the future, making such price revolve randomly around its intrinsic value at every point in time. There are a lot of empirical and theoretical disagreement among investors and researchers alike over the validity of market efficiency. The emergence of behavioural finance encouraged the introduction of psychological behaviour of market participants into the debate. The proponents of behavioural finance claim that irrationality and illogicality in human behaviour create mispriced asset and a predictable pattern for stock prices. Therefore, investors can earn excess returns by studying historical prices and identifying stocks that are undervalued (Naseer & Tariq, 2015). This necessitated further clarification from the proponents of the efficient market. They claimed that efficiency does not imply that stock price is equal to their true value all the time but the difference between asset values and their prices is due to random error. They also asserted that asset value is a function of an uncertain future and any investors outperforming the market is not due to skill but purely by chance (Arnold, 2012:563; Hu, 2014).

Early generations of researchers are strongly on the side of efficient market hypothesis as evident from the famous statement of Jensen (1978), that there was no proposition in economics

which had more concrete empirical evidence affirming it than the efficient market hypothesis (Guerrien & Gun, 2011). However, recent empirical and theoretical evidence of stock market efficiency are mixed and contradictory in both emerging and developed market. London stock exchange is one of the very developed markets where both domestic and foreign firms are listed and traded. (Michie, 1999) The behaviour of the United Kingdom (UK) market in the lead up to and aftermath of the British referendum to leave the European union(EU) put a new question mark on the efficiency status of the market. (Moore, 2016) He posited that the market cannot be so efficient because the actual result of the vote is contrary to the expectations of a lot of market participants as most of them expected people to vote to remain in the EU and attributed such behaviour to investors bias. In an efficient market, such investors prejudices are supposed to cancel one another out making the data to follow a random distribution. However, this is not the case as most investors got it wrong. He concluded that UK market participants are not rational as presumed by the proponents of efficient market hypothesis. The mixed results from a wide range of research and a new concern raised by the conclusion of Moore (2016) over the efficiency status of the UK market motivated this research.

Three levels of efficiency have been identified: weak form, semi-strong form and strong form market efficiency. Weak form market efficiency is the lowest classification of market efficiency and the subject of this empirical research because Gimba (2010) and Kelichukwu, (2016) posited that a further test at semi-strong and strong form level will be

pointless once there is no proof that any stock market is weak form efficient. The weak form classification of the efficient market has always been assessed using the random walk theory. Random walk describes price series that differs subsequently to past prices such that future prices are unpredictable. (Fama,1995) Most empirical study of weak form market efficiency in London stock exchange made use of FTSE100 for periods less than 20years and none has made use of FTSE 250 index. Stephens (2016) argues that FTSE 250 is a better index because it contains smaller companies and offers the potential for faster growth and supported his argument with the statistics that FTSE 250 has risen by 84% over the last five years while FTSE 100 only risen by 36%.

Therefore, the main objective of this research is to critically evaluate whether the London Stock exchange is efficient in the weak form over a 30-year period between 1986 and 2016 using three different statistical tests. To achieve this objective, the study: I. examines whether successive price changes in the London stock exchange are independent of one another or correlated. ii. assesses whether variances of differences of stock returns on the London stock exchange over different intervals follow a linear trend or not. iii. evaluates whether average return on stocks listed on the London stock exchange follow a stationary trend over time.

The rest of the paper is organised as follows: section two reviews related literature; section three describes data and methodology; section four contains empirical results and discussion of findings; and section five deals with conclusion, recommendations, and area of further research.

2.0 Review of Related Literature

2.1 The Concept and Forms of Market Efficiency

Stock market efficiency is broadly classified into operational efficiency, allocational efficiency and pricing or informational efficiency. A market is classified as operationally efficient if market participants are unable to make abnormal profits because transactions are carried out reliably, very fast and at a very low cost. Allocational efficiency occurs in a market when resources are rightly apportioned amongst competing real investments. Pricing efficiency, which is the focus of this research work, occurs when stock prices instantly incorporate any news to the market in an objective manner. (Arnold, 2012:545) A market is considered informationally efficient when financial markets participants cannot steadily achieve returns over and above the expected risk-adjusted returns based on available information at the period of investing. (Gimba, 2010; Hu, 2014) In an efficient market, price series wandered as if a random number was added to the current price (Brealey, Myers, & Allen, 2014, p. 321) Consequently, technical and fundamental analysis are futile because a buy and hold investment strategy concentrating on market risk and return characteristics of a well-diversified portfolio will perform as well as an investment strategy based on the study of past share prices, or on the analysis of published information such as annual accounts. (Nwachukwu & Shitta, 2015) Watson & Head (2007, p. 39) posited that many financial analysts believe that capital markets are not efficient and therefore continue with the use of charts and other methods to identify trends in stock price series for a possibility of

