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AN EMPIRICAL INVESTIGATION OF THE RANDOM WALK HYPOTHESIS OF STOCK PRICES ON THE NAIROBI STOCK EXCHANGE

Nicholas Muthama (Corresponding author)
Department of Mathematics and Informatics, Taita Taveta University College
PO Box 635-80300, Voi, Kenya
Tel: +254-726-711-097

Nicholas Mutothya
Department of Mathematics and Informatics, Taita Taveta University College
PO box 635-80300, Voi, Kenya
Tel: +254-727-907-470

ABSTRACT: *Stock exchange markets play a critical role in their economies. They facilitate the movement of capital, often aggregating resources of small individual savers into sufficiently large capital sums that can be successfully invested by commercial companies and at the same time provide opportunities for investors to generate returns. Fluctuation in this markets influence personal and corporate financial live and economic health of a country. The debate on random walk hypothesis has been pointed out as dealing with whether or not security price fully reflect historical prices or returns information.*
This study empirically investigates whether or not stock prices at Nairobi stock exchange follow a random walk model. Previous studies have been inconclusive and produced varying and conflicting findings. The key question investigate is whether successive share price returns on the Nairobi stock exchange independent random variables so that the price return cannot be predicted from historical price returns. This study employed serial correlation tests and runs tests to analyze daily price returns for eighteen companies whose stocks constituted the NSE 20 share over the period July 2008 to June 2011.
The findings suggest that random walk model cannot be a good description of successive price returns at the Nairobi stock exchange. This is analogous to the earlier evidence by Parkinson 1984 that random walk model does not apply on Nairobi stock exchange. The findings are contrary to earlier evidence (Dickson and Muragu; 1994, Githiga; 2008 and Anyumba; 2010) that random walk model was a good description of successive price returns at the NSE. The results obtained are contrary to the hypothesis that successive stock prices are independent random variables and also not consisted with efficient market hypothesis.

KEYWORDS: Stock Exchange Market, Random Walk, Serial Correlation Tests, Price Returns, Runs Tests

INTRODUCTION

Background to the Study

In the recent years, there has been considerable interest in exploring the random walk theory as applied in the stock markets. Although the genesis of market professional is the chartist theories and the theory of fundamental analysis, there is radically different approach to stock market analysis – the theory of random walk in stock market prices. The random walk hypothesis (RWH) asserts that stock price returns movements are unpredictable and do not follow any known direction or patterns, they are likely to go up as they are likely to go down regardless of

past performance (Kendall, 1953; Fama, 1965; Samuelson, 1973). According to Bodie (2009) and Olweny (2011) prices of securities depend on factors that affect expected return and expected risk. Information on these factors is released in market at different intervals and investors react differently to the information. Security price therefore follow a random walk path and no one can predict accurately the direction and magnitude of their movement from the past series of prices.

The random walk hypothesis of stock price return has been a subject of intense debate among academics professionals, investors and financial professionals. Researchers (Basu, 1977; Banz, 1981; Foster, 1984; Osman, 2007 and Keim, 2008) have uncovered market anomalies and stock market inefficiencies that contradict RWH. Proponent of random walk have argued that the anomalies are the iceberg and content that once an anomaly is discovered, investors competing to profit by exploiting it should result in its disappearance. The financial crisis of 2007 – 2010 has also led to renewed scrutiny and criticism of RWH, with some investors and market strategist (like Jeremy Grantham a British Investor and Martin Wolf, the chief economics commentator for the financial times) claiming that belief in the hypothesis caused financial leaders to underestimation the dangers of asset bubbles breaking and dismissed the hypothesis as being a useless way to examine how markets function in reality. In addition there are investors who have beaten the market; for example, warren buffet, whose investment strategy focus on undervalued stocks, made millions and set an example for numerous followers.

The earliest effort in studying random walk of stock prices is attributed to Bachelier (1900) who his work implied that the price changes have independent and identical distributions. According to Fama (1965) theory of random walk implies that, the past history of the price series cannot be used to predict the future in any meaningful. The future path of the price level of a security is no more predictable than the path of series of cumulated random numbers or path of a drunk left in middle of a field.

Randomness is achieved through the active participation of many investors seeking greater wealth. They aggressively pounce on even the smallest information advantage at their disposal and in doing so they incorporate their information into the market prices and quickly eliminate the profiting opportunities that gave rise to their aggression (Samuelson, 1965). RWH presumes that information is freely and readily available and that there enough market participants with sufficient resources to take advantage of any profiting opportunity arising from systematic price movements of an individual stock. These participants compete against each other making all non random fluctuations too small to be exploited profitably (Seelenfreund, 1968).

According to Seelenfreund (1968) and Muragu (1994) the main concern of empirical research on the random walk hypothesis is to test whether successive price changes are independently distributed random variables. The empirical testing of random walk hypothesis has been of two types. The first and predominant method has involved statistical tests of the series of prices over time, this include serial correlation coefficient and run test. The second method involves directly testing whether mechanical trading rules can be devised to beat a naive buy and hold strategy. If stock price changes are independent, mechanical trading rules should not show a profit.

Random walk hypothesis is inextricably related to efficient market hypothesis (Sunil, 1996). In an efficient market any new information about a firm is incorporated into share prices rapidly and rationally with respect to the direction and magnitude of the share price movement. Security prices tend to fluctuate randomly around their intrinsic values, and fully reflect the latest

available information in the market. No investor has an advantage in predicting a return on a stock price since no one has access to information not already available to everyone else, and thus consistent abnormal returns cannot be earned (Fama, 1976).

Fama (1965) categorized efficient market hypothesis into three major levels depending on the type of information assumed to be used by the market in setting prices. The weak-form of the EMH states that the sequence of past price returns contains no information about future price returns. The semi strong form of EMH that holds security prices fully reflect all available public information and the strong form of the EMH that states that the security prices reflect all the information available from both public and private sources at each point in time. The levels of efficiency are nested. Strong-form efficiency implies semi-strong form of efficiency, and semi-strong efficiency in turn implies weak form of market efficiency. The empirical implication of efficiency with respect to a particular information set is that the current price of security embodies all the information in that set.

The Nairobi Stock Exchange

The Nairobi stock exchange (NSE) is a public market for the trading of securities issued by publically quoted companies and government of Kenya at an agreed price. The Nairobi stock exchange is the centre point of Kenya capital market; stocks are listed and traded on the exchange. The apex regulatory body is the Capital market authority. With permission of the London stock exchange Nairobi stock exchange started its operations in 1954 as an overseas stock exchange. At first it was voluntary association of stock brokers registered under societies act and share trading was restricted to residential European community. In 1963, after independence, African and Asian were permitted to deal in securities, but it was hard to convince native Kenyans of the significance of the exchange. NSE has been the subject of significant changes towards the development of Kenya capital market in the recent years. Development of capital market is crucial for capital accumulation, efficient allocation of resources and promotion of economic growth of a country. Since its incorporation NSE has seen an increase in the number of stock brokers, introduction of investment banks, establishment of custodial institutions and credit rating agencies and the number of listed companies have increased over time. Securities traded include, equities, bonds and preference shares.

The NSE has been one of the most popular investments in Kenya in the recent past due to its high return. It has become an integral part of the Kenya economy and any fluctuation in this market influences financial lives of individuals as well as corporate entities. Presently 51 companies are listed at NSE and two indexes are computed daily; the NSE-20 share index which is equal weighted geometric mean for twenty large and most active stocks that represents of all sectors and the NSE all stock index which is value weighted arithmetic mean. Companies listed in NSE are classified in to two market segments; main investment market segment and the alternative investment market segment. The main segment had 47 listed companies, which are further classified into four categories; Agriculture, Commercial and services, Finance and investment and investment and allied. The alternative investment segment has 4 listed companies.

