Tests of Random Walk and Efficient Market Hypothesis in Developing Economies: Evidence from Nigerian Capital Market

AGBAM, AZUBUIKE SAMUEL
Department of Finance and Banking
University of Port Harcourt, Choba, Nigeria.
E-mail: azubuikesamuelagbam@yahoo.com
asagbam@gmail.com

ABSTRACT
Stock exchange markets play a critical role in the 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 the 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 in Nigeria Stock Exchange follow a random walk model so that the price return cannot be predicted from historical price returns. The study employed serial correlation tests and runs tests to analyze weekly price returns for thirty companies whose stocks constitute the component stocks of the Nigeria Stock Exchange. The scope of the study consists of 30 component stocks traded on the floor of the Nigerian stock Exchange. The period covers January 5, 2010 to January 6, 2011. The findings suggest that random walk model is not a good description of successive price returns in the Nigeria Stock exchange, implying that results obtained are contrary to the hypothesis that successive stock prices are independent random variables and also not consistent with efficient market hypothesis.

Keywords: Nigeria, Stock Market, Share Price, Market Efficiency, Weak-Form Hypothesis, Random Walk, Serial Correlation, Test for Independence, Runs Test.

Introduction

In finance, a stock represents a share in the ownership of an incorporated company. Stocks are evidences of ownership, or equity. Investors buy stocks in the hope that it will yield income from dividends and appreciate, or grow, in value. Shares of widely held companies are traded on stocks markets. Stockholding is popular because stocks represent ownership of capital that can be easily transferred by means of organized trading in the stock markets. In financial markets the dynamics of stock prices are reflected by uncertain movements of their values over time. One possible reason for the random behaviour of the asset price is the efficient market hypothesis (EMH). In financial literature the term stock market efficiency is used to explain the relationship between information and share prices in the capital market of any economy. The EMH has been a major area of research in financial economics, particularly as it pertains to stock markets of developing economies (Rapuchukwu, 2010). The EMH basically states two things: the past history of a stock price is fully reflected in present price; the markets respond immediately to any new information about the stock. These two assumptions imply that changes in the stock price are a Markov process. A Markov process named after Andrey Markov, a Russian mathematician, is a stochastic process that satisfies the Markov property. A Markov process can be thought of as "memoryless": loosely speaking, a process satisfies the Markov property if one can make predictions for the future of the process based solely on its present state just as well as one could knowing the process's full history. That is, conditional on the present state of the system, its future and past are independent. It is a random process usually characterized as meaningless: the next state depends only on the current state and not on the sequence of events that preceded it. This specific kind of "memorylessness" is called the Markov property. A Markov process is a stochastic model that has the Markov property. The term "Markov chain" refers to the sequence of random variables such a process moves through with the Markov property defining serial dependence only between adjacent periods (as in a "chain"). It can thus be used for describing systems that follow a chain of linked events, where what happens next depends only on the current state of the system. A Markov chain is collection of random variables () (where the index runs through 0, 1, . . .) having the property that, given the present, the future is conditionally independent of the past.

In other words
P (= $|X_0 = i_o, X_1 = i_1, . . ., X_{t-1} = i_{t-1}$) = P ($X_t = j|X_{t-1} = i_{t-1}$). (1.1)

If a Markov sequence of random variables X_n take the discrete values α_1, . . ., α_N, then
P ($x_n = \alpha_{in}|x_{n-1} = \alpha_{in-1}, . . ., x_1 = \alpha_{i1}$) = P ($x_n = \alpha_{in}|x_{n-1} = \alpha_{in-1}$), the sequence x_n is called a Markov chain (Popoulis, 1984, p. 532).

A famous Markov chain is the so-called "drunkard's walk", a random walk on the number line where, at each step, the position may change by +1 or -1 with equal probability. From any position there are two possible transitions, to the next or previous integer. A Markov chain is defined as a sequence of random variables X_1, X_2, X_3, . . With the Markov property, namely that, given the present state, the future and past states are independent. Formally,

$$P_r(X_{n+1} = x|X_1 = x_1, X_2 = x_2, . . ., X_n = x_n) = P_r(X_{n+1} = x|X_n = x_n), \quad (1.2)$$

if both sides of the equation are well defined.