making abnormal gains by predicting future prices. Financial analysts also attempt to predict future prices by using publicly available information to evaluate the fundamental value of a stock and comparing such value with stock price to identify undervalued or overvalued stocks. However, the proponents of efficient market hypothesis states that the use of both technical analysis and fundamental analysis by financial analysts increase the speed with which share prices incorporate new information and reach equilibrium, thereby preventing the attainment of abnormal returns that they pursue. (Malkiel, 2003)

The behavioural finance also antagonised the efficient market theory because of some irrational behaviour by the participants such as overconfidence, overreaction or under reaction to new information. (Naseer & Tariq, 2015) Arnold (2012:543) claimed that over reaction or under reaction by some investors to new information does not negate the concept of market efficiency. It only requires the reaction to be normally distributed and follow a random walk such that the net effect would not allow any opportunity for above average returns.

Informationally efficient markets are categorised into weak form efficiency, semi-strong form efficiency and strong form efficiency. This categorisation is based on the extent to which the stock prices incorporate the available information. In weak form market efficiency, stock prices are equal to the fundamental value of the stocks as all publicly available past information determined that price. Analysing past behaviour of the stock prices cannot help in predicting future prices. Future price of stock is a function of unpredictable

information that is not yet revealed by the current price. (Ali, Nawaz, & Shah, 2013) Therefore, investment strategies that are based on historical data cannot consistently yield excess returns because past performance of stocks cannot signal future performance. However, Andrianto & Mirza (2016) stated that information is not costless and always not readily available. Semi strong market efficiency requires the security prices to reflect past publicly available information and quickly and rationally adjust to all new information such that quoted price of securities represents the primary estimate of the intrinsic value of stock. However, uneven cost of transactions and varying awareness level of market participants delay immediate reflections of information on stock prices. (Novickyte & Degutis, 2014) In strong form market efficiency, price series incorporate both public and private information. Insider information also reflects in the stock prices. Researchers have contested this fact as it is expected that managers and other insiders will know more about the performance of the companies than outsiders. Novickyte & Degutis (2014) asserted that the theory could still hold because insider trading is illegal and a criminal offence. However, Virgilio (2015) later posited that a wide consensus of researchers agree to the unpracticability of market efficiency at the strong form because insiders will always know more about their organisation and information always get to some investors earlier than others.

2.2 Theoretical Framework of the Market Efficiency Fair Game Model

The framework for the models as stated by Gimba (2010) is expressed by the following equation

$$M_{s,k+1} = P_{s,k+1} = \sum (P_{s,k+1}/I_k) \quad (1)$$

Where

$M_{s,k+1}$ = above average market returns of security s at time $t+1$

P_{k+1} = actual price of security s at time $t+1$

$\sum (P_{s,k+1}/I_k)$ = projected price of security s at time

$(t+1)$ based on information I_k

Based on the model, the above average returns of security s ($M_{s,k+1}$) at time $k+1$ based on information I_k = zero because actual price P_{k+1} is equal to expected price $\sum P_{s,k+1}/I_k$. Game or expected returns theory implies that securities prices are a good estimation of the real value of the stocks such that are no arbitrated opportunities and variations on stock prices are unpredictable. (Guerrien & Gun, 2011) Therefore excess market return is zero and return on stocks above market expectation is not possible. If this theory holds, participants in the London stock exchange should not make any returns above that of the market even if they take higher risk. However, the expectation of the fair game model that excess market returns should be zero is not completely realistic as investors are expected to be compensated for time and for taking higher than market risk. Although Fair game model is one of the theories introduced by Fama (1970) to test weak form market efficiency, it is considered grossly inadequate and the Submartigale theory was introduced to address the shortcomings of Fair game model.