Statement of the Problem

The proposition that stock prices could be well approximated by a random walk model is a subject that has raised intense debate among academics and financial professionals. Proponents of RWH (Fama, 1965; Kendall, 1953; Robert, 1959; Stigtlitz, 1981; Milton, 1953; Samuelson, 1973 and Malkiel, 1994) argue that as a result of intelligent analysts competing to discover and

trade on new and relevant information at any point in time, stock prices rapidly and rationally adjust to reflect all available information and give collective judgment of the analysts; consequently stock prices fluctuate randomly around their intrinsic values and one would expect price changes to be independent and random. They believe that it is impossible to outperform the market without additional risk.

On the other hand opponents of the RWH (Cootner, 1964; Alexander, 1964; Keim and Reid, 1971; Jegadeesh, 1990; Summer, 1989; De Bondt and Thaler, 1985; Lo and MaCkinlay, 1988), argue that stock price returns do maintain trends and predictable pattern overtime. They believe that it is possible to outperform the market by carefully selecting entry and exit point. Moreover researchers have documented several market anomalies and inefficiencies which can be exploited to produce superior returns; this contradicts the EMH.

Although many studies on security price returns predictability have been carried out on capital markets in developed economies such as USA, Britain and Japan and there is consensus among researchers that security price returns are unpredictable (Ross and Westerfield, 1988; Stiglitz, 1981; Fama, 1970). Little is documented and the consensus seems to break down when the debate is extended to emerging markets in general and NSE in particular where conclusions have been mixed and conflicting. Continued research on stock price behavior at NSE is required in order to build consensus among the market participants.

While some studies indicate that historical data cannot be used to predict future prices and concluded that stock prices at NSE follow a random walk. Anyumba (2010) tested random walk for NSE indices; NSE-20 share index and NASI, using variance ratio test. She found that random walk on NSE–20 share weekly and monthly indices and NASI weekly indices but RWM did not hold on NASI monthly indices. Githiga (2008) tested for independence using serial correlations for weekly weighted average prices. He found that weekly weighted average price changes are independent random variable. Dickson and Muragu (1994) tested independence of weekly stock prices using serial correlation and run test. He found that with proper control over the quality of data and use of large number of observation RWM can be a good description of successive price returns.

Other studies have documented contrary evidence that historical data can be used to predict future prices and concluded that stock prices at NSE do not follow Random walk. Okello (2006) examined profitability of filter rules test in the NSE. He found that it is possible to profit from serial dependencies at NSE. Kiio (2006) examine the semi strong form of efficiency by looking at the speed of adjustment of share prices on cash dividends announcement. She found that the market does not efficiently react to cash dividend announcement in price adjustment. Kamuruci (2003) tested predictability of share prices from accounting earnings using weekly data. He found that share prices moved in the same direction with the earnings. Parkinson (1984) using monthly data tested weak form of efficiency using autocorrelation and run test. He found there were noticeable patterns in share price and thus random walk was not a valid description of share price changes at NSE.

Many investors spend time and resources seeking out mispriced securities. They buy securities hoping to make profit in future on selling them at a price higher than the purchase price. It becomes apparent that it is not always possible to achieve the expected profit within the stipulated time. At times the gains are less than predicted and other times gains are greater than predicted.

There seem to be no consensus on the behavior of stock prices at NSE. The studies done on the NSE are too few give conclusive results, therefore the need to carry out the research. Two weaknesses have also been noted in previous studies. The first one is loss of information due to aggregation of data resulting from use of indexes, averages, weekly or monthly observations; such observations may give a completely false impression of the extent of price volatility especially in highly volatile stock market. The second weakness is on data analysis. Some of previous studies conducted analysis based on conventional techniques such as autocorrelation and variance ratio test (Githiga, 2008; Anyumba, 2010) which may not be always appropriate since they assume that stock returns are normally and linearly distributed, which may not always be the case. This study differs from the other studies in that it employs daily price observation for individual stocks and uses both conventional techniques- serial correlation and non parametric test- run test in the analysis.

The question which this research attempts to answer is as follows: Are successive share price returns on the Nairobi stock exchange independent random variables so that the price return cannot be predicted from historical price return?

Objective of the Study

The objective of this study is to investigate whether stock price returns on the Nairobi stock exchange depict a random sequence.

Importance of the Study

Findings of this study whether in support of or against RWH will be important. If the finding is in support, then it will be an academic success, and will enrich academic literatures that provide empirical evidence in support of RWH. In addition investors will understand why it would not be always possible to achieve the expected return within stipulated time at NSE, and that a buy and hold strategy can be followed and direct effort to portfolio diversification instead of spending time and resources vainly seeking mispriced securities. If the finding is against the RWH, then it may be possible to develop profitable trading strategies to beat the market- a gold mine for investors.

This study is beneficial to the regulator and stock market administrators in formulating policies geared towards developing the market. Regulator and administrator belief that, the market is not a reliable price setter and that it is easy, unless they hold stringent controls to manipulate the market prices. They direct much of their effort and resources towards controlling, monitoring and supervision of the market giving other major issues such developing the market lesser attention. If findings of this study support RWH, then market is reliable price setter and thus regulators can redirects their effort to other issues in the market such as structural review necessary to increase the level of trading and activity of the exchange.

Investors sometimes entrust the investment decisions to fund managers. The fund managers attempt to select individual constituent stocks by predicting the future of the market and its sectors. The results of this study will benefit the fund managers in constructing portfolios that would maximize investors return given the nature of the stock price movement.

The efficiency of the stock market and the predictability of share prices is one area that has attracted substantial attention to researchers and scholars. This study gives a good insight to them to do further research and publication in this area. This study will add to the existing body of knowledge and suggests areas for further research.

LITERATURE REVIEW

2.1 Introduction

This section provides reviews and summary of empirical studies and theoretical literature on efficient market hypothesis and random walk hypothesis. The chapter is organized as follows. Section 2.2 presents the theoretical literature. Section 2.3 gives a review of the empirical literature. Section 2.4 discusses the predictability of stock price return at NSE. Section 2.5 presents the summary of the literature review.

2.2 Theoretical Literature

In the market studies dealing with share price returns and predictability of the prices returns from historical data and efficiency of the market has been of considerable interest. Random walk and efficient market hypothesis are central ideas in explaining the stock market behavior. The supposition that market behavior embodies and reflects relevant information rapidly and rationally has a great impact on security prices, that any change in relevant information causes immediate prices adjustment.

2.2.1 Efficient Market Hypothesis

Efficient market hypothesis hold that any new information about a firm is incorporated into share prices rapidly and rationally with respect to the direction and magnitude of the share price movement. Security prices tend to fluctuate randomly around their intrinsic values, and fully reflect the latest available information in the market. No investor has an advantage in predicting a return on a stock price since no one has access to information not already available to everyone else, and thus consistent abnormal returns cannot be earned (Fama, 1976). For a capital market to be termed as efficient several assumptions are made. An important premise of an efficient market requires that a large number of profit maximization participants analyze and value securities, independent of the other. The second assumption is that new information regarding securities comes to the market in a fashion, and the timing of one announcement is generally independent of others. The third assumption is profit maximizing investors adjust security prices rapidly to reflect the effect of new information (Reilly and Brown, 2006).

Market efficiency is attained because of competitive activity of security analysts. Each analyst seeks to detect mispriced securities and create perfectly hedged portfolios with zero net investment but non zero expected return. Therefore, in an efficient market, the expected returns implicit in the current price of the security should reflect available information including its risk which means that investors who buy at these informationally efficient prices should receive a rate of return that is consistent with the perceived risk of the stock. Individual analysts can make mistakes of judgment or estimation but where the mistakes made are independent, the consensus, which is the price reflected in the market, is the best possible. (Foster, 1984 and Beaver, 1981).

Efficient market hypothesis have been categorized into three major levels depending on the type of information assumed to be used the market in setting prices. The weak-form of the EMH states that the sequence of past price returns contains no information about future price returns. It assumes that current market prices already reflect all past returns and any other security market information, this implies that past rates of return and other historical market data should have no relationship with future rates of return. Therefore, this hypothesis contends that one should gain little from using any trading rule that decides whether to buy or sell a security based on past rate of return or any other past security market data (Reilly, 2006).

