Impact Factor: 5.00

LOGAN JOURNAL OF COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE, AND ROBOTICS.
12(3) 2025 LJCSAIR

ISSN: 3067-266X

EXAMINING THE WEAK-FORM EFFICIENCY OF THE NIGERIAN STOCK EXCHANGE EDUCATION

Elizabeth M. Okafor
Department of Finance, Faculty of Administration and Management, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

DOI: https://doi.org/10.5281/zenodo.16752513

Abstract: Runs test is a statistical procedure which determines whether the sequence of returns within the distribution have been derived with a random process or not. This study examines the efficiency of The Nigeria Stock Exchange in the weak-form level and the predictability of equity prices/returns using monthly observations. The data set covers the period of ten years- January, 2013 to December, 2022. The stocks were randomly selected based on their ability to trade frequently on the floor of the market, and absorb the shocks of thin trading with irregular hiking. All time-series data were obtained from The Nigeria Stock Exchange database. The study employed non-parametric tool: runs test. Based on the result of the runs test, it can be concluded that the monthly stock return series do not move randomly hence the NSE is not weak form efficient. The policy implication of the analyses is that the Nigeria Stock Exchange, as an emerging market, must be closely monitored to achieve an optimal maturity level. It is therefore recommended that policy makers to enlighten potential investors of the opportunities that are available in the stock market. Such enlightenment should seek to stimulate their interest in capital market activities and thus increase the breadth and depth of the capital market.

Keyword: Stock markets, random walk, efficient markets hypothesis, runs tests, The Nigeria Stock Exchange

Introduction

The Stock Exchange is a market for the buying and selling of stocks, shares and securities. It is essentially a secondary market in that only existing securities as opposed to new issues, could be traded on (Afolabi, 1998, Bailey, 2005), so that trade takes place between investors and need not directly involve the corporations themselves (Bailey, 2005). Stock exchanges provide a more organized way to trade shares (Levinson, 2006). They are generally superior to the OTC market for several reasons. First, they bring many investors together, offering greater liquidity and thus making it possible to obtain better prices. Second, the exchange is able to obtain and publish the prices at which trades have occurred or are being offered, giving investors an important source of information not available on the OTC market. Third, the exchanges have rules and procedures to ensure that parties live up to their commitments. All well-known companies whose shares are traded publicly list their shares

on exchanges. Exchanges set requirements for listing, and very small firms or firms whose shares seldom trade will not qualify.

Shares, also known as equities, are fractional ownership in a company (Olowe, 1996; Levinson, 2006; Alfred, 2007; Bhalla, 2012). A Stock market is said to be efficient if the share prices at any time "fully reflect" all available, relevant information (Fama, 1970, 1991). Academic research suggest that share prices follow a random walk. That is, successive price changes are independent of each other. The search for an explanation of this apparent randomness led to the formation of Efficient Market Hypothesis (EMH) (Adams et al. 2003).

The concept of efficient markets is embodied in the theory of Efficient Market Hypothesis. It states that stock prices always reflect all known information. As a result, stock prices are always perfectly priced, and no investor can have an edge on finding undervalued or overvalued securities. Eugene Fama, in the 1960s, developed the idea of efficient market hypothesis (EMH) as an academic concept of study; and describes it as where security prices at all time reflect all available, relevant information; and that it is impossible to beat the market because prices already incorporate and reflect all available information (Fama, 1965a,b, 1970, 1991; Fama and Blume, 1966, Fama, French, Jensen and Roll, 1969). The hypothesis suggests that stock markets are "informationally efficient". That is, any new information relevant to the market is spontaneously reflected in the stock prices. For one thing, not everyone has access to the same news, nor does everyone receive the news in a timely fashion. Because of this discrepancy, market participants commonly talk about three forms of the EMH, each of which is based on the availability of a different level of information (Strong, 2004).