In this context, modeling the stock price is concerned with modeling the arrival of new information, which affects the price. Two important things to retain are: probability distribution and information. These play a major role in the modeling of future stock prices. In other words, the future price of a stock can be predicted within a certain level of exactitude, if one can anticipate new information about the stock. Remarkably, efforts have been made to apply econometric techniques of model building in the prediction of stock prices in an effort to demonstrate that the market fluctuations are essentially unpredictable (Bernstein and Bostain, 1974; Black, 1971; Brealey and Myer, 1976; Buhlmann, 2005). The EMH was first introduced into the literature by Eugene Fama, and he provides the formal definition of "market efficiency" and classifies market efficiency into three categories (Fama, E. 1970, 1991). However, similar ideas had been put forward prior to this by Samuelson (1965) and Mandelbrot (1966). The underlying idea of the EMH and its predecessors is that financial market prices must always already reflect any and all available information at any given point in time. Samuelson (1965) summarizes this neatly:

> *"In competitive markets there is a buyer for every seller. If one could be sure that a price will rise, it would already have risen". …(Competitive) prices must display price changes over time, $X_{t+1} - X_t$, that perform a random walk with no predictable bias.*

Fama (1970) then set out to give this idea empirical content. He did so by setting up a series of equations which could then be tested econometrically against real-world financial market data. Fama assumed that expected future value is a function of expected future returns based on the information that is supposed to be fully reflected in the price. Or,

$$E(\tilde{p}_{j,t+1}|\theta_t) = [1 + E(\tilde{r}_{j,t+1}|\theta_t)]p_{jt} \qquad (1.3)$$

Where E is the expected value operator;
p_{jt} = the price of security at time t;
p_{jt+1} = its price at t+1;
r_{jt+1} = the percentage return $\frac{(p_{jt+1} - p_{jt})}{p_{jt}}$;
θ_t represent the information that is assumed to be "fully reflected" in the price at time t; and the tildes indicate that the variables are random at time t.So, expected price of security j, E ($\tilde{p}_{j,t+1}$), projected on the basis of information θ_t will be equal to the initial pricep_{jt}, and the expected returns, $E(\tilde{r}_{j,t+1})$, also projected on the basis of information θ_t.
As Fama (1970) notes, however,

> *" … the expected value is just one of many possible summary measures of a distribution of returns, and market efficiency (i.e., the general notion that prices*

> *"fully reflect" available information) does not imbue it with any special importance. But some such assumption is the unavoidable price one must pay to give the theory of efficient markets empirical content".*

This gives the economist some measure of freedom in how they should estimate expected value inclusive of returns.The purpose of this is to rule out trading strategies that are based only on information θ_t that can generate returns in excess of equilibrium expected returns. This leads to what Fama calls a "fair game" scenario in which excess returns above expected returns are nil. Fama states this as follows:

$$X_{j,t+1} = p_{j,t+1} - E(\tilde{p}_{j,t+1}|\theta_t) \tag{1.4}$$

Then,

$$E\left(\tilde{x}_{j,t+1}\middle|\theta_t\right) = 0 \tag{1.5}$$

Fama is here careful to point out that the only reason that we can assume that this is a "fair game" model is because of the priori assumptions that have been built into the model.

> *Though we shall sometimes refer to [this model] as a "fair game" model, keep in mind that the "fair game" properties of the model are implications of the assumptions that (i) the conditions of market equilibrium can be stated in terms of expected returns, and (ii) the information θ_t is fully utilized by the market in forming equilibrium expected returns and thus current prices.*