The Submartingale Model

This model is a stochastic process where the current returns of securities are less than or equal to the previous returns of securities. The average return is expected to increase over time in compensation for the inherent risk of holding stocks. Excess returns on securities are equal to zero in the fair game model while it is greater than zero in submartingale model. The model can be statistically represented as follows

$$E\left(\frac{r_{t-1}}{I_t}\right) \geq P_{j,t} \quad (2)$$

According to the model, expected returns series follow a martingale given information I_t available at time t . Information sequence I_t cannot be used to forecast changes in stock prices except that the expected return predicted at time t for time $t+1$ is greater than or equal to zero. (Gimba, 2010). Just buying and holding stocks will produce as much returns as that produced by following any trading rules based on the available information at the time of investment. This theory is an improvement on the fair game model because it expresses market equilibrium in terms of expected market returns on securities, it did not express the predictability and probability process of the successive change in prices.

The Random Walk Model

Random walk theory is an improvement to both the fair game and the submartingale theory. it expresses the unpredictability of returns as follows

$$P_{t+1} = P_t + e_{t+1} \quad (3)$$

Where

P_{t+1} = price of security at time $t+1$

P_t = price of security at time t

e_{t+1} = error term with zero

mean and constant variance

The implication of random walk is that only unpredictable information is responsible for the difference between that prices of stock in time t and time $t+1$. Therefore the two prices are independent of each other and it is not technically feasible to use time t information to predict time $t+1$ price.

All the three models imply that previous information cannot help in predicting future prices in a way that investors make excess returns compared to a naïve buy and hold model. (Guerrien & Run, 2011) but random walk theory can be considered the most powerful in testing the efficient market hypothesis. (Gimba, 2010). This study, therefore, used the random walk model to critically evaluate whether the London stock exchange is efficient in the weak form. If random walk theory holds in the London stock exchange, it is expected that the prices of listed securities changes in an unpredictable manner. However, the model only tests the predictability of stock returns but cannot examine whether prices truly reflect all the available information and whether prices reflects the fundamental value of securities. In stock market efficiency, prices not only follow a random walk but also revolve around the intrinsic value (Guerrien & Gun, 2011). Jovanovic, Andreadakis, & Schinckus (2016) also stated that the efficient market hypothesis and random walk hypothesis are two different theories and it is possible for stock prices to follow a random walk even if the market prices do not fully reflect all publicly available information. However, Random walk remains the best model to empirically examine the efficient market hypothesis.

2.3 Empirical Evidence of the Weak Form Market Efficiency

There have been an increasing number of publications on efficient market hypothesis since the work of Fama (1970). While empirical results of some publications support the theory, others contradict it. Advocates of the efficient market hypothesis such as Wong & Kwong, (1984) and Malkiel (2005), upheld Fama's arguments of stock prices incorporating all publicly available information in an unbiased fashion. Some opponents of the proposition negated the concept completely while some indicated that it lacked enough empirical evidence and needed to be proven. (Hu, 2014)

Earlier empirical evaluation of the hypothesis of market efficiency were mainly in line with Fama's conclusion. For example, Lee (1992) evaluated the weekly price of 10 industrialised countries including the UK for periods ranging from 1967 to 1988, using variance ratio test and concluded they all followed random walk process and therefore, efficient in the weak form. The result of Choudhry (1994) was in consistent with the conclusion of Lee (1992), when he used Augumented Dicky-Fuller (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root and Johansen's co-integration test, to examine market efficiency in the countries that belong to Organisation for Economic Co-operation and Development (OECD) between 1953 and 1989. Chan, Gup, & Pan, (1997) applied similar methodology with that of Choudhry (1994) to evaluate 384 monthly observations from 1962 to 1992 for price series of some selected countries including the UK. Their result also concurred that stock prices follow no particular trend, suggesting that the UK stock exchange is weak form efficient.

However, most studies from 1997, have mixed and contradictory results. For example, Al-Loughani & Chappelle (1997) reached mixed conclusions when they study daily price series of Financial Times Stock Exchange (FTSE) 30 share index between June 30, 1983, and November 16, 1989. The result of lag range Multiplier, Serial auto correlation test and BOS Linear test refuted the random walk while Augmented Dickey-Fuller test showed result in conformity with the efficient market hypothesis in the weak form.