The semi strong form of EMH holds that security prices fully reflect all available public information. It asserts that security prices adjust rapidly to the release of all public information; that is, current security prices fully reflect all public information. The semi strong hypothesis encompasses the weak form hypothesis, because all the market information considered by the weak- form such as stock prices, rates of return and trading volume is public. This hypothesis implies that investors who base their decision on any important new information after it is public should not derive above average risk-adjusted profits from their transactions, considering the cost of trading because the security price already reflects all such new public information (Mishkin, 2007).

The strong form of the EMH states that the security prices reflect all the information available from both public and private sources, at each point in time. This means no investor, even where investor has insider information, he may not be able to device trading strategies based on such information to consistently earn abnormal returns. The levels of efficiency are nested. Strong-form efficiency implies semi-strong form of efficiency, and semi-strong efficiency in turn implies weak form of market efficiency. The empirical implications of efficiency with respect to a particular information set are that the current price of security embodies all the information in that set.

2.2.2 Random Walk Hypothesis

Random walk hypothesis postulate that successive price changes in individual securities are independent random variables. According to Fama (1965) and Kendall (1953) in a random walk market, stock prices fluctuate randomly around their intrinsic values, returns quickly towards the equilibrium and fully reflect the latest information available in the market. Although the price adjustments may be imperfect, it is unbiased; meaning that sometimes the market will over-adjust and other times it will under-adjust, but it cannot be predicted which one will occur at any given time.

The random walk theory presumes that information is freely and readily available and there are large numbers of competing rational profit maximizing participants with sufficient resources to take advantage of any profit opportunity arising from systematic price movements of an individual stock. Competition will cause the full effect of new information on intrinsic values to be reflected instantaneously in the actual prices and make all non random fluctuations so small that they cannot be exploited profitably; neither the technical analysis which study past stock prices in an attempt to predict future prices nor fundamental analysis which analyze publically available information to determine misprices stocks would enable investor to achieve returns greater than those could be earned on buy and hold strategy (Seelenfreud, 1968; Robert, 1959; Fama, 1970).

According to Bodie (2009), because security prices adjust to all new information the security prices should reflect all information that is publicly available at any point in time. The security prices that prevail at any time should be an unbiased reflection of all currently available information, including the risk involved in owning the security. The combined effect of Information coming in a random, independent, unpredictable fashion, numerous competing investors adjusting stock prices rapidly to reflect this new information means that one would expect price changes to be independent and random.

2.3 Empirical Literature

2.3.1 Market Anomalies in Stock Exchanges

Several easy accessible statistics for example a stock price- earnings- ratio or market capitalization seems to predict abnormal returns, such findings are difficult to reconcile with the efficient market hypothesis and are therefore often referred to as efficient market anomalies. Some researchers have documented these market anomalies that can be exploited to earn excess return. Such market anomalies include; Size effect, Price-earnings ratio prediction, January effect, momentum effect, Holiday effect, seasonal effect, calendar anomalies and weather.

Portfolios composed of low price to earnings ratio stocks often outperforms portfolios composed of high P/E ratio. Some researcher have hypothesized, based on the capital asset pricing model and other models relating risk to return, that the reason for this is because low P/E stocks have greater risk, and potentially greater returns. Basu (1977) revealed that portfolios of low price-earnings (P/E) ratio stocks have higher returns than portfolios for high P/E ratio stocks. Osano (2010) found portfolios for firms with low P/E achieved higher returns than portfolios with low P/E ratio at NSE. An interpretation of these results is that returns are not properly adjusted for risk. If two firms have the same expected earnings, the riskier stock will sell at a lower price and lower P/E ratio. Because of the high risk the low P/E ratio stock also have high expected return therefore unless the CAPM beta fully adjust for risk, P/E ratio will act as a useful additional descriptor of risk and will be associated with abnormal returns if the CAPM is used to establish bench mark performance.

The size effect refers to the negative relation between the stock returns and the equity value of the firm. Banz (1981) was the first to document this anomaly for U.S stocks. He found that on average annual returns for portfolios formed by small firms were consistently higher than the returns for portfolio formed by large firms. The coefficient on size has more explanatory power than the coefficient on the CAPM beta in describing the cross sectional of returns. The size effect has been reproduced for numerous sample periods and for different major security markets around the word (Hawawini and Keim, 2000). An investor can measure firm size at little cost and earn excess returns by exploiting simple rule such as investing in low capitalization stocks. One would not expect such minimal effort to yield large rewards in an efficient market.

It has been observed that stock of companies with high book-to-market ratios outperform low book to market ratios. Studies have shown that this effect seems to be independent of the stock beta, and therefore independent of the systematic risk. This effect could be explained by the fact that companies with low book to market ratio tend to be companies investors expect to grow rapidly. However, rapid growth continuously decline as companies grow larger. Fama and French (1992) showed that the ratio of book value of the firm's equity to the market value of the equity is a powerful predictor of returns across securities. They also showed that dependence of returns on book to market value ratio was independent of the beta suggesting that either high book to market value ratio firms are relatively underpriced or that the book to market ratio is serving as a proxy for a risk factor that affect the equilibrium returns.

Earnings announcement can have variable effect on stock prices. Sometimes stock prices go up until earning are announced, the decline on the news or they may decline before the announcement if the expectations are negative. Expectations are usually based on analysts' reports and their forecasts of future earnings. A fundamental principle of EMH is that any new information ought to be reflected in stock prices very rapidly. When the news are made public and there is earning surprise, the stock prices should jump up immediately. A puzzling anomaly

is the apparently sluggish response of stock prices to firms earning announcement (Ball and Brown, 1968).

Foster et al(1984) found that the more dramatics the earning surprise, the more the effect it had on stock prices, with positive surprise causing the stock prices to rise for up to two months after the announcement and negative surprise causing decline in stock prices within first several days of the announcement. Not only does this indicate that abnormal returns can be earned by simply watching earning announcement for surprise and respond quickly to them, but it also show that price changes are not as fast as EMH would imply.

January effect refers to the tendency for stock market returns to be higher in January than any other month (Rozeff and Kinney 1976). The January effect is particularly strong in small size stock (Kiem, 1983), but also present in large stocks. Kamau (2003) sought to establish if there was turn of the month and January effects on stock prices at the NSE during the period July 1995 to June 2003 using NSE daily closing prices. He found that it did not suffice. Keim (2000) and Reinganum (1983) showed that the small firm effect occur virtually in the month of January. According to Amihud and Mendelson (1989) Small firm stocks exhibit abnormally high risk adjusted returns because these firms are less analyzed and their stocks are less liquid. Liquidity effect might be a partial explanation of the abnormal returns. Arbel and Strebel (1983) gave another interpretation of small firms in January effect that because small firms tend to be neglected by large institutional traders, information about small firms is less available. This information deficiency makes smaller firms riskier investment that commands high returns. Neglected firms might be expected to earn higher equilibrium returns as compensation for the risk associated with limited information (Merton, 1987).

Researcher have documented momentum effect in stock prices; a tendency of poorly performing stocks and well performing stocks in one period to continues that abnormal performance in the following period. Jegadeesh and Tatman (1993) found that recent past winners out performed recent past losers. Momentum is found to be strong and highly significant but this is fundamental (Conrad and Kaul, 1988; Lo and Mackinlay, 1990). One needs to separate any anomalous momentum effect (unwarranted time series predictability) from the fundamental momentum effect (cross sectional dispersion effect and time varying risk premium), which may be very difficult. Lishenga et al (2011) documented returns of momentum strategies at NSE during the period 1997 to 2007. They found that expected profits are highly predictable for most of the trading strategies from the time series component.