The "fair game" properties of the model that ensure that all information is always already reflected in the market price and that, by implication, no one can consistently make above average market returns arise out of the underlying assumptions of the model itself. It is for this reason that Fama then goes on to undertake extensive empirical testing of the model against real-world financial data in order to see whether it is an accurate representation of real-world financial markets or not. In probability theory, a martingale is a model of a fair game where knowledge of past events never helps predict the mean of the future winnings. In particular, a martingale is a sequence of random variables (i.e., a stochastic process) for which, at a particular time in the realized sequence, the expectation of the next value in the sequence is equal to the present observed value even given knowledge of all prior observed values at a current time. Fama (1970) breaks the EMH into three forms: the weak; the semi-strong; and the strong. The weak-form states that prices on publicly traded assets already contain all available information at any moment in time. This form implies that past prices cannot be used as a predictive tool for future stock price movements. Therefore, it is not possible for a trader to make abnormal returns by using only the past history of prices and volume. The semi-strong form builds on the weak form by adding that markets adjust instantaneously to new information; that current market prices reflect all publicly available information, such as information on money supply, exchange rate, interest rates, announcement of dividends, annual earnings, stock splits, etc. Finally, the strong form claims that all information known to any participant is fully reflected in prices (e.g. such as an impending announcement of a takeover or merger, (Keith Cuthbertson, 1996)). In other words, under the strong form of EMH market prices of securities reflect all relevant information, including both public and private information. By way of econometric testing Fama then go on to show not only whether the EMH is a good approximation of real-world financial markets but also which markets approximate to which form of the EMH. Market Efficiency has an influence on the investment strategy of an investor because since in an efficient market, the prices of securities will reflect the market's best estimate of their expected return and risk, taking into account all that is known about them. Therefore, there will be no undervalued securities offering higher than deserved expected returns, given their risk. So, in an efficient market, an investment strategy concentrating simply on the overall risk and return characteristics of the portfolio will be more sensible. If however, markets are not efficient, and excess returns can be made by correctly picking winners, then it will pay investors to spend time finding these undervalued securities (Rutterford, 1983). Fama and French (1988) have argued that there are long term pattern in stock prices with several years of upswing followed by more sluggish periods. According to Fama (1965; 1995), a stock market where successive price changes in individual securities are independent is, by their definition a random walk market. According to Kendall (1953), stock prices following a random walk implies that the price changes are as independent of one another as the gains or losses. The independence assumption of the random walk is valid as long as knowledge of the past behavior of the series of price changes cannot be used to increase expected gains. More specifically, if successive price changes for a given security are independent, there is no problem in timing purchases and sales of that security. A simple policy of buying and holding the security will be as good as any more complicated mechanical procedure for timing purchases and sales (Fama, 1965; 1995). Following the work of Fama, the EMH has been widely investigated in both developed and emerging markets. Especially, in emerging stock markets, most empirical studies have focused on the weak-form, (the lowest level of EMH) because if the evidence fails to support the weak-form of market efficiency, it is not necessary to examine the EMH at the stricter levels of semi-strong form and strong form (Wong and Kwong, 1984). So this study only elaborates the weak form of efficiency in Nigerian Stock Market. Ample research work has been documented on the weak form of efficiency throughout the world. According to Errunza and Losq (1985), Harvey (1993), Calessens, Dasgupta and Glen (1993), most of the research has been conducted on stock market of developed countries and less attention has been paid to emerging stock markets, so this study is a step toward research on emerging stock markets. More recent developments in the weak-form efficiency include the following: Aga and Kocaman (2008; Samuel and Oko (2010); Odife (1990); Ogege and Mojekwu (2013); Sunde and Zivannomoyo (2008), Nwosa and Oseni (2011); Gimba, (2010), Godwin (2010), Makailu and Sandra (2007), Sandra (2009), Chiwira and Muyambiri (2012), Afego, (2012), etc. Most researchers use the runs test and/ or variance ratio test and their results provide evidence that the stock markets follow random walk model and so efficient in the weak form. They have consensus that the power of variance ratio test is superfluous than any other test used for random walk [Lo and MacKinlay (1989)]. Tian, Zhang and Huang (1999) derived the non-overlapping VR (NVR) statistic, which follows a Beta distribution. As argued by Lo and MacKinlay (1989), the OVR test is expected to have higher power than the NVR test. The advantages of the VR test are summarized by Cecchetti and Lam (1994). The application of the Variance Ratio test to measure the time series data was observed by Campbell and Mankiw (1987a, 1987b, 1989), Cogley (1990) and Poterba and Summers (1988). This paper aims to seek evidence of the weak-form market efficiency and efficient market hypothesis in the Nigerian capital market. Some works has been done on the subject by Gimba, (2012); Ogege and Mojekwu, (2013); Nwosa and Oseni (2011); (Mikailu and Sandra, 2007), Sandra (2009), Godwin (2010) etc, but according to Gimba (2012), no published research exists for the Nigeria stock market index. In order to achieve the objective, a set of complementary tests, namely serial correlation and runs tests are employed in this paper. The data used for these tests primarily comprise weekly observed stock prices.In this study, the random walk approach is presented with the specific aim of giving a definite description of the Nigerian Stock Market prices. In a world without interest rates, idealized stock prices should be martingale (Agwuegbo, Adewole and Maduegbuna 2010). This is one way of formulating the so called efficient market hypothesis (Buhlmann, 2005; Fama, 1965; 1995).

Statement of the Problem

Stock exchanges are the most important segment of the secondary market where securities are traded. Stock exchanges are organized marketplaces in which stocks, shares, bonds and other securities are traded by members of the exchange, acting as both agents (broker) and principals (dealers or traders). Here, the constantly changing prices of supply and demand set quotations for the issue of shares. In the market studies, dealing with share price returns and predictability of 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 the market 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. The question which this paper attempts to answer is as follows: Are successive share price returns on the Nigeria 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 Nigeria stock exchange depict a random sequence.

Significance of the Study
Findings of this study, whether in support of or against Random Walk Hypothesis (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 impossible to achieve the expected return within stipulated time at Nigeria stock exchange, 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.

Hypothesis
In view of the problem definition of the study, the following hypotheses (stated in the null form) were tested.