Roberts (1959) and Fama (1970, 1991) classified the hypothesis into three versions according to the levels of information, namely: weak-form (How well do past returns predict future returns?); semi-strong form (How quickly do share prices reflect public information announcements?); and strong-form efficiencies (Do any investors have private information that is not fully reflected in the market prices?). As we move from weak-form to strong-form, we are referring to progressively more information.

The EMH does not say that investors will never beat the market and will never make large profits. In other words, $\varepsilon_{j,\,t+1}$ can be large and positive. What it does say is that, on average, over a period of time, investing is a fair game. You win some, you loose some. Being an occasional winner is not what is important (Tyson, 2003; Jordan and Miller, 2009). So, the $\boldsymbol{\varepsilon_{j,\,t+1}}$ will sometimes be positive and sometimes negative, with the result that the sum of the excess returns over a number of periods of time will be average zero. According tom Easterling (2005), the range of up days versus down days is close to 50/50; the pattern is much more balanced. the historical evidence indicates a fair share of both winning and losing days across both bull and bear markets.

Under the random walk hypothesis, it is not possible to earn an extra profit using trading strategies based on the past history of prices (Cowles, 1933, 1944; Roberts, 1959; Fama, 1965; Samuelson, 1965). The efficient market hypothesis (EMH) demonstrates that knowledge of past security prices would not necessarily lead to high profits. Any information that could be used to predict stock performance is already reflected in the stock price today. Because of the wide availability of public information, it is nearly impossible for an investor to beat the market systematically (Cowles, 1933, 1944; Roberts, 1959; Fama, 1965; Samuelson, 1965 Fama, 1970, 1991).

In an efficient capital market, there should not exist a significant correlation between the security prices over time (Brealey, 1969). In other words, share prices behave randomly. Hence the weak form of efficiency is referred to as the random walk hypothesis. Fama (1970) used the term "random walk" as a synonym for the so-called "weak-form" market efficiency – a condition in which market prices cannot be predicted at the basis of past prices alone. The consequence of this hypothesis is that past prices cannot have any predictive power for future prices once the

current prices have been used as an explanatory variable. (DeBondt and Thaler, 1985; Cunningham, 1994; Poshakwale, 1996).

Objectives

The objectives of this study are:

i. To examine the random walk behavior of stock returns in The Nigeria Stock Exchange.

ii. Ascertain the unpredictability of equity return.

The Concept and application of Runs Test

Through the use of non-parametric statistical technique called a runs test (based on the distribution of runs, that is sequence of increments with the same sign (Fabozzi, *et al* 2006)), analysts can test the likelihood that such a series of price movements occurred by chance. A run, according to Strong (2004, 2006; Cheney and Moses, 1992), is an uninterrupted sequence of the same observation. If there are too many runs, it would mean that the residuals change signs frequently, thus indicating negative serial correlation. Similarly, if there are too few runs, they may suggest positive autocorrelation. A run test is a statistical procedure that examines whether a sequence of data is occurring randomly from a specific distribution (Bujang and Sapri, 2018; Simon and Laryea, 2004; Dickinson and Muragu, 1994).

The runs test is a shortened version of the full name: The Wald – Wolfowitz runs test, so named after mathematicians Abraham Wald and Jacob Wolfowitz. Runs test is a way of testing for independency in time series, where the term "runs" refer to a sequence of changes of the same character, i.e. how successive returns are of the same manner in form of positive or negative. This means that we look for positive return followed by positive return, or negative return followed by negative return, the run length is interrupted when the return changes sign. Mood (1940) was the first to provide a comprehensive analysis of runs. Moreover, Mood shows that the distribution of the number of runs converges to a normal distribution asymptotically when properly normalized. The original implication of the test is to simply classify them as positive or negative depending on if they are above or below zero (Gujarati & Porter, 2009).