Worthington & Higgs (2004) found evidence of randomness in the price series of the UK market when they tested whether some European stock markets are weak form efficient. The results of all methodologies employed are in agreement that successive price changes in the UK market conform to random walk process. Contrary to this, Borges (2010) concluded that the UK market did not satisfy the condition for randomness of data when he applied runs test and variance ratio test to examine whether daily and weekly stocks returns of some European market from 1998 to 2007 follow a random walk.

Onali & Goddard (2011) employed rescaled Range Analysis (RRA) in evaluating the presence of long-run dependence in stock returns of selected European stock exchange including the UK. They discovered no proof of interdependence in the successive stock prices in the long run. This conclusion implies that the UK market follows a random walk.

Andrianto & Mirza, (2016) asserted that market efficiency, in the weak form, is valid in the Indonesia stock market. They found no correlation between prices of previous days and

current days when they used serial auto correlation to examine if stock prices of Indonesia stock market between 2013 and 2014 followed a random walk. Narayan, Narayan, Popp, & Ahmed (2015) applied unit root test to banks listed on New York stock exchange (NYSE) and found efficient market hypothesis to be day of the week dependent.

Tiwari & Kyophilavong, (2014) concluded that stock prices are predictable in all the BRICs countries except Russian. Contrary to the conclusion of Tiwari & Kyophilavong, (2014) Kelichukwu (2016) asserted that application of trading rules by market participants in the Nigeria stock market can not yield any abnormal profit because it is weak form efficient. He tested monthly average stock returns from period ranging from 1985 to 2015 using the wavelet based unit root test.

In the work of Lee, Lee, & Lee, (2011), there was an evidence to prove that stock price series seem stationary. They employed panel data stationary test to study the stock returns movement under different development levels between 1999 and 2007 and concluded that efficient market hypothesis do not hold in some selected markets including the UK. This is supported by the work of Nwachukwu & Shitta, (2015), who tested whether some selected emerging and industrialised markets including the UK complied with market efficiency. Their result showed that price series of the UK stocks contain information for predicting future prices.

Narayan, et al. (2016) employed a Garch model to test for the presence of a unit root in stock price movement using 156 stock listed on the New York stock exchange (NYSE) between 1980 and 2007. They found that some stocks in the

market follow a random walk while others follow a stationary trend.

In conclusion, the results from a wide range of research testing for validity of market efficiency in the weak form can be considered inconclusive and necessitating a further study. Most empirical study of weak form market efficiency in London stock exchange made use of FTSE100 for periods less than 20years. This study consider a larger sample size (30years) that reflects more recent trading in the london stock exchange.

3.0 Data and Methodology

The data employed in this work comprise of daily prices of Financial Times Stock Exchange (FTSE) 250 index for observation periods ranging from January 1, 1986 to June 30, 2016, a total of 7807 observations obtained from yahoo finance for week days only. The justification for the selection of large sample size is to have sufficient statistical power and increased precision as most previous work employed data less than 20years. Some investors argue that FTSE 250 is a better index because it contains smaller companies and offers the potential for faster growth. FTSE 250 has risen by 84% over the last five years while FTSE 100 only risen by 36%. (Stephens , 2016) Secondary data provided modest measure of data quickly and it was readily available at no cost. The fact that substance of the data is almost impossible to alter motivated the choice of secondary data. Both data and the research findings are also open to the public for assessment. However, the fact that secondary data might be compiled for a purpose other than that of the researcher is a major shortcoming of using secondary data. This is not applicable in this case because the

data sourced are appropriate and readily verifiable. The collected data were converted into constantly compounded returns using a natural logarithm. The daily returns computed can be represented mathematically as follows.

$$r_t = \log(p_t) - \log(p_{t-1}) = \log\left(\frac{p_t}{p_{t-1}}\right) \quad (4)$$