1. The movements in the prices of stocks traded on the floor of the Nigeria stock exchange are not independent;
2. The movements in the prices of stocks traded on the floor of the Nigeria stock exchange are not random.

Limitations of the Study
The major limitation of the study was the missing data for some stocks on the various weeks. The previous stock price was taken to be 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.

Literature Review
There are two main hypotheses relevant to the possibility of being able to make a prediction in stock markets.

- Random walk hypothesis – RWH (Kendall, 1953; Roberts, 1959; Fama, 1965); and

- Efficient market hypothesis – EMH (Samuelson, 1965; Jensen, 1978).

These hypotheses are considered as the cornerstone of modern financial theory, but they are questioned by many and they have generated immense disputes (Thawornwong and Enke, 2004).

Random walk in stock prices involves two separate hypotheses (Fama, 1965).

1. Successive changes of prices of stocks are independent. More specifically, the sequence of price changes during time period t is independent of the sequence of price changes during previous time periods. In other words the knowledge of the sequence of price changes leading up to a time period t is of no help in assessing the probability distribution for the price change during time period$t$. Therefore, Pr $(x_t = x|x_{t-1}, x_{t-2}, \dots)$ = Pr $(x_t = x)$, where Pr$(x_t = x)$ is the unconditional probability that the price change during time t will take the value x, while Pr $(x_t = x|x_{t-1}, x_{t-2}, \ldots)$ is the unconditional probability that the price change during time t will take the value x on the knowledge that previous price change took the values x_{t-1}, x_{t-2}, etc.
2. The price changes conform to some probability distribution. The shape of this distribution is very helpful for the investor, since it determines the riskiness of investment, provides information for the nature of the process generating price changes and it closely related to the type of data to which it is applied.

As the author (Fama, 1965) points out from the above two hypotheses, independence of prices is the most important, since it determines whether random walk is valid. The reason is that successive price changes are either independent, in which case the random walk hypothesis is valid or they are not, in which case the hypothesis is not valid. According to Malkiel (2003), random walk hypothesis states that previous stock prices do not help in predicting future prices, since future prices simply reflect new information which are by definition unpredictable. Stock prices follow a random walk, and therefore their path is unpredictable. According to Seiler and Rom (1997), stock prices fluctuate daily as random white noise, which according to Black (1986) consists of a large number of small actions made by many investors whose actions usually are not based on any information, but simply for their own personal reasons as to increase their liquidity. Osborne (1959) argues that stock prices are always changing and at the same time they are in a statistical equilibrium, with analogous properties to an ensemble of particles which are moving in a random way, a phenomenon that has been observed by the biologist Robert Brown and therefore it is known as Brownian motion, this is why, random walk is also known as Brownian motion (Siriopoulos, 1998). The advocates of random walk holds that it is impossible to predict the price of a security from the past performance because the changes in economic condition, securities, valuations, corporate profits and market as a whole all occur in a myriad of different ways. In random walk process, successive stock returns must be identically distributed and independent so that the correlation between one period's return and the immediate following period is zero, [Fama (1965), D'ambrosio (1980), and Cooper (1983)]. So any non random fluctuation would be exploited by the technical analyst; or speculators would buy before an expected rise in price or sell short before an expected fall in price. In random walk the flow of information is random, and security prices adjusted with that information so the new security prices would also be randomly attuned, and hence each day securities have different prices depending on the flow of information. And nobody can predict about the future security prices.

According to Professor Malkiel (1995)

> *"Thus an accurate statement of the narrow form of the random-walk hypothesis goes as follows: the history of stock price movements contains no useful information that will enable an investor consistently to outperform a buy-and-hold strategy in managing a portfolio".*

As McInish and Puglisi (1982) point out, a sufficient condition for weak-form efficiency is that stock price fluctuates randomly. As a result, a market is efficient in the weak form if stock prices follow a random walk process.

The Basic Random Walk Model

Believers of the efficient-markets concept also tend to espouse the concept of the random walk that the market behaves in discernible way. A sufficient condition for weak-form efficiency is that stock price fluctuates randomly. Suppose ε_t is an error term with mean 0 and variance σ^2. The series P_t is said to be random if $P_t = P_{t-1} + \varepsilon_t$ (2.1)

A random walk is defined as a process where the current value of a variable is composed of the past value plus an error term (uncorrelated) defined as a white noise (a normal variable with zero mean and variance one). The implication of a process of this type is that the last prediction of y next period is the current value, or in other words the process does not allow to predict the change (y_t- y_{t-1}). This is, the change of y is absolutely random. A random walk process is non-stationary, and its variance increase with t.