Trading by a corporate insider can change the value of the firm's stock and the level of efficiency determines whether any insider or investor will obtain above normal returns as a result. Investment decision based on information on information that is not available in the general public either allows the insider to profit or avoid losses. The later was quite evident in the case of Uchumi supermarket where net worth investors disposed off a huge chunk of the firm's shares a few days before the supermarket was put on receivership and suspended from trading at the NSE. The ability of insider to trade profitably in their own stocks has been documented. Stock prices rise after insiders intensively bought shares and fall after intensive sales (Jaffe, 1974; Seyhum, 1986; Givoly and Polman, 1985).

Human Psychological behavior greatly influences stock prices. New information can elicit a frantic market, may cause an increase in stock prices and may make investors disregard rational valuation, preferring to buy the stock to ensure they are not left behind. Fear can cause

significant decrease in stock prices when investors rash for exit in an effort to avoid losses.

Some anomalies occur once and disappear while others occur repeatedly. While existence of anomalies is the stock market is generally accepted the question of whether investors can exploit them to earn superior returns is in the future is a subject that has been on debate. Proponent of the EMH, argue that it is unlikely that anyone could consistently profit from exploiting anomalies. The first problem lies in the need for history to repeat itself. Second, even if the anomalies recurred once trading costs and taxes are taken into account, profit could dwindle down or disappear. Finally any returns will have to be risk adjusted to determine whether trading rules on the anomaly allowed an investor to beat the market. Other the other o hand some researchers and investors argue that anomalies reflect inefficiencies within market which can be exploited to produce superior returns.

2.3.2 Predictability of Returns

A successful prediction of stock's future price would yield significant profit for predictor. Some market participants believes that stock price movements are governed by the random walk hypothesis and thus are unpredictable but others disagree and have a myriad of methods and technologies which purportedly allow them to gain future price information. The ability to predict stock price changes based on a given set of information lies behind the notion of market efficiency. Where the market efficiency is low, predictability of the stock price movement is high (Mobarek and Keasey, 2000).

Some researchers have obtained evidence in support of random walk hypothesis. This evidence has been found for different market and varying time horizons. Fama (1965) carried out a study on the behavior of stock market prices. He computed serial correlation coefficient and carried out run test in daily price changes of 30 stocks that comprised the Dow Jones industrial average index. He found that the serial correlation coefficient for successive price changes were extremely close to zero; the average for absolute coefficients was 0.026. He also found that the number of actual runs of successive price changes was not significantly different from the expected number of runs. He concluded that daily price changes were independent from previous changes.

Kendall (1964) examined the temporal dependence of UK industrial share prices. He used weekly data for eighteen industries and one composite U.K. stock market indices over the period 1928 to 1938. He could not identify share price trends. There was neither significant correlation between one period's price changes and the previous period change, nor with the price changes of the earlier periods.

Roberts (1959) provided evidence of the random walk on Dow Jones industrial average. He argued that security price changes fully reflect the available information set which include all public information, and that suggested that stock market prices were indistinguishable from a series of cumulated random numbers.

Dickson and Muragu (1994) examined the informational efficiency and random walk hypothesis on the Nairobi stock exchange using serial correlation and run test. He first created a data base of weekly share price lists for the period January 1979 to December 1988 and selected thirty most actively traded companies as measured by the number of transaction price observations. Using the weekly data, He computed serial correlation coefficient for each of the thirty companies for lags of 1 to 30 weeks. Results from individual serial correlation coefficient indicated that

majority of them were not statistically different from zero at 5% level of significance. These results were robust for both weekly and monthly returns. The few significant correlations were seen to be small in absolute values with very little explanatory power.

On run test, the actual number of runs was less than expected number of runs in 14 companies; the actual number of runs exceeded the expected number of runs in 14 companies. In 2 companies actual and expected number of runs was equal. He suggested that with proper control over the quality of data and the use of a large number of data observations the random walk model can be a good description of successive price returns in Nairobi stock exchange.
Githiga (2008) tested the independence of successive weekly average price returns 16 stocks trading at the Nairobi stock exchange over the period 2003 to 2007. He examined the serial correlation between an observation and the lagged observations. He found that autocorrelation coefficient was less than 0.5 but greater than -0.5 throughout the period; no significant correlation between one observation and the lagged. He concluded that price returns at Nairobi stock exchange are independent and one cannot predict future prices based on the past price trends.

Anyumba (2010) tested whether NSE indices follows random walk. She assessed Variance ratio of NSE- 20 share index and Nairobi stock all share index (NASI) for the period March 2004 to April 2009. He found that NSE- 20 share weekly and monthly indices and weekly NASI were unpredictable but monthly NASI was predictable in some case.

Random walk hypothesis has been challenged by increasing number of studies that suggest that stock returns are not fully explained by common measures of risk, and other studies that have documented returns predictability across a variety of time horizons. Grossman (1976) and Grossman and Stiglitz (1980) argue that perfectly informational efficient markets are impossibility. If markets were perfectly efficient, there would be no return for gathering information as such little or no reason to trade and markets would eventually collapse. Other word the degree of market inefficiency determines the effort investors are willing to expend to gather and trade on information; hence non-degenerate market equilibrium will arise only when there are sufficient profit opportunities, i.e., inefficiencies, to compensate investors for the costs of trading and information-gathering.

Leroy (1973) and Lucas (1978) argued that the random walk hypothesis is neither a necessary nor sufficient conditions for rationally determined security prices; unforecastable prices need not to imply a well functioning financial market with rational investors and forecastable prices need not to imply the opposite. Various anomalies have been identified relating to calendar periods such as those across weekends and turn of the year. Variable such as market-to-book ratio and size have been shown to explain expected return.

Lo and Mackinlay (1988) tested the predictability of stock market return for U.S. market using single variance ratio test methodology. They used 1216 weekly observations from September 6, 1962 to December 26, 1985. Weekly stock return were derived from the centre for research security price return index (CRSP) table and performed test on both equal and value weighted CRSP indexes. They found that the first order autocorrelation for weekly returns was approximately 30 percent. There was positive autocorrelation for weekly holding period returns. The average variance ratio for individual security was less than a unity implying that there was negative serial correlation on average but statistically insignificant. They claimed that the random walk hypothesis was not valid for weekly stock market returns. For individual securities

they argued that returns contained much company specific noise that made it difficult to detect the presence of predictable component. They concluded that the result did not necessary imply the inefficiency of stock price formation.

Sweedey (1988) extended Fama and Blume (1966) study. He examined fifteen Dow Jones stocks which Fama and Blume had found filter rule, earned excess returns over buy and hold strategy. He found that fourteen of these fifteen stocks still produced excess return. These returns exceeded the commission level of some floor brokers and concluded that filter rules could be use to generate profit, however this profit is sensitive to transaction cost and bid- ask spread.

Jegadeesh (1990) examined the predictability of monthly returns on individual securities at the new Yolk stock exchange over the period 1934 to 1987. He obtained security returns data from the center for research in security monthly return file. Regression model was fitted separately for each month using the OLS procedure and obtained parameter estimates and test statistics. He found highly significant negative first order serial correlation in monthly returns and significant positive high order serial correlation. He denoted that predictability of stock returns can be attributed either to market inefficiency or to systematic changes in expected returns. He enlightened that the models of time varying expected returns considered in his test were not able to satisfactory the empirical regularity.

Parkinson (1984) examined the weak form of efficiency in Nairobi stock exchange over the period 1974 to 1984 using autocorrelation test and run test. He used monthly price data for 50 stocks that were listed on the NSE over the 5 years period of the study. He found that majority of the stocks had negative autocorrelation coefficient. Out of the 50 stocks 11 has first lag serial correlation greater than 0.3. On run test the actual runs were less than expected in 49 out of the 50 stocks. He concluded that there were noticeable patterns of share price and thus random walk was not a valid description of the share price changes of the Nairobi stock exchange.