Where

p_t = stock returns at time t

p_{t-1} = stock price at time $t - 1$

3.1 Method of Data Analysis

This research work employed both parametric and nonparametric methods in evaluating the hypotheses stated in Sections 3.1.1, 3.1.2, 3.1.3. Although the parametric test is more robust and allow for more conclusions to be made, it is based on some underlying assumptions about the population distribution of which the violation of such assumptions could make the result misleading. (Field, 2009, pp. 131-133) Nonparametric methods are considered simple and they relax some assumptions about the distribution of data. It is, however, less powerful compared to a parametric test. (Field, 2009, pp. 539-540) The decision to use both methods is to have a more informed and robust result as the shortcoming of one is compensated for by the other. In reality, data samples almost always do not follow a normal distribution but the parametric test is still suitable for this work because of the large sample size. According to the central limit theorem, the distribution of data would be roughly normal if the sample size is adequately large and sample size greater than 30 is generally considered acceptable. (Field, 2009, p. 42; Saunders, Lewis, & Thornhill, 2012, p. 254)

3.1.1 Serial Correlation

The serial correlation was employed to investigate the first objective of critically examining whether successive price changes are independent of one another. Hypothesis to be tested are:

H0: *Successive price changes in the London stock exchange are not correlated*

H1: *Successive price changes in the London stock exchange are correlated*

The null hypothesis will be rejected if the computed serial correlation is statistically and significantly different from zero at 5% significant level.

Serial correlation can be mathematically represented as follows

$$P_K = \frac{\sum_{t=1}^{N-K} (r_t - \bar{r})(r_{t+k} - \bar{r})}{\sum_{t=1}^{N-K} (r_t - \bar{r})^2} \quad (5)$$

Where

P_K = serial correlation coefficient of price change at lag k

N = Number of Observations

$\bar{r}$ = Sample mean of the price change

k = lag of the periods

r_t = price change over period t

r_{t+k} = price change over period $t + k$

Ljung-Box portmanteau statistics (Q) was used to test whether all auto correlations are concurrently equal to zero. This is represented statistically as follow

$$Q_{lb} = N(N+2) \sum_{j=1}^k \frac{r_j^2}{N-j} \quad (6)$$

Where

Q_{lb} = j auto correlation

N = number of observations

The Q statistics follows a chi-square distribution and the total number of observations equates the degree of freedom.

Serial correlation is a very good measure of how prices relate to their lag values. However, there is a possibility of accepting that a market is efficient and rejecting the random walk theory which the efficient market hypothesis is based.

3.1.2 Variance Ratio Test

Variance ratio test was the instrument applied to appraise the second objective of critically examining whether the variances of differences between successive price changes is linear or not. The hypothesis tested are stated as follow

H0: *Variances of differences of stock returns in the London stock exchange follow a linear trend*

H1: *Variances of differences of stock returns in the London stock exchange do not follow a linear trend*

Using this method in testing the study hypothesis, the null hypothesis will be rejected when the computed variance ratio is not equal to one. The null hypothesis will also be rejected if the Z and Z* estimated is not within ± 1.96 . Variance ratio can be calculated by dividing the computed variance of a longer interval by that of a shorter interval and multiplying the result by the result of dividing the ratio of shorter interval by that of the longer interval. (Abedini, 2009) The formula for computing Variance ratio is stated below

$$VR(q) = \frac{\frac{1}{q} Var(P_T - P_{T-q})}{Var(P_T - P_{T-1})} = \frac{\sigma^2(q)}{\sigma^2(1)} \quad (7)$$

Where

q = any positive integer

VR = Variance Ratio

Variance ratio is a popular and good measure of predictability of asset prices. However, it does not report the causes of the differences. The shape of the distribution can also affect the results. (Abedini, 2009)

3.13 Unit root Test

Unit root test is the statistical tool employed to assess the third objective of examining whether average stock returns on stocks listed on the London stock exchange follow a particular trend or not. The following hypothesis were tested

HO: Average returns on stocks listed on the London stock exchange do not follow a stationary trend

H1: Average returns on stocks listed on the London stock exchange follow a stationary trend