Consider,

$y_t = y_{t-1} + \varepsilon_t$, $t = 1, 2, \ldots$ (2.2)

Where we assume that (ε_t: $t = 1, 2, \ldots$) is independent and identically distributed with a mean zero and variance σ_t^2. We assume that the initial value, y_0, is independent of ε_t for all $t \geq 1$. The process in (2) is called a random walk. The name comes from the fact that y at time t is obtained by starting at the previous value, y_{t-1}, and adding a zero mean random variable that is independent of y_{t-1} (Wooldridge, 2006). Sometimes, a random walk is defined differently by assuming different properties of innovation, ε_t(such as lack of correlation rather than independence) but the current definition suffices for our purposes.

First we find the expected value of$y_t y_t$.This is most easily done by using repeated substitution to get $y_t = e_t + e_{t-1} + \dots e_1 + y_0$ (2.3)
Taking the expected value of both sides gives
$E(y_t) = E(e_t) + E(y_{t-1}) + \dots + E(e_1) + E(y_0) = E(y_0), for\ all\ t \geq 1.$ (2.4)
Therefore, the expected value of a random walk does not depend on t. A popular assumption is that $y_0 = 0$_ the process begins at zero at time zero in which case$EE(y_t) = 0$ for all$t$. By contrast, the variance of a random walk does change with tt. To compute the variance of a random walk, we assume that y_0 is non-random so that Var $(y_0) = 0$; this does not affect any important conclusions. Then, by the i.i.d assumption for $(e_t\varepsilon_t)$,
Var (y_t) = Var $(e_t\varepsilon_t)$ + Var (e_{t-1}) + . . . + Var $(e_t\varepsilon_t) = \sigma_e^2 t$. (2.5)
In other words, the variance of a random walk increases as a linear function of time. This shows that the process cannot be stationary. Even more importantly, a random walk displays high persistence behaviour in the sense that the value of $y\ y$ today is important in determining the value of yy in the very distant future. To see this, write for h periods hence,
$y_{t+h} = e_{t+h} + e_{t+h-1} + \dots e_{t+1} + y_t\ \ y_t.$ (2.6)
Now suppose at time$t$, we want to compute the expected value of y_{t+h} given the current valuey_t. Since the expected value ofe_{t+j}, given $y_t y_t$, is zero for all for $jj \geq 1$, we have
$E(y_{t+h}E|y_t) = y_t\ y_t$, for all $h \geq 1$. (2.7)
This means that, no matter how far in the future we look, our best prediction of y_{t+h} is today's value y_t. It is often said that asset prices, such as stock prices or exchange rates, follow a random walk; that is, they are non-stationary. Suppose ε_t is a white noise error term with mean 0 and variance σ^2. Then the series is said to be a random walk if
$y_t = y_{t-1} + \varepsilon_t$ (2.8)
In the random walk model as (7) shows, the value of y at time t is equal to its value at time $(t-1)$ plus a random shock.Believers in the efficient capital market hypothesis argue that stock prices are essentially random and therefore there is no scope for profitable speculation in the stock market. If one could predict tomorrow's price on the basis of today's price, we could be all millionaires (Gujarati, 2005).
Now from (2.8), one can write
$y_1 = y_0 + \varepsilon_t.$
$y_2 = y_t + \varepsilon_2 = y_0 + \varepsilon_1 + \varepsilon_2$
$y_3 = y_t + \epsilon_3 = y_0 + \varepsilon_1 + \varepsilon_2 + \varepsilon_3$

In general, if the process started at some time 0 with a value of y_0, we have $y_t = y_0 + \sum \varepsilon_t$ (2.9)
Therefore, $E(y_t) = E(y_0 + \sum \varepsilon_t) = y_0$ (2.10)

In like fashion, it can be shown that
Var $(y_t) = t\sigma^2$ (2.11)
As the preceding expression shows, the mean of y is equal to its initial, or starting value, which is constant, but as t increases, its variance increases indefinitely, thus violating a condition of stationarity. An interesting feature of the persistence of random shock, (i.e. random errors), which is clear from (9): y_t is the sum of initial y_0 plus the sum of random shocks.
As a result, the impact of a particular shock does not die away. For example, if ε_t = 2 rather than ε_0 = 0, then all $y_t's$ from y_2 onward will be 2 units higher and the effect of this shock never dies out. That is why random walk is said to have an infinite memory. As Kerry Patterson notes, random walk resembles the shock fever, that is, it has infinite memory.