Kiio (2006) examined the efficiency of the Nairobi stock exchange at the semi strong level by looking at the speed of adjustment of share prices on cash dividends announcement over the period 2000 to 2004. She used daily data for the stocks that constituted the NSE 20 share index. The event of her study was cash dividends announcement. The event window was 21 days; the date of the announcement and 10 trading days before and after announcement in order to capture the reaction over the period. She found that there were negative returns before the announcement date and positive returns after the announcement date. Cumulative adjusted excess return was significant for 10 days before and after the announcement of cash dividend. She concluded that although dividend announcement has impact on share prices at the NSE, the market does not efficiently react to cash dividend announcement in price adjustments.

Kamaruci (2003) examined the relationship between the accounting earnings and share prices using weekly data for 53 publically quoted companies at Nairobi stock exchange over the period 1996 to 2001. He examined the relationship between percentage changes in price and concurrent percentage change in earnings. He used cross tab to determine if an earlier positive change was followed by an increase in earning and if negative change in share prices was followed by a decrease in earning. He found that 60.38% of the companies had their share prices moving in the same direction with the earning.

Ngugi (2003) argued that when information disclosure is minimal, say at the firm level, investors assume the worst and therefore discount the price of shares heavily. Firms are therefore driven to disclose information because its news would not be worse than the market would assume. As a

result, prices will be less noisy and therefore more accurate, increasing the trading activities with enhanced ability to transact at current prices.

Market analysts are diametrically opposed to the notion of efficient market which content that past performance has no influence on future performance. Technical analysts argue that prices gradually adjust to new information and believe that nimble traders can develop systems to detect the beginning of a movement to a new equilibrium. Hence, they hope to buy or sell the stock immediately after its break out to take advantage of the subsequent, gradual price adjustment.

According to Jensen and Bennington (1978), technical analysis is based on three assumptions. The first assumption is that market prices discount all information; this means that everything that is known and relevant to security price at any given time is reflected in the security price. Therefore all present information relevant to the price of a security is already discounted. If any new information comes out the market will immediately factor it into account after which the information will no longer be relevant to the process of forecasting.

The second assumption is that market prices move in trends which persist over a period of time; this implies after a trend has been established, the future price movement is more likely to be in the same direction as the trend. Market prices react slowly and overlong period to new information and the reaction is so slow that one needs not be concerned with the information itself but direction in which prices are moving since when price move in a particular direction whether up or down it will continue to trend. Third assumption is that history tends repeats itself; the repetitive nature of price movement is attributed to market psychology. In other words market participants tend to provide a consistent reaction to similar market stimuli overtime. In a market increasingly driven by market psychology, fundamentals take a back seat to technical analysis as reliable approach in predicting where the market will go next.

The key to successful technical analysis is a sluggish response of stock prices to fundamentals of supply and demand. This prerequisite is diametrically opposed to the notion of efficient market which content that past performance has no influence on future performance Reilly and Brown (2002). According to Jansen et al (2006) much of criticism of technical analysis is rooted in academic theories, specifically EMH but ignores the way market works; in that many investors base their expectations on past earning and track record. Future stock prices can be strongly influenced by investors' expectations; it follows that past price influence future price.

Fundamental analysts hold the view that by using publically available information, it is possible to determine the real (intrinsic) value of a security. To forecast future security prices, fundamental analyst combines economic, industry, and company analysis to derive a stock's current fair value and forecast future value. If fair value is not equal to the current stock price, fundamental analysts believe that the stock is either over or under valued and the market price will ultimately gravitate towards fair value and as consequence they changes their portfolio position. Fundamentalists neither heed the advice of the random walkers nor believe that markets are efficient. But believe that prices do not accurately reflect all available information and seek out perceived price discrepancies to exploit them.

Fundamental analysts use earnings and dividends prospects of a firm, expectation of future interest rates and security prices to determine the present discounted value of all cash flows a security holder will receive from each unit of security Reilly and Brown (2000). Only those

analysts who identify firms that a better than everyone else estimate or poorly run firms that are not as bad as their stock prices suggest will be rewarded. The insider dealers believe that they can hedge on price sensitive information which is not in the public domain for companies issuing securities to increase expected gains.

Follower of efficient market hypothesis however disagrees with both the fundamental and technical analysts; the EMH content that it is essentially impossible to beat the market in the long run i.e. produce returns that outperform the market through fundamental or technical analysis Fama (1976). The rationale for this argument is that since the market efficiently prices all securities on ongoing basis any opportunity for excess returns, derived from fundamental or technical analysis would be almost immediately withered away by the markets' many participants making it impossible for anyone to meaningfully outperform the market over the long term.

2.4 Predictability of Stock Prices at the NSE

According to Pesaran (2003) examples of possible market predictors are past changes in the macroeconomic variables such as; interest rates, inflation, dividend yield, price earnings ratio, output growth and the term premium. Efforts to develop models that could be used to predict share prices at the NSE have produced varying and sometimes conflicting findings.

Akwimbi (2003) Explored the relationship between stock return for companies listed at NSE and some selected market and industrial variables using arbitrage pricing model(APT) .He applied regression method on security monthly returns and economic indicators on 39 companies trading at NSE over the period 1995 to 2002. His results suggested that a multi index APT using selected economic and industrial variables such as interest provides additional power in explaining the variability of the NSE stock returns over a single index model using the market index alone. It is therefore noted that the inclusion of economic variable to large extent improve the explanation of the cross section of expected returns.

Olweny (2011) conducted a study to establish the reliability of the dividends discount model on valuation of common stock at the NSE. He studied 18 companies trading only on ordinary share over the period 1995 to 1999. He compared predicted share prices with the actual prices. Using t- test he tested for significance in the price differences. He found that only 3 companies showed differences were significant. He concluded that the dividend discount model was not a reliable in the valuation of stock at the NSE. A similar study was done on 13 companies listed at the NSE over the period 1983 to 1988 by Kerandi (1993). She aimed at determining predictive ability of the dividend valuation model on ordinary share prices. The model postulated by William (1938) and Gordon (1962) was found not to be a good predictor of the stock prices at NSE. The model could only predict 54% of the ordinary share prices for companies listed at the NSE.Omosa (1989) studied the predictability of selected assets pricing model on the NSE. She used the box - jecking model, time series analysis and the ARIMA model and found that all did not qualified to be good predictor of the share prices.

Osano (2010) studied the extent to which price to earnings ratio and price to book value ratio in the NSE can predict share returns. He used daily prices for companies that traded continuously over the period 1998 to 2007. Price to earnings ratio and price to book for the firms were computed for the period 1998 to 2002 for testing their predictive ability in the subsequent years 2003 to 2007. He formed two portfolios; one for those firms with high valuation multiple and the other for those firms with low valuation multiple ratio. Two sample paired t-tests were used to

test if there was significant difference between the average returns for the two portfolios. He found that the portfolio for the firms with low P/E and P/B ratio performed significantly better and achieved higher returns than the portfolios with low P/E and P/B ratio. He further used coefficient of variation (CV) to measure performance. He found that portfolio firms with low P/E ratio had the lowest CV followed by portfolio for the firms with low P/B ratio. Worst performance was for portfolios for firms with high P/E and P/B. He concluded that those valuation multiples can be used to measure or predict stock returns.

Macharia (2002) had tested the extend of predictive ability of P/E ratio using a sample fourteen companies trading at the NSE over the period 1996 to 2002 and a predictive regression model. He found that P/E ratio has a predictive ability of share prices at the NSE. Ndung'u (2003) found that it is possible to predict the stock price at the NSE by referring on the company size as measured by the outstanding shares. He use weekly returns for the period 1996 to 2002 to compute the excess returns under the capital asset pricing model (CAPM) assumptions of linear relationship between security's expected return and its risk. Through his study he showed a weak firm size effect on stock return.