Runs A run, according to Bujang and Sapri (2018) is defined as a series of consecutive observations' value. It is a sequence of events of a certain type preceded and followed by occurrences of the alternate type or by no event at all. For finding the number of runs, the observations are listed in their order of occurrence. Each observation is denoted by a "-" "+" sign if it is more than the previous observation. If the observation is same as previous observation put "0". The total number of runs up (+) and down (-) is counted.

For daily data, a run is defined as a sequence of days in which the stock price changes in the same direction. For example, consider the following combination of upward and downward price changes:

$$+ + - - + - + - - - + +.$$

A + sign means that the stock price increased, and a – sign means that the stock price decreased. Thus, the example has 7 runs, in 12 observations. A sample with too many or too few runs suggests that the sample may not be random.

Runs Tests

A run test is a statistical procedure that examines whether a sequence of data is occurring randomly from a specific distribution. That is run test is used for examining whether or not a set of observations constitutes a random sample from a finite population. It may also be defined as a statistical procedure which determines whether a sequence of data within a given distribution have been derived with a random process or not. It may be applied to test the randomness of data in a survey that collect data from an ordered population (Bujang and Sapri, 2018).

It has, been used by former researchers of weak-form efficiency in emerging markets (see for example, Barnes, 1986, Claessens et al. 1995; Dickinson and Muragu, 1994; Simon and Laryea, 2004; Rahman and Hossain, 2006). It is based on the premise that if a series data is random, the observed number of runs in the series should be close to expected number of runs. If there are too many runs, it would mean that the residuals change signs frequently, thus indicating negative serial correlation. Similarly, if there are too few runs, they may suggest positive autocorrelation (Gujarati, 2003). Positive autocorrelation refers predictability of returns in the short horizon, while negative autocorrelation reflects predictability in the long horizon (Fama and French, 1988; Fama, 1991). Implicitly, too many runs or few runs indicate evidence against the hypothesis of Random Walk (Spiegel and Stephen, 1999; Bujang and Sapri, 2017).

The run test for randomness is carried out in a random model in which the observations vary around a constant mean. The observation in the random model in which the run test is carried out has a constant variance, and the observations are also probabilistically independent.P

A run is an uninterrupted sequence of the same signs: plus, negative or no change. It is a nonparametric (does not require assumptions; the returns need not to be normally distributed) test that checks the randomness of runs. It does not require that return distributions are normally or identically distributed, a condition that most stock-return series cannot satisfy. Moreover, it eliminates the effect of extreme values often found in returns data (Al-Khazali, David, & Pyun (2007).

Hypothesis Test for Randomness of Stock Prices

The study tests the hypothesis by observing the number of runs, i.e., the successive price changes (returns) with the same sign.

H_0: The sequence of stock prices/returns is random

H_1: The sequence of stock prices/returns is non-random (systematic).

The consecutive price changes or returns are random when the difference between the actual number of runs and the expected number of runs are not significantly different from zero. The presence of a significant difference indicates returns are systematic, and hence refutes the assumption of independence of returns. The hypothesis is tested by observing the number of runs, i.e., the successive price changes (or returns) with the same sign.

However, according to Korsvold and Jennergren (1974), it is important to note that randomness is merely a sufficient and not a necessary condition for the EMH. Thus, a rejection of the null hypothesis does not necessarily equate to a rejection of the EMH. Therefore, in this study, a rejection of the null hypothesis will simply be interpreted as an indication and not a proof of an informationally inefficient market. Conversely, failure to reject the null hypothesis will be interpreted as an indication that the EMH holds true.

Furthermore, in order to convey a comprehensive understanding of the test used in this study, the subsequent sections will be devoted to a thorough description of the said tests.