Martingale and Fair Game Model
The EMH can be viewed upon as being a fair game, in where no player has any informational advantage to gain abnormal returns (Elton, *et al.*, 2007). This is a central point, conceptualized in the Fair Game Model. In the model, there is no way that the information can be used to obtain above equilibrium returns. When the sum of the product of each possible price change times the probability of its occurrence is zero, it is called martingale, of which a random walk [(50 percent probability up, 50 percent probability down is a special case (Siegel, 1998)].In general, the fair game model states that a stochastic process X_t with the condition on information set I_t, is a fair game if it has the following property:
$\varepsilon(x_{t+1}|I_t) = 0$ (2.12)
In the case of stock markets, Fama (1970) introduced a model of the EMH that is derived from the Fair Game property for expected returns and expressed it in the following equations:
$x_{j,t+1} = p_{j,t+1} - \varepsilon(p_{j,t+1}|I_t)$, (2.13)
With $\varepsilon(x_{t+1}|I_t) = \varepsilon[p_{j,t+1} - (p_{j,t+1}|I_t)]$ (2.14)
where $x_{j,t+1}$ is the excess market value of security j at time t+1, $p_{j,t+1}$ is the observed (actual) price of security j at time t+1, and $\varepsilon(p_{j,t+1}|I_t)$ is the expected price of security j that was projected at time t, conditional on the information set I_t or equivalently $z_{j,t+1} = r_{j,t+1} - \varepsilon(r_{j,t+1}|I_t)$, (2.15)
with $\varepsilon(r_{j,t+1}|I_t) = \varepsilon[r_{j,t+1} - (r_{j,t+1}|I_t)]$ (2.16)
where $z_{j,t+1}$ is the unexpected (excess return for a security j at time t+1, $r_{j,t+1}$ is the observed (actual) return for a security j at time t+1, and $\varepsilon(p_{j,t+1}|I_t)$ is the equilibrium expected return at time t+1 (projected at time t) on the basis of the information set I_t. This model implies that the excess market value of security j at time t+1 ($p_{j,t+1}$) is the difference

between actual price and expected price on the basis of the information set I_t. Similarly, the unexpected (excess return for a security j at time t+1 ($z_{j,t+1}z$) is measured by the difference between the actual and expected return in that periods conditioned on the set of available information at time t, I_t. According to the Fair Game model, the excess market value and excess return are zero. In other word, Equation (1.6) and (1.7) indicate that the excess market value sequence $\{r_{j,t+1}\}$ and $\{z_{j,t+1}\}$ respectively are fair game with respect to the information sequence $\{I_t\}$.

Stock Prices and Martingales

A fair game is sometimes referred to as a martingale difference (Cuthbertson, 1996). Thus a fair game has the property that the expected 'return' is zero, given Ω_t. Let us assume a simple model of returns, namely that the equilibrium or required return is a constant = k. The fair game property implies that the conditional expected excess return is zero:

$$E[(R_{t+1} - k)] = 0 \quad (2.17)$$

Given the definition of R_{t+1} we have

$$E_t[\text{In } (P_{t+1}/P_t) + D_{t+1}/P_t] = k \quad (2.18)$$

The Framework

One of the most enduring questions in finance is whether capital market is efficient (securities prices are set in an efficient manner). As we noted earlier, the term 'market efficiency' is used to explain the relationship between information and share prices in the capital market literature. It examines the degree, the pace, and the accuracy of the available information being incorporated into security prices. Based on the type of information that is fully reflected in the security prices, three forms of efficient market hypothesis have been propounded by Fama (1970); namely: the weak, a form of theory that suggests that you can't beat the market by knowing past prices. It is named 'weak-form' because the security prices are the most publicly and accessible pieces of information. Semi-strong efficiency- perhaps the most controversial form of the theory suggests you can't beat the market using the publicly available information. Strong-form efficiency: the theory that states no information of any kind (public or private) can be used to beat the market. However, it has been stated that capital markets with higher informational efficiency are more likely to retain higher operational and allocational efficiencies (Muslumov, *et.al.* (2004). A market is efficient with respect to a set of information if it is impossible to make economic profits by trading on the basis of this information set (Ross, 1987; Sharpe, 2006). Consequently no arbitrage opportunities, after costs, and after risk premium can be tapped using ex ante information as all the available information has been discounted in current prices. According to Samuelson (1965) and Fama (1965), under the efficient market hypothesis [EMH], stock market prices must always show a full reflection of all available and relevant information and should follow a random walk process. Successive stock price changes (returns) are therefore independently and identically distributed (*iid*). Furthermore, stock market returns unlike other economic time series, typically exhibit a set of peculiar characteristics such as clusters or pools of volatility and stability (i.e. large changes in these returns series tend to be followed by large changes, and small changes by small changes) Mandelbrot (1963) and Fama (1965), and Leptokurtosis, (i.e. the distribution of the returns tend to be fat-tailed) Fama (1965). The Efficient Market Hypothesis has been tested in hundreds of studies over the past years: Fama and French (1996), Malkiel (1995), Ikenberry, Lakonishok, and Vermalen (1995), Jegadeesh, and Titman (1993), Chopra, Lakonishok, and Ritter (1992), Seppi (1992), Harris (1989), Ippolito (1989), Grossman and Stiglitz (1980), Chrest (1978), Black and Schole (1974), Moore (1964). Efficient market hypothesis suggests that stock prices must follow a random walk that is why random walk hypothesis has a very important financial theories and statistical modeling.