Okello (2006) studied the 20 companies constituting the NSE 20 share index for three years from 1990 to 2002 to determine the profitability of filter rule test in the NSE. Using the filter rule developed by Fama and Blue (1966) he found that the filter rule exist in NSE and with a filter of between 4.3% and 4.9% investors can profit in the market. The filter rule trading strategies attempts to profit from serial dependencies in the stock return and states that an investor should buy when stock price rise by a given percentage above its local low and sell when it falls by a particular percentage below its past local high.Dickson and Muragu (1994) studied the weekly price movement at NSE using traditional random walk methodology of serial correlation and run test as applied by Fama (1965) and Cooper (1982) and found that stock prices follow a random walk. Muragu (1990) had done a similar study and found that with proper control random walk holds for NSE.

2.5 Summary

Much of studies on EMH and RWH have been carried out in the developed markets and there is consensus among researchers that these markets are efficient and security price returns follow random walk. On the other hand not much is documented and the consensus seems to break down when the study is extended to emerging market in general and NSE in particular where some studies suggest that stock price returns are predictable, others give a contrary suggestion that stock price returns are unpredictable and follow a random walk. There have been scores of studies that have documented long term historical anomalies in the stock market that seem to contradict efficient market hypothesis and random walk hypothesis. While the existence of anomalies is generally accepted, the question of whether investors can exploit them to earn superior returns in future is a subject of debate. Investors evaluating should keep in mind that although they have existed historically, there is no guarantee they will persist in future. In addition transaction cost and tax may prevent outperformance in future.

Many of previous studies conducted their analysis based on conventional techniques such as autocorrelation and variance ratio test which may not be always appropriate. The main problem with these methods is that they assume that stock returns are normally and linearly distributed. They used indexes, weekly or monthly observations; such observations may give a completely false impression of the extent of price volatility especially in highly volatile stock market.The literature review has indicated that existing empirical evidence is not clear cut in support for

random walk hypothesis at NSE. Empirical studies have resulted to mixed and conflicting finding.

RESEARCH METHODOLOGY

3.1 Introduction

This section presents the research methodology of the study. The chapter is structured as follows; Section 3.2 is a description of the research design used. Section 3.3 presents the population of the study. Section 3.4 explains the study sample and how it was arrived at. Section 3.5 outlines the procedure used in collecting data. Section 3.6 presents methods used to analyze the data.

3.2 Research Design

This is an empirical study testing whether successive daily price changes of stocks trading at the NSE are independent and hence produce a random walk sequence. The design was adopted as it allows collection of large amount of data from the target population. This design is useful in studying the randomness of stock price returns to test whether they exhibit random walk behavior. The data consists of past series of stock prices for 20 companies whose shares formed the NSE- 20 share index over the period July 2008 to June 2011. Serial correlation test and runs test were used test for independence of successive price series.

3.3 Population

The population of the study comprises all the companies quoted at the NSE

3.4 Sample

The sample consists of 18 companies that continuously constituted the NSE 20 share index and traded for a period of three years from July 2008 to June 2011. To arrive at the sample twenty companies that comprising the NSE-20 share index were selected and any company that did not constitute the NSE- 20 share index at any time over the study period was dropped. In June 2008 NSE announced that Equity bank had replaced Diamond trust bank in the Finance and investment sector, East Africa cables had replaced Sameer limited and Athi River mining had replaced Total Kenya in the industrial and allied sector, Safaricom Ltd had replaced TPS Serena in the commercial and services sector. In December 2009 Cooperative bank replaced Centum investment and in October 2010 East Africa cables was replaced by Kenol Kobil.

3.5 Data Collection

Studies in stock markets rely heavily on historical quantitative data. The data consists of series of daily stock prices for companies that constituted the NSE- 20 share index over the period July 2008 and June 2011. Secondary data was obtained from the Nairobi stock exchange library. Share price used in the study were obtained from the NSE information services historical database. The NSE information services historical database is a reliable source of data for shares price trading at NSE.

The use of a series of the daily closing prices of a single stock ensures that one is examining an understandable and clearly defined market. In addition daily price observations illustrate reactions to easily available information and inter observational data of fundamental importance that wider interval observations such as weekly or monthly cannot reflect. In this study NSE–20 share index is included for the sake of comparison.

3.6 Data Analysis

There has been some controversy in the literature as to what is the underlying probability

distribution of price changes. The most popular view is that it is a lognormal. This view is based on the observation that prices are bound from below but unbound from above. In this view it would be necessary to study logarithm of price changes and parametric test used since population is assumed to be normally distributed. To stand aside from the controversy one would use non parametric tests. However non parametric tests tend to be less efficient than parametric test. In this study data was subjected to a series of different tests; parametric and non parametric tests. Independence of share price returns was tested using the following tests; serial correlations test (also known as auto correlation) and run test. Data processing was done using statistical package for social sciences (SPSS) and Microsoft excel.

3.6.1 Serial Correlation Tests

This is a mathematical representation of the degree of similarity between a given time series and a lagged version of itself over successive time interval. If random the auto correlation should be near zero for any and all time lag separation. If non random at least one auto correlation will be significant non zero.

Step1 Computing the natural logarithm returns difference (μjt)

$\mu_{jt} = lnP_{jt} - lnP_{jt-k}$

Step 2: Computing the auto correlation coefficient

The auto correlation coefficients are computed for each stock across 5 lags as follows;

$$\Upsilon_{jk} = \frac{COV(\mu_{jt}, \mu_{jt-k})}{VAR(\mu_{jt})}$$

Where Υ_{jk} is auto correlation coefficient of security j at lag k; k= 1, 2,…, 5

The statistic is used to test for the presence of both positive and negative correlation in the natural logarithm returns residual.

Step 3: Testing the hypothesis

H0: Υ_{jk} = 0, the correlation coefficient of successive price returns on the NSE at lag k is zero.

H1: Υ_{jk} <> 0, there correlation coefficient of successive price return on the NSE at lag k is not zero.

According to Chatfield (2004) if the time series is completely random and the sample size is large the lagged correlation coefficient is approximately normally distributed with mean zero and Variance 1/N. It follows that the critical level of the correlation for 95% significance (α = 0.05) is $\Upsilon_{0.95} = \pm\frac{2}{\sqrt{N}}$

Where, N is the sample size.

Region of acceptance and rejection of the null hypothesis		
$\Upsilon_{jk} < -\Upsilon_{0.95}$	$-\Upsilon_{0.95} \leq \Upsilon_{jk} \leq +\Upsilon_{0.95}$	$\Upsilon_{jk} > \Upsilon_{0.95}$
Reject H0: Negative autocorrelation	Accept H0: No autocorrelation	Reject H0: Positive autocorrelation

3.6.2 Run Test

Siegel (1956) defined a run as a succession of identical symbols which are followed or preceded by a different symbol or no symbol at all. To test whether the sequence of observed series of share price returns is a random sequence, the number of runs observed in a series is used.

Step1 Compute the sequential difference

Compute the changes in successive stock prices.

$$\Delta P = P_t - P_{t-1}$$

Step 2 Determination of runs in the price series.
The series of changes are replaced by a series of symbols: a plus when price change is positive, Minus when price change is negative and zero when there is no change in price.
The total number of runs of the price changes will serve as an indicator of degree of randomness of the sample. In a series of security price changes, either very few or very many runs are unlikely if such security price changes are truly random over time. Clustering of symbol is an indicator of a trend. To test a series of price (returns) changes for independence, the number of runs in the series is compared to see whether it is statistically different from the number of runs in a purely random series of the same size.
Step 3 Compute of test statistic
Expected total number of runs is given by;

$$Mean = \frac{N(N+1) - \sum_{i=1}^{3} n_i^2}{N}$$

$$Standard\ deviation = \left[\frac{\sum_{i=1}^{3} n_i^2 \{\sum_{i=1}^{3} n_i^2 + N(N+1)\} - 2N\sum_{i=1}^{3} n_i^3 - N^3}{N^2(N-1)}\right]^{\frac{1}{2}}$$

$$z - score = \frac{R + 0.5 - M}{\sigma_m}$$

Where
N = Total number of price changes
ni = Number of price changes of each kind (plus, minus, zero)
R =observed number of runs
σm = standard deviation
m =Mean
Hypothesis
H0: The successive price returns of a company's shares on the NSE are random.
H1: The successive price returns of a company's shares on the NSE are not random.
Step 4 Compare Z score calculated with the Z tabulated in the table
The expectation under this test is that the standard (Z) score obtained fall between the ranges of -1.96 and +1.96. It is when this happens that the successive price changes are said to be random.