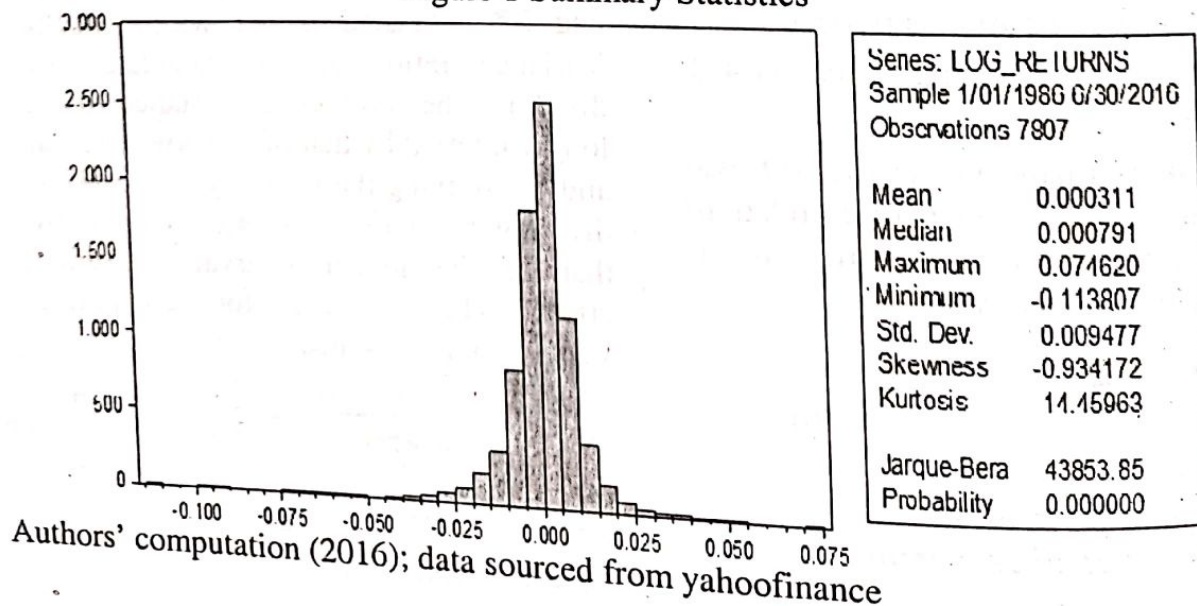
There is evidence of randomness in price series if unit root is present. A Unit root means that the unknown elements in an equation are equal to one. Unit root is present when a shock into the stock price series creates a permanent change in that process and such a change

hinders the prediction of future price movement. On the contrary, randomness is not present in stock price behaviour if price level keeps reverting to its mean. (Phiri, 2015) This implies that the mean return is not a function of time and it follows a trend that can help market participants in predicting the future performance of stocks. This research work employed the Augmented Dickey-Fuller (ADF) unit root test which is a parametric test and the Philips-Peron (PP) unit root test which is a nonparametric test. The main problem with these two methods is that addition of more dependent variables to the regression reduces their power. (Kelichukwu, 2016) However, those problems do not reduce the power of the test because this research work is focused on a univariate time series.

4.0 Empirical Results and Discussion of Findings.

Summary Statistics

Figure 1 Summary Statistics



In a normal distribution, the mean and median are expected to be identical or at least not too far apart, the skewness should be zero and kurtosis should have a value of three. (Abedini, 2009). Although a mean return for all the 7807 observations of 0.000311 and a median of 0.000791 showed in figure 1 are not too far apart, a Jarque-Bera (JB) value of 43853.85 (figure 1) and a probability less than 0.001 (figure 1) indicate that the distribution is not normal. To validate the violation of the assumption of normality, high negative skewness of -0.934172 and a figure of 14.45963 showed in figure 1 imply that the distribution has a left tail that is short and fat with a high peak. However, the distribution can still be considered approximately normal because of a very large sample size (7807) employed in this study. This is based on the central limit theorem. (Field, 2009, p. 45)

Empirical Result of Serial Correlation

The empirical result rejects the null hypothesis that changes in the price of stocks between two periods are not correlated. The auto correlation and partial auto correlation at all lags showed in table 1 are significantly different from zero except for lag 9 and 16 that have zero auto correlation. Table 4.1 also displayed a significantly high Q statistics at all lags, indicating a significant serial correlation between consecutive price changes in the London stock exchange. The P values at all lags as showed in table

1 are also less than 5% specified significant level. The alternative hypothesis that changes in the price of stocks between two periods in the London stock exchange are correlated was accepted. This suggests that successive stock prices in the London stock exchange are not independent of one another. There are high enough correlations between consecutive stock prices to help technical analysts study historical trend and predict future prices for a possibility of earning abnormal returns. The theoretical implication is that the consecutive stock prices do not follow a random walk. Therefore, the London stock exchange is not informationally efficient in the weak form.