Recently, several studies have uncovered empirical evidence which suggests that stock returns contain predictable components, Fama and French (1988), Lo and Mckinley (1988), etc Some empirical evidence go against the random walk hypothesis for stock returns, Summer (1986), Fama and French (1988), Lo and Mckinley (1989), and Poterba and Summer (1988), and also Magnus (2008). In other words, the stock prices approximate a random walk. (That is why sometimes the random walk hypothesis and efficient market hypothesis are used interchangeably). As time passes, price wanders or walks more or less randomly across the charts. Since the walk is random, a knowledge of past price changes does nothing to inform the analyst about whether the price tomorrow, next week, or next year will be higher or lower than today's price. The weak-form of the EMH is summed up in the words of the pseudonymous "Adam Smith", author of the Money Game:

> *"Prices have no memory, and yesterday have nothing to do with tomorrow". It is an important property of such a market, so that one might do as well flipping a coin as spending time analyzing past price movements or patterns of past price levels".*

Thus, if the random walk hypothesis is empirically confirmed, we may assert that the stock market is weak-form efficient. In this case any work done by chartists based on past price pattern is worthless. Random walk theorists usually take as their starting point the model of a perfect securities market in which a relatively large number of investors, traders, and speculations compete in an attempt to predict the course of future prices. Moreover, it is further assumed that current information relevant to decision-making process is relatively available to all at little or no cost.

If we "idealize" these conditions and assume that the market is perfectly competitive then equity prices at any given point of time would reflect the market's evaluation of all currently available information. In such ideal markets, prices would change solely as new hitherto unavailable information becomes known. And unless the new information is distributed overtime in a non-random fashion and we have no reason to presume this, price movements in a perfect market will be statistically independent of one another. The empirical literatures on the weak-form efficiency in emerging stock markets by authors show conflicting result. Some authors support while others, oppose the efficient market hypothesis. They include Nisar and Hanif (2012), Nikita and Soekarno (2012), Gupta and Yang (2011); Angelov (2009); Shaker, (2013); AlAshikh, (2012); Moustafa (2004); Haque, Liu, and Nisa (2011); Khrakpo, (2013); Khandokar, Siddik and Azam (2011); Karkmaz, and Akman (2010); Khan and Ikram and Mehtab (2011); etc. Some authors, for example, Mohammed Hokrah, (2013), suggested that more investigations be made were results are not very clear.

Evidence from Nigeria

The weak-form Efficient Market Hypothesis proposes that share prices fully reflect historical price and earnings information. This implies that returns on share prices follow a random walk and are unpredictable. There exists a strong measure of consensus supported by tremendous amount of evidence among financial economists on the validity of the weak and semi-strong forms of the EMH with respect to developed capital markets. However, existing evidence on developing countries markets remains scanty (Adelegen (2004). Therefore, there is a need for triangulation in research by providing evidence from emerging markets like Nigeria. Two pieces of research that focus specifically on African markets are Dickinson and Muragu (1994) and Olowe (1999). Dickinson and Muragu create a database of weekly prices over ten years of the 30 most actively traded equities on the Nairobi Stock Exchange. They fail to find evidence inconsistent with weak-form efficiency in the stock exchange by means of both runs tests and Q-tests statistics, but suggest that a number of studies must be carried out on any market using a variety of methodologies to draw firm conclusions about weak-form efficiency. Olowe (1999) carries out tests using monthly data on 59 randomly selected securities from 1981 – 92 on the Nigerian Stock Exchange. He finds the Nigerian market to conform to weak-form efficiency in joint Q-tests of partial autocorrelation coefficients for ten lags in the return data, though he argues that poor informational flows and inefficient communications systems cast doubts on the ability of the market to pass higher hurdles of efficiency. Besides Olowe (1999) study, other empirical tests of the weak form of the Efficient Market Hypothesis have been conducted on the Nigerian Stock Exchange by Ekechi (2002), Inegbedion (2009), Aguegbo, *et a*l (2010) and Rapuluchukwu (2010). Results of the various tests are not consistent. While the studies conducted by Odukwe (1983), Ayadi (1983), and Rapuluchukwu (2010) concluded that the Nigerian Stock Market is efficient in the weak form, those conducted by Ekechi (2002), Inegbedion (2009), as well as Aguegbo, *et al* (2010), indicate that the Nigerian Stock Market is not efficient in the Weak form. But it is pertinent to note that all the studies that showed that the Nigerian Stock Market is efficient in the weak form utilized the All-share index of the Nigerian Stock Exchange, which is the aggregation of price gains and losses for all the securities traded on the floor of the Nigerian Stock Exchange, in their analysis; while the studies that showed that the market was not efficient in the weak form used a sample of selected securities. Okpara Godwin Chigozie (2010), investigated whether the Nigeria stock market (from the period 1984 to 2006) follow a random walk. To carry out the investigation the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model was employed. The result shows that the Nigeria Stock Market follows a random walk and is therefore weak form efficient. However, the year 1987, the period of financial deregulation, 1988 when some public companies were privatized, 1995 the period of internationalization of the Nigerian Capital Market and the year 2000-2006 recorded persistent volatility clustering suggesting weak-form efficiency in the market for these years. Nevertheless, the parameter estimates of their conditional mean equations (except in 1995) were insignificant. Besides these years, other years were conspicuously found to exhibit weak-form efficiency. Thus, the Nigerian stock market is weak form efficient and as such no investor can usurp any privileged information to beat the market and make abnormal profit.