Test Statistics:

$$Z = \frac{r - \mu_r}{\sigma_r} \qquad (1)$$

Where:

$r =$ the number of runs

$\mu_r =$ the expected number of runs; and

$\sigma_r =$ the standard deviation of the number of runs

The values of μr and σr are computed as follows:

$$E(r)=ur = \frac{2n_1n_2}{n_1+n_2}+1 \quad (2)$$

$$\sigma 2r = \frac{2n_1n_2(2n_1n_2-n_1-n_2)}{(n_1+n_2)^2(n_1+n_2-1)} \quad (3)$$

$$\sigma r = \sqrt{\frac{2n_1n_2(2n_1n_2-n_1-n_2)}{(n_1+n_2)^2(n_1+n_2-1)}} \quad (4)$$

Methods of Study

Study Design

This section states the methods of data collection and procedures for minimizing and controlling response errors, as well as the procedures, modalities and sequential steps adopted to ensure that the results of the research investigation are dependable, accurate and valid. This is consistent with Obadan and Iyoha (1999), and Agbonifoh and Yomere (2002) on methodology as the methods, procedures or modalities by which the researcher intends to accomplish the objectives of his research project. This is a descriptive study, which aims to describe the behaviors of the Nigerian stock market, particularly with respect to how stock prices respond to available information.

On the basis of methodology, this study is a longitudinal survey, since it examines the prices of shares traded on the floor of Nigerian Stock Exchange for a period of time, and observe changes in prices as well as the pattern of changes. Again, this is consistent with Agbonifoh and Yomere (2002) on longitudinal survey as one which studies a phenomenon, event, or group over a period of time. Specifically, this chapter presents a careful description of the research design, population, and method of data analysis.

Equally too, this study is empirical research. Empirical research design is the most relevant form for time series data analysis. It also allows the behavior of the time series data, which will be sampled at a regular interval, to be studied before a particular model can be applied to analyze the data. Therefore, the empirical methodology helps to avoid the possibility of generating wrong results and conclusions. Further, the nature of the data analysis is determined by the actual behaviour of the financial data rather than a preconceived notion (Chawla and Sondhi, 2016). The conclusions of this study are strictly drawn from concretely empirical evidence, and therefore "verifiable" evidence.

Population of the Study

As at May 31, 2018, The Nigerian Stock Exchange has more than 200 listed companies with a total market capitalization of over ₦13-trillion (NSE, 2019). All listings are included in The Nigerian Stock Exchange All-Shares index. In terms of market capitalization, The Nigerian Stock Exchange is the largest stock exchange in Africa (NSE, 2019).

The Nigerian Stock Exchange has a total of eight (8) sectors. The population of this study is made up of all the eight (8) sectors of The Nigerian Stock Exchange. Most listed companies have been reclassified for better grouping with the eight (8) sectors. And most of the old sectors have now been merged under one sector while others have been modified. These changes will enable more accurate market-related analyses at the local and global levels, including analysis of local economic sector performance. The changes will also facilitate the development of new investment instruments, such as indices, etc. Each sector is clearly defined and further divided into sub-sectors, which describe the nature of business activities. The eight (8) sectors in The Nigerian Stock Exchange include the following:

1. Financials. The financial sector consists of Banks, Investment funds, Insurance companies, among others.

2. Basic Materials. The utilities sector consists of electric, gas and water companies as well as integrated providers 3. Consumer Goods

4. Consumer Services
5. Energy (Oil & Gas)
6. Healthcare
7. Industrials
8. Technology

Sample Size and Sampling Procedure

The sample size is ten (10) stocks. The study employs monthly raw returns of ten (10) companies, continuously traded in the Nigerian Stock Exchange (NSE) over the period January 2013 to December 2022. The choice of the period is motivated by the fact that this timeline (2013) captures the year the NSE all-share index rose astronomically by 42.8 percent, thereby enforcing attraction of investments to further deepen the market.

The companies were randomly selected based on their ability to trade frequently on the market and absorb the shocks of tin trading with irregular hiking. They include: Dangote cement, Dangote sugar, Guinness, J. Berger, Neimeth, Okomu Oil, PZ, UPDC, Vita form, and Zenith Bank. Consequently, only those stocks that were listed before 1st January, 2010 were considered. [Several studies investigate the consequences of thin trading (e.g., Lo and MacKinlay, 1989; Stoll and Whaley, 1990; Miller, Muthuswamy, and Whaley, 1994)].