The result of this research work is in conformance with Al-Lounghani & Chappel (1997) result of serial auto correlation of FTSE 30 share index between 1986 and 1989. Nwachukwu & Shitta, (2015) also reached a similar conclusion when they employed first order serial correlation of consecutive stock prices of UK stocks. However, the early work of Fama (1965) was based on serial correlation to prove market efficiency but the result of this study suggests otherwise Worthington & Higgs (2004) also applied the serial auto correlation but suggested a contrary result to this research work. Data employed in this research reflect more recent trading in London stock exchange and this could be the reason for the difference in results

Table 1: Empirical Result of Serial Correlation

Sample period: 1/01/1986 -6/30/2016

Number of observations: 7806

Lag	Auto Correlation	Partial Auto Correlation	Q-Statistics	Probability
				<0.001
1	-0.443	-0.443	1534.5	<0.001
2	-0.044	-0.3	1549.8	<0.001
3	-0.034	-0.263	1559	<0.001
4	0.048	-0.164	1576.9	<0.001
5	-0.011	-0.127	1577.8	<0.001
6	-0.043	-0.163	1592.4	<0.001
7	0.028	-0.128	1598.4	<0.001
8	0.001	-0.114	1598.4	<0.001
9	0	-0.103	1598.4	<0.001
10	0.004	-0.081	1598.5	<0.001
11	-0.01	-0.086	1599.4	<0.001
12	0.019	-0.057	1602.2	<0.001
13	-0.02	-0.069	1605.3	<0.001
14	0.007	-0.063	1605.7	<0.001
15	0.005	-0.049	1605.9	<0.001
16	0	-0.042	1605.9	<0.001
17	0.003	-0.029	1606	<0.001
18	-0.007	-0.03	1606.4	<0.001
19	-0.01	-0.048	1607.1	<0.001
20	0.01	-0.041	1607.9	<0.001
21	-0.012	-0.06	1609.1	<0.001
22	0.016	-0.044	1611.2	<0.001
23	0.003	-0.029	1611.3	<0.001
24	-0.011	-0.039	1612.2	<0.001
25	-0.009	-0.057	1612.9	<0.001
26	0.038	-0.007	1623.9	<0.001
27	-0.04	-0.048	1636.7	<0.001
28	0.013	-0.04	1638	<0.001
29	0.011	-0.019	1639	<0.001
30	0.011	0.006	1640	<0.001

Authors' computation (2016); data sourced from yahoofinance

4.3 Empirical Result on Variance Ratio Test

The null hypothesis that variances of differences of stock returns over different interval in the London stock exchange follow a linear trend was rejected and alternative hypothesis that Variances of differences in the stock returns over different interval in London stock exchange do not follow a linear trend was accepted. The rejection of the null hypothesis was based on the fact that estimated absolute value under both homoscedasticity and heteroscedasticity assumptions (as displayed in table 2) are outside the ± 1.96 critical value and variance ratio computed at lag 2, 4, 6 and 16 (table 2) are all less than one indicating a negative correlational relationship between successive stock prices. The implication of the results of variance ratio

test is that the efficient market hypothesis is not valid in the London stock exchange even at the weak form.

The result of this research also contradicts the conclusion of Lee (1992) who applied the same methodology to evaluate market efficiency of UK and other 9 industrialized countries. There is also disagreement between the conclusion of this research and that of Worthington & Higgs (2004) on whether random walk theory is valid in the UK stock market. The variance in results could also be as a results of more recent data applied in this research. However, the suggestion from this research work concurred with that of Borges (2010) that variance ratio of differences in stock returns over different intervals are not linear and consequently, the market is not informationally efficient in the weak form

Table 2: Result of Variance Ratio Test

	2	4	8	16
Variance Ratio	0.556749	0.272149	0.138648	0.070951
Z value	-39.16188	-34.37341	-25.72710	-18.64798
Z* value	-17.08669	-15.50939	-12.18696	-9.49783
HO decision	Reject	Reject	Reject	Reject
Weak form Efficiency	No	No	No	No

Authors' computation (2016); data sourced from yahoofinance

4.4 Empirical Result from Unit Root Test

Both Augmented Dickey-Fuller (ADF) test and Phillips Peron (PP) test rejected the null hypothesis because the t statistic values (table 3) were more negative than the critical value at 1%, 5% and 10% respectively. Rejection of the null hypothesis was further supported by the fact that the probability value of 0.0001 (table 3) is less than 1%, 5% and 10% respectively.