Region of acceptance and rejection of the null hypothesis		
$z - score < -1.96$	$-1.96 \leq z - score \leq +1.96$	$z - score > +1.96$
Reject H_0	Accept H0	Reject H0

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This section presents results of the analysis and finding of the study with reference to the objective of the study. The chapter is organized as follows; Section 4.2 gives summary statistics. Section 4.3 provides results of the data analysis and it includes relevant tables that help to explain the results of the analysis.

4.2 Summary Statistics

Using natural logarithm return difference of daily stock prices serial correlation coefficients have been computed for each of the 18 companies and NSE 20 share index for lags of 1 to 5 days. The computed correlation coefficients are to be used to test independence of successive price returns at individual lag. The null hypothesis is that there is no significant correlation. At 5% level of significance the successive price returns are independent if the correlation coefficient at all lags lie between $-\frac{2}{\sqrt{N}}$ and $+\frac{2}{\sqrt{N}}$, where N is the number of return observation.

Runs test was conducted for the 18 company's daily stock prices and the NSE 20 share index. The results of runs test are used to test randomness of successive price returns. The null hypothesis is that successive price returns of a company's shares are random. At 5% level of significance, the computed test statistics (Z-score) is significant if it fall beyond the critical values of -1.96 and +1.96.

4.3 Results of the Data Analysis

The empirical results are classified in accordance with the different statistical techniques used. The findings of individual statistical technique are discussed in each subsection below.

Table 4.1: Correlation Coefficients for Daily Stock Price Returns Sequences at Lag 1, 2,3,4,5.

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Average	No. of SCC.
Rea Vipingo	-0.447	0.043	-0.023	-0.021	0.006	-	1
Sasini Ltd	-0.340	0.024	0.017	0.014	0.009	-	1
CMC Holdings	0.138	0.054	-0.013	-0.091	-0.030	0.011	2
Kenya Airways	0.175	-0.017	-0.039	0.000	0.032	0.030	1
Nation Media	-0.409	0.024	0.018	-0.005	-0.002	-	1
Safaricom Ltd	0.142	0.030	0.019	-0.038	-0.033	0.024	1
Barclays Bank	0.023	0.027	0.015	-0.011	-0.013	0.008	0
Equity Bank	0.001	-0.033	-0.022	-0.018	-0.021	-	0
Kenya	0.256	0.065	0.006	-0.106	-0.085	0.027	1
Standard	0.111	0.029	-0.007	-0.010	-0.080	0.008	2
Athi River Mining	-0.078	0.051	-0.004	-0.050	0.003	-	1
Bamburi Cement	-0.493	0.008	-0.011	0.005	0.005	-	1
British American	-0.151	0.025	-0.006	0.039	0.006	-	1
East African	0.207	0.237	0.099	-0.066	-0.053	0.084	3
KenGen	-0.206	0.095	0.002	-0.006	0.009	-	2
KPLC	-0.273	-0.003	0.040	-0.012	0.021	-	1
Mumias Sugar	0.110	0.016	-0.109	-0.367	-0.015	-0.073	3
Express Kenya	-0.192	-0.078	0.065	-0.038	0.022	-	2
NSE 20 Share	0.497	0.002	-0.002	0.006	-0.006	0.099	1

Significant if |Correlation|> 0.07303

4.3.1 Results of the Serial Correlation Test

The summarized results of the serial correlation coefficients are presented in table 4.1. The table shows the serial correlation coefficients at lag 1,2,3,4 and 5. These values measure the relationship between the prices return at given period and price returns in previous periods. A positive serial correlation suggests a tendency for prices returns rise in one period to have been followed by a further rise in the next period. A negative serial correlation suggests a tendency for prices returns fall in one period to have been followed by a further fall in the next period.

At lag 1, 9 companies have negative serial correlation and 9 positive serial correlations. 16 out of the 18 companies have absolute serial correlation between 0.078 and 0.493 (Rea Vipingo, Sasini Ltd, CMC Holdings, Kenya Airways, Nation Media Group, Safaricom Ltd, Kenya Commercial Bank, Standard Chartered Bank, Athi River Mining, Bamburi Cement, British American Tobacco, East African Breweries, KenGen, KPLC, Mumias Sugar Company, Express Kenya Ltd). These values are statistically different from zero at 5% level significance. The NSE index has positive serial correlation (0.497) which is also statistically different from zero at 5% level of significance. This means at lag 1, we can reject the independence hypothesis for 16 out of 18 companies and also for NSE 20 index at 5% level of significance.

At lag 2, 4 companies have negative serial correlation and 14 positive serial correlations. Only 3 out of 18 companies (KenGen, East African Breweries and Express Kenya Ltd) have serial correlation coefficient statistically different from zero at 5% level of significance. The NSE index has positive (0.002) which is not statistically different from zero. At lag 2 we fail to reject null hypothesis for 15 companies and also fail to reject null hypothesis for NSE 20 share index.
At lag 3, 9 companies have positive serial correlations and nine negative serial correlations. Only values for 2 companies (East African Breweries and Mumias Sugar Company) are statistically significant from zero at 5% level of significance. We fail to reject null hypothesis for 16 companies. The NSE index has a negative serial correlation (-0.002) which is not statistically significant from zero and thus we fail to reject null hypothesis.

At lag 4, the serial correlation is negative for 14 companies and positive for 4 companies. Only three values are statistically significant from zero and thus we fail to reject null hypothesis for 15 companies. The serial correlation coefficient for NSE index is -0.006 which is not significant from zero and therefore fail to reject null hypothesis. At lag 5, only 2 companies with statistically significant serial correlation and there fail to reject null hypothesis for 16 companies and the NSE index. Generally we failed to reject the independence hypothesis at lag 2, lag 3, lag 4 and lag 5.

Majority of the individual serial correlation coefficients [66 out of 90 (73%)] are not statistically different from zero at the 5% level of significance. The number of significant coefficients across the 5 lags for each company is shown in the last column of table 4.1. At 5% significance level, no statistically significant coefficients are indicated for 2 out of 18 companies at any lag. 10 companies have only one significant coefficient. 4 companies have two significant coefficients and 2 companies have three significant coefficients.

The significant coefficients imply dependency of price return series. The results indicate predictability of share returns from the immediate previous period information which violates the assumption of the random walk model. Future price returns can only be predicted from lag 1 price return values. Higher lags values cannot be used to predict future price returns.

Table 4.2: Runs Tests Results

	Total Number of Obser	Negative		Positive		Zero		Expected Number	Actual Number	Z-Score
		Number of	Number of	Number of	Number of	Number of	Number of			
Rea	756	268	178	248	165	240	144	504	487	-1.30
Sasini Ltd	756	310	168	306	170	140	106	480	444	-2.76
CMC	756	305	173	292	175	159	121	487	469	-1.41
Kenya	756	306	156	260	136	190	132	495	424	-5.53
Nation	756	253	165	246	163	257	156	504	484	-1.57
Safarico	756	257	151	218	145	281	150	502	446	-4.30
Barclays	756	269	145	259	151	228	138	503	434	-5.33
Equity	756	288	138	285	140	183	116	495	394	-7.81
Kenya	756	256	148	250	143	250	152	504	443	-4.87
Standard	756	259	168	272	167	225	154	503	489	-1.07
Athi	756	231	161	277	170	248	129	503	460	-3.31
Bamburi	756	188	145	197	154	371	168	476	467	-0.75
British	756	204	156	240	175	312	154	497	485	-0.89
East	756	258	145	262	150	236	148	504	443	-4.69
KenGen	756	314	161	284	151	158	120	486	432	-4.07
KPLC	756	287	174	236	144	233	143	502	461	-3.16
Mumias	756	321	153	267	147	168	119	489	419	-5.41
Express	756	234	182	198	153	324	157	493	492	-0.11
NSE 20	756	397	146	335	135	24	23	399	304	-7.11

Significant if -1.96< computed Z score <1.96

4.3.2 Results of the Runs Test

The results of the runs test are presented in Table 4.2. Negative runs shows decrease in price returns. Cluster of negative price returns or long negative runs corresponds to a down ward trend. Fourteen out of the eighteen companies have average length of two minus sign for negative runs and four have average length of one negative sign. NSE index has average length of three negative signs for negative runs. This indicates that there were short terms down ward trends in prices returns and the NSE index.