The All-share Index is used to measure the stock market in terms of the magnitude and direction of general price movement. It also indicates the total market index, which reflects the behavior of stock in the market. (Udom and Richard, 2019). The All-Share Index (ASI), also serves as useful indicator of stock market efficiency. Secondary data were collected on the Nigerian Stock Exchange All-share historical weekly returns, various issues of the statistical Bulletin and Annual Reports of the Central Bank of Nigeria (CBN), text books, Journals and unpublished materials. Data on stock prices for the ten (10) sampled securities as well as the All-share Index of the Nigerian Stock Exchange were also obtained from the internet (using the website of cash-craft asset management). Owing to the absence of consistent real series, nominal values of the variables under consideration were used. The main data for stock price changes for all the securities traded on the floor of the Nigerian stock Exchange is the All-share Index of the Nigerian Stock Exchange. The choice of the All-share index is informed by the fact that it is the aggregation of all price gains and losses for a given period. To this end, the All-share index for the period January, 2013December, 2022 is used to compute market statistics.

Sources of Data Collection

Data was collected from 10 stocks listed on the Nigerian Stock Exchange. Monthly stock price data were obtained from the exchange database over the ten (10) years trading period. The start date is 2nd January, 2013 to 31 December, 2022.

Sampling Design

In view of the problem definition, the variables surveyed are the stock prices of 10 selected securities for the period January 2013 – December 2022. From a population of over two hundred (200) quoted companies, a sample of ten (10) securities were randomly selected based on their ability to trade frequently on the market and absolve the shocks of tin trading with irregular hiking. The age of the securities on the floor of the Nigerian Stock Exchange was also considered. Consequently, only those securities that were listed before 1st January 2003 were considered.

Empirical Evidence- result

We were prompted to begin investigating the random walk and unpredictability of the selected stocks in the year 2013. This timeline captures the year the NSE all-share index rose astronomically by 42.8 percent, thereby

enforcing attraction of investments to further deepen the market. A sight view of the trajectories of the selected company prices and returns are shown in the figures below.