The implication of rejecting the null hypothesis that average stock returns

do not follow a stationary trend is that stock price variations always revert to its mean. Randomness in price series is not upheld. This suggests weak form market efficiency is not present in the London stock exchange. Therefore, future stock prices might be predicted by analysing and identifying trend in the previous prices.

The outcome of this research suggests a different conclusion from that of Choudhry (1994) but agree with Al-Lounghani & Chappel (1997). who also used Augmented Dickey-Fuller Unit root

test to examine whether the UK market is weak form efficient. Worthington & Higgs (2004) also applied both Augmented Dickey-Fuller (ADF) Philip Peron (PP) unit root test to examine validity of market efficiency in european equity market but their result and that of this resaerch are in conflict. Lee, et al.(2011) reached similar outcome when they found evidence of stationarity in the price series of stocks in the london stock

exchange, suggesting an invalidity of random walk. Most studies contradicting the conclusion of this work are relatively old and can be considered not to reflect the current tradings in the london stock exchange.

Table 3 Empirical Result of Unit Root Tests

	ADF unit root		PP unit root	
	intercepts	Intercepts with trend	Intercepts	Intercepts with trend
Critical value of 1%	-3.431011	-3.959211	-3.431011	-3.959211
Critical value of 5%	-2.861717	-3.410379	-2.861717	-3.410379
Critical value of 10%	-2.566906	-3.126945	-2.556906	-3.126945
t-statistics	-77.26839	-77.26598	-79.21517	-79.20874
Probability Value	0.0001	0.0001	0.0001	0.0001
H0 decision	Reject	Reject	Reject	reject
Weak form Efficiency	No	No	No	No

Authors' computation (2016); data sourced from yahoofinance

4.5 Implications of Findings

The results of all the three tests agree that serial stock prices do not comply with the criteria of a random walk. The findings of this research have both theoretical and practical implications. Establishment of no randomness in price series of stocks listed on the London stock exchange implies that weak form efficient market hypothesis is not valid in London stock exchange. This implies that prices of stocks might not incorporate all available information and stock prices might not reflect their fundamental value of stocks indicating a possibility of stocks being overpriced or under-priced. Although arbitrage might exist, it could be very costly and does not eradicate price variance from its fundamental value

rapidly enough. Careful evaluation of past trend can help in predicting future prices of stocks because significant correlation exists amongst successive stock prices in the London stock exchange. There is a possibility of earning above average returns even if investors do not assume extra risk However, arbitrage opportunity might exist due to market inefficiency but not everyone has the expert knowledge to exploit the market. Non-financial firms would still find it difficult to benefit from future price speculations even if price series are predictable.

The strength of this research work is that all the three methodologies agree about the result. Absence of data break makes the result of this study very robust. However, the result is limited to just the London stock exchanges and cannot be generalised to all other stock exchanges.

5.0 Conclusion, Recommendations, and Area of further Research

This research work based the assessment of market efficiency on random walk model and the three different statistical tests employed to critically examine whether the London stock exchange follow a random walk showed no evidence of randomness. Serial correlation established a relationship between stock returns and their lag value. Variance ratio test revealed absence of linearity of variances of stock returns over different intervals. This negates the concepts of randomness as variance of increments in a random walk is expected to be linear. The mean returns on stocks listed on the London stock exchange follow a stationary trend as unit root test showed that price levels always revert to its mean after an unexpected occurrence in the market. Therefore, it can be concluded that the London stock exchange is not weak form efficient as all the methodologies were consistent in rejecting randomness of stock behaviour.

Based on the conclusion, the study recommends that: i. firms should ensure good information management. ii. Companies should not only focus on long term issues; short term appearance and perceptions is equally important. This is not supporting creative accounting but a very cautious investment strategy that put into consideration the possibility of overreaction from investors. iii. Thorough investigation into the relationship between risk and returns to identify stocks trading below or above their intrinsic value.

The presumption of efficient market hypothesis that market prices are the best measure of stock value indicate that there is in existence another value measurement metric which needs to be

well defined. Therefore, further research is required on those metrics to better access whether asset prices truly reflect their fundamental value.

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