Positive runs show increase in price returns. Cluster of positive price returns result or long positive runs correspond to upward trend. 15 out of the 18 companies have positive runs of average length of 2 positive sign and 3 have positive runs of average length of 1 positive sign. NSE index has average length of 2 positive signs for each positive run. This indicates that there were short terms upward trends in prices returns and the NSE index. 12 companies have runs of zeros of average length of 2 and 6 companies have runs of zeros of average length of 1. The NSE index has runs of zeros of average length of 1. The price return sequences were moving up and

down along the zero return line in zigzag (not random). Sometime the sequence would move several steps down ward or upward.

Expected number of runs is the number of runs in a purely random series of the same size as our price series. The total number of runs observed serves as indicator of the degree of randomness of the sample. Too few runs, too many runs or a run of excessive length suggest dependence between observations and are unlikely in a truly random sequence. A lower than expected number of runs indicates market's overreaction to information, subsequently while higher number of runs reflects a lagged response to information. Either situation would suggest an opportunity to make excess return (Poshokwale, 1996). To test a series of price returns for independence, the observed number of runs in the series is compared to see whether it is statistically different from the number of in a purely random series of the same size. When the expected number of run is significantly different from the observed number of runs, the test reject the null hypothesis that the daily price returns are random.

The run test converts the total number of runs in to a Z statistic. For large sample the Z statistics gives the probability of difference between the actual and expected number of runs. When successive price changes are independent the Z value is expected to fall between the range of -1.96 and +1.96. In this case we fail to reject the null hypothesis at 5% level of significance. A Z value greater than +1.96 or less than -1.96, reject null hypothesis at 5% level of significance. A Z value less than -1.96 means that the observed number of runs is less than the expected, when greater than +1.96 means that the observed number of runs is greater than expected.

All computed Z values are negative implying that the observed number of runs is less than expected number of runs. The Z value is less than -1.96 for eleven out of the eighteen companies. The Z value for the NSE 20 share index is less than -1.96. This means that we reject the randomness hypothesis for 11 companies and the NSE 20 share index at the 5% significance level. Four companies have the Z value close to – 1.96.

4.4 Summary of the Findings

The aim of the study was to investigate whether stock price returns on the Nairobi stock exchange depict a random sequence. The analysis for daily price returns over the period July 2008 and June 2011 have given interesting results in that, nine companies with significant correlation coefficients at lag 1 also have significant Z value. Seven companies with significant correlation coefficient at lag 1 have Z values that are not statistically different from zero. Two companies with lag 1 correlation coefficients that are not significant have significant Z values. None of the eighteen companies with both lag 1 correlation coefficient and the Z value being statistically insignificant at 5% level. The correlation coefficient and Z value for NSE 20 share index are both significant. Results for both serial correlation coefficients test and the runs test indicate rejection of the null hypothesis implying that the price return sequence is not randomness sequence.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This section gives the summary, conclusion and recommendations from the study. Section 5.2 gives the summary of the study. Section 5.3 presents the conclusions to the study. Section 5.4 presents limitations of the study. Section 5.5 provides recommendation for further research and section 5.6 presents policy implication.

5.2 Summary of the Study

This study attempted to answer the following question; Are successive share price returns on the Nairobi stock exchange independent random variables so that the price return cannot be predicted from historical price return. Serial correlation test and run tests were used test for independence of successive price series. Historical price series for 18 companies, whose shares consistently constituted the NSE- 20 share index over the period July 2008 to June 2011, was used.

This study answered the question by testing the following null hypotheses: H0: γ_{jk} = 0, the correlation coefficient of successive price returns on the NSE at lag k is zero. The hypothesis was tested by using serial correlation coefficient. The result of this study show that during the period July 2008 to June 2011, there were significant correlations between stock prices and their lag 1 observations, the absolute correlation coefficient was found to lie above 0.0730. The average serial correlation coefficients of the companies across the 5 lags were small in magnitude. Results indicate that majority of the correlation coefficients at lag 1 were statistically different from zero at 5% level of significance. For all other lags, (lag 2, 3, 4, 5) majority of the coefficients were not statistically different from zero and the few significant coefficients were small in magnitude. The results based on correlation coefficients at lag 1 indicate that they were not consisted with the independence hypothesis.

The second null hypothesis tested to answer the question: H0: The successive price returns of a company's shares on the NSE are random. The hypothesis was tested using the run test. The results of the run test indicate that the prices series of the majority of the companies were non random. Observed number of runs was fewer than the expected number of runs in all cases. All the Z scores were negative and significant for 11 out of the 18 companies. The computed Z values were less that – 1.96 for the 11 companies.

IMPLICATION TO RESEARCH AND PRACTICE

This research is of great importance to the Stock Exchange firms, specifically Nairobi Stock Exchange market. The NSE can make use of this method to determine stock prices at any time.

CONCLUSION

The results of the study show that stock prices were not fluctuating randomly during the study period. The significant correlation coefficients between stock price series and their first lag version indicated that stock prices could be predicted from the previous day's prices. The results for both correlation coefficients and runs tests were not consistent with random walk and thus the two null hypotheses; the correlation coefficient of successive price returns on the NSE at lag k is zero and the successive price returns of a company's shares on the NSE are random were rejected. The empirical results of this study confirm the previous research finding for both serial correlation and runs test (Parkinson; 1984). Parkinson found significant results for both serial correlation coefficients and the runs test which were not consisted with the randomness of prices series.

The conclusion of this study implies that an investor is capable of outperforming the market if he uses the information contained in the past prices of stocks. In addition the market cannot be taken to be a reliable price setter. The evidence provided here support the notion held by the stock market administrators and regulators that the market is not a reliable price setter and that it is easy to manipulate the market unless controls are hold.

7.1 limitations of the Study

The major limitation of the study was the missing data for some stocks on various days. The previous stock price was taken to be the price for the missing values. In addition lack of well designed database capturing prices in one work sheet meant that a lot of time was taken to set up the database.

RECOMMENDATION FOR FURTHER RESEARCH

What will be the appropriate investment strategy for investors in the Nairobi stock exchange and how market inefficiency influences investor's choices of investments are issues worth researching.

A research can be done to establish whether there are active trading rules that to be used to outperform the market since significant coefficients may not be material enough to attract profitable trading opportunities from an investment point of view, given the level of transaction costs. The nature of the underling distribution of returns at the NSE should be investigated.

POLICY IMPLICATIONS

The implication of these results is that the Nairobi stock exchange appears to be inefficient market, suggesting that the opportunity to make excess returns exist which investors and market analysts can exploit. Rejection of random walk hypothesis imply that investors cannot adopt a 'fair return for risk' strategy', by holding a well diversified portfolio while investing in the Nairobi stock exchange.

Policy makers need to re look at the pricing mechanisms of the exchange since it may be unreliable price setter at least to the extent of using past price information hence need to make necessary structural reviews geared towards achieving fair value pricing of securities in the exchange. There is need to establish sufficient prudential policy measures, supervision and regulatory framework for the activities of the exchange and companies trading in the exchange.

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