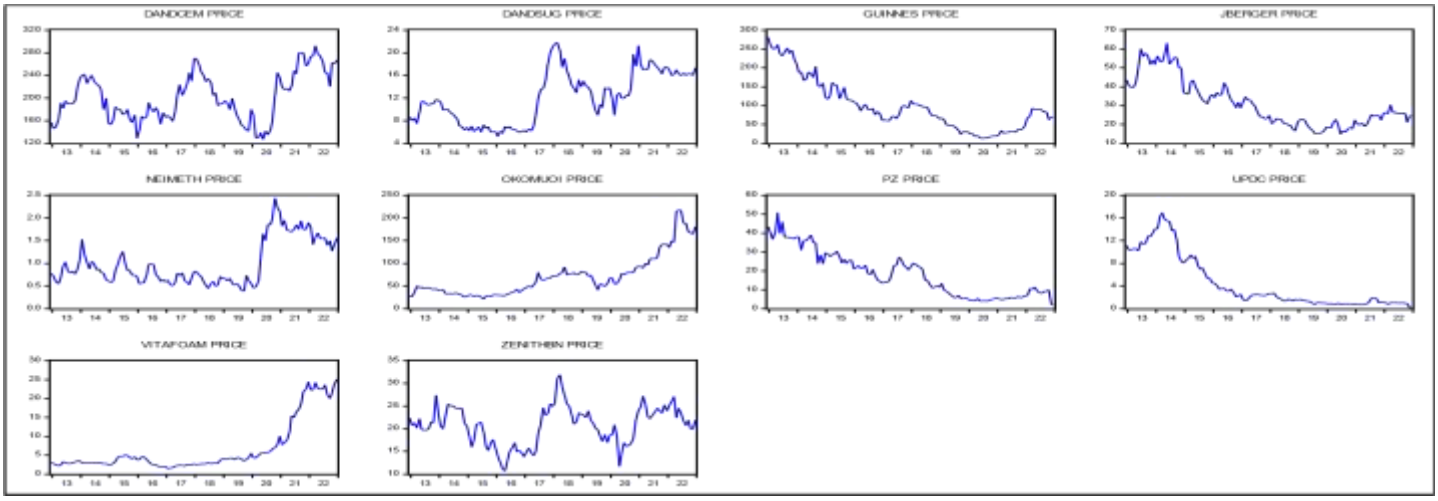

Figure 1-Prices of Selected Stocks over the Period Jan 2013 to Dec 2022

Observing how returns change as time evolves, the duration and amplitude of each positive and negative sequence is of course thought to be random but there seems to be a rather weak tendency for positive returns to be followed by positive returns and negative returns to be followed by negative returns hence visually the returns data of the indices shows signs of weak autocorrelation. It is not easy to analyze data visually but something could be said about the volatility of the indices.

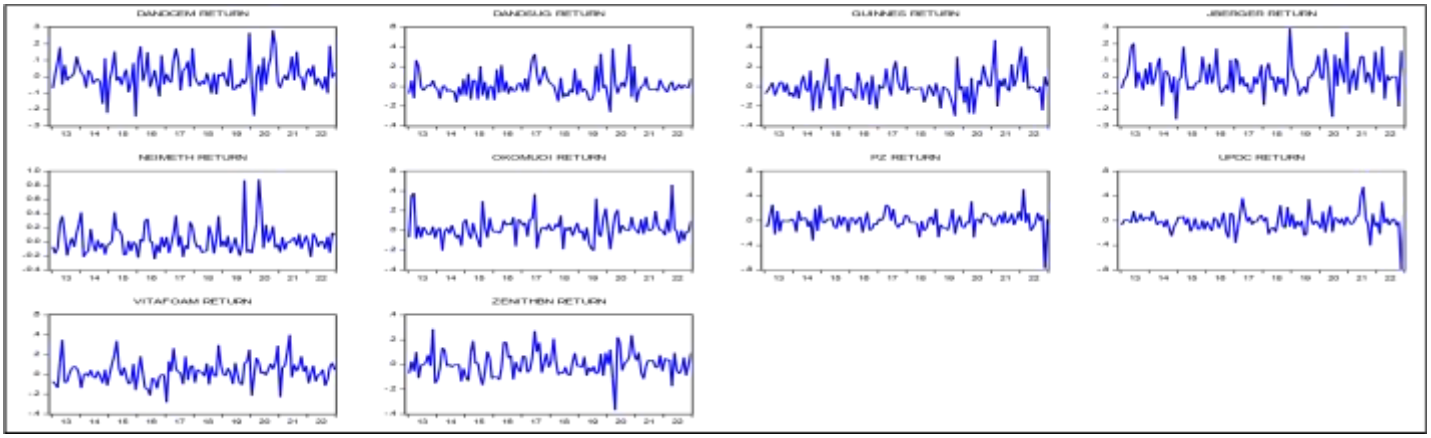

Figure 2-Increments/Returns of Selected Stocks over the Period Jan 2013 to Dec 2022

The trajectories of prices for four of the companies (Guinness, J-Berger, UPDC and PZ) started declining since 2013. The prices of other companies showed fluctuations, indicating gain or loss over the sample period.

Generally, randomness or stochastic behavior of stock prices/returns is a clear indication of market efficiency in the weak form hypothesis. We proposed to test the contradiction to this hypothesis using runs test.

It is important to note that the null hypothesis or weak-form market efficiency is not rejected when the Z-score is less than the alpha value at 5%.

Since the Z values or standard scores with respect to four (4) of the companies, which include Guinness (-0.135), Neimeth (-0.42), Vital Form (-1.24) and Zenith Bank (-1.556), are negative (less than alpha value at 5%), the null hypothesis is not rejected. Hence there is no real evidence to suggest that the returns are not random.