Agwuegbo, Adewole and Maduegbuna (2010) in their paper title 'a random walk model for stock market prices' describes the stock market as one of the most popular investments in the recent past due to its high returns. The market has become an integral part of the global economy to the extent that any fluctuation in the market influences personal and corporate financial lives of the economic health of a country. The daily behavior of the market reveals that the future stock prices cannot be predicted based on past movements. In this study, they analyzed the behavior of daily return of Nigeria stock market prices. The sample included daily market prices of all securities listed in the Nigeria Stock Exchange. The result from the study provided evidence the Nigeria stock exchange is not efficient even in weak form and that NSE follow the random walk model. The idealized stock price in the Nigeria stock exchange is a martingale. They concluded saying that martingale defines the fairness or unfairness of the investment and no investor can alter the stock price as defined by expectation. Nwosa and Useni (2011) examine the weak-form efficient market hypothesis in the Nigerian stock market, using a sample data spanning the period 1986 and 2010. The study adopted a serial autocorrelation and regression method of analysis. The variables used in the study were tested for stationarity using the Augmented Dickey Fuller and Philip Perron test. The result showed that the variables are stationary at first differencing. The result of the serial correlation analysis both reveal that the Nigerian Stock Market is informational inefficient, i.e. stock price does not exhibit random walk. The study recommended that to enhance informational efficiency in this era where the lost of the global financial crisis have dominated the minds of investors, there is the need to ensure strong and adequate supervision by the regulatory authorities and also the need for a greater development of the Nigeria stock market through appropriate policies which would enhance the informational efficiency of the market. Nwaolisa and Kasie (2012) focused on concept, history and theory of EMH as espoused by renowned authors over the past decades in relation to Nigerian Capital Market. It tends to critically analyze the efficient hypothesis using its historical perspective. They summarize the origins of and inter-linkages between these contributions to investments. Mojekwu and Ogege evaluate the weak form efficiency. Using monthly data over the period of January 1985 to December, 2010, econometric methods was used to investigate stock prices in the context of the random walk hypothesis. However, based on the empirical results of the paper, it appears that there is strong correlation between past prices and present prices, meaning the investor will be able to earn abnormal profit. Hence, the Nigerian stock market is not efficient in the weak form. Adelegan (2004) writing on: How efficient is the Nigerian stock market? Further evidence, extends evidence on the efficiency of the stock markets in emerging markets using daily data from the Nigeria Stock Exchange. The data used in the study were obtained mostly from the daily official price list of 50 companies quoted on the Nigeria Stock Exchange for the period 1992-1993. Serial correlation tests and sign tests were carried out and tests based upon correlation coefficients across all lags for each company showed that in the vast majority of cases they were consistent with the independence approach. The results of the runs test indicated that the prices series of the majority of the companies were not random. Results that are inconsistent with the randomness hypothesis were observed mainly in the runs test, but this is not enough to conclude that the market is inefficient. In testing the weak form of efficient market hypothesis in Nigerian Capital Market, Ajao and Osayuwu (2012) cover all securities traded on the floor of the Nigeria Stock Exchange; and the month end value of the All Share Index from 2001 to 2010 constitute the data analyzed. The serial