However, in each of the other six (6) companies, the associated p-value to the Z-stat are more than alpha value at 5%, suggesting the rejection of the null hypothesis of randomness. It means that there are indications that the returns are not random (predictable). These results in Table 4.1 confirm evidences.

Table 1-Runs Test Results

Company	Number of Runs	Z-Stat	Prob
DANDCEM	64	0.816	0.414
DANDSUG	62	0.828	0.408
GUINNES	60	-0.135	0.893
JBERGER	64	0.563	0.574
NEIMETH	56	-0.42	0.674
OKOMUOI	64	0.759	0.448
PZ	62	0.196	0.845
UPDC	68	1.287	0.198
VITAFOAM	54	-1.24	0.215
ZENITHBN	52	-1.556	0.12

Based on the result of the runs test, it can be concluded that the monthly stock return series do not move randomly hence the NSE is not weak form efficient. An efficient stock market means that stock market prices are unpredictable, not dependable, cannot be consistently mispriced, not liable to arbitraging and can be left unprotected to market speculations and manipulations. An efficient stock market cannot seriously suffer from inflated stock prices, insider trading and speculation which could have negative effects on investor's confidence.

Summary, conclusion and recommendation

This study examined the random walk behavior and efficiency of the Nigeria stock market using runs test. The empirical results rejected the random walk hypothesis at the weak-form level, implying that stock prices, did not, to some extent, reflect all historical information. Consequently, past prices are not independent, and have predictive power for future prices.

This analysis has important implications for the fortune of equity investors: To increase market activities through reduction in transaction cost and increase in membership of the NSE; and minimize institutional restrictions on trading of securities in the bourse. This will make all other markets to flow as a deregulated market. It is therefore, recommended that there is need for policy makers to enlighten potential investors of the opportunities that are available in the stock market. Such enlightenment should seek to stimulate their interest in capital market activities and thus increase the breadth and depth of the capital market.

REFERENCES

Al-Khazali, O. M., Ding, D. K., & Pyun, C. S. (2007). A new variance ratio test of random walk in emerging markets: A revisit. The Financial Review, 42(3), 303–317.

Adams, N. T., Booth, P. M., Bewie, D. C., & Freeth, D. S. (2003). Investment mathematics. John Wiley & Sons Ltd.

Afolabi, L. (1998). Monetary economics (Revised edition). PERRY BARR LTD.

Agbonifoh, B. A., & Yoweri, G. O. (2002). Research methodology in the social sciences and education. Centre-piece Consultants Limited.

Alfred, D. D. (2007). Corporate finance: Issues, investigations, innovations and applications (2nd ed.). High Rise Publications.

Bailey, R. E. (2005). The economics of financial markets. Cambridge University Press.

Barnes, P. (1986). Thin trading and stock market efficiency: The case of the Kuala Lumpur stock exchange. Journal of Business, Finance and Accounting, 13(4), 609–617.

Bhalla, V. K. (2012). Investment management: Security analysis and portfolio management. S. Chand & Company.

Brealey, R. A. (1969). An introduction to risk and returns from common stock. MIT Press.

Bujang, M. A., & Sapri, F. E. (2018). An application of the runs test to test for randomness of observations obtained from a clinical survey in an ordered population. Malaysia Journal of Medical Science, 25(4), 146–151. https://doi.org/10.21315/mjms2018.25.4.15

Chawla, D., & Sondhi, N. (2016). Research methodology: Concepts and cases (2nd ed.). Vikas Publishing House Pvt Ltd.

Cheney, J. M., & Moses, E. A. (1992). Fundamentals of investments. West Publishing Company.

Cowles, A. (1933). Can stock market forecasters forecast? Econometrica, 1, 309–324.

Cowles, A. (1944). Stock market forecasting. Econometrica, 12, 206–214.

Cunningham, L. A. (1994). From random walks to chaotic crashes: The linear genealogy of the efficient capital market hypothesis. The George Washington Law Review, 546, 551.

DeBondt, W., & Thaler, R. F. (1985). Does the stock market overreact? Journal of Finance, 40, 793–805.

Dickinson, J. P., & Muragu, K. (1994). Market efficiency in developing countries: A case study of the Nairobi stock exchange. Journal of Business Finance & Accounting, 21(1), 133–150.

Easterling, E. (2005). Unexpected returns: Understanding secular stock market cycles. Cypress House.

Fabozzi, F. J., Focardi, S. M., & Kolm, P. N. (2006). Financial modeling of the equity market: From CAPM to cointegration. John Wiley & Sons Inc.

Fama, E. F. (1965). The behavior of stock-market prices. Journal of Business, 38(1), 34–105.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. Journal of Finance, 28(2), 383–417.

Fama, E. F. (1991). Efficient capital markets: II. Journal of Finance, 46(5), 1575–1617.

Fama, E. F., & Blume, M. (1966). Filter rules and stock market trading profits. Journal of Business, 39, 226–241.

Fama, E. F., & French, K. (1988). Permanent and temporary components of stock prices. Journal of Political Economy, 96(2), 246–273.

Fama, E., Fisher, L., Jensen, M., & Roll, R. (1969). The adjustment of stock prices to new information. International Economic Review, 10, 1–21.

Gujarati, D. N. (2003). Basic econometrics (4th ed.). McGraw Hill Inc.

Gujarati, D. N., & Porter, D. C. (2009). Basic econometrics (5th ed.). McGraw Hill.

Jordan, B. D., & Miller Jr., T. W. (2008). Fundamentals of investment: Valuation and management (4th ed.). McGraw-Hill.

Korsvold, P., & Jennergren, L. (1974). Price formation in the Norwegian and Swedish stock markets - Some random walk tests. Swedish Journal of Economics, 76(2), 171–185.

Levinson, M. (2006). Guide to financial markets (4th ed.). The Economist.

Mood, A. (1940). The distribution theory of runs. Annals of Mathematical Statistics, 11, 367–392.

NSE. (2019). Market model and trading manual-equities (Issue 2, October).

Obadan, M. I., & Iyoha, M. A. (1999). Macroeconomic policy analysis: Tools, techniques, and applications to Nigeria. National Centre for Economic Management and Administration.

Olowe, R. A. (1996). Financial management: Concepts, analysis and capital investments (1st ed.). Brierly Jones Nigeria Ltd.

Poshakwale, S. (1996). Evidence on weak form efficiency and day of the week effect in the Indian stock market. Finance India, 10, 605–616.

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

Roberts, H. V. (1959). Stock-market "pattern" and financial analysis: Methodological suggestions. The Journal of Finance, 14, 1–10.

Roberts, H. (1967). Statistical vs clinical prediction of the stock market. Unpublished manuscript, Centre for Research in Security Prices, University of Chicago.

Samuelson, P. A. (1965). Proof that properly anticipated prices fluctuate randomly. Industrial Management Review, 6, 41–49.

Simons, D., & Laryea, S. A. (2004). Testing the efficiency of selected African stock markets. A Working Paper. http://paper.ssrn.com/so13/paper.cfm?abstract_id=874808

Spiegel, M. R., & Stephens, L. J. (1999). Schaum's outline of theory and problems of statistics (3rd ed.). McGraw Hill Inc.

Strong, R. A. (2004). Practical investment management (3rd ed.). Thomson: South.

Strong, R. A. (2006). Portfolio management handbook (4th ed.). Jaico Publishing House.

Tyson, E. (2003). Investing for dummies (3rd ed.). Wiley Publishing Inc.

Udom, I. S., & Richard, E. O. (2019). Implications of stock market efficiency on Nigerian manufacturing sector performance. Global Advanced Research Journal of Management and Business Studies, 8(2), 16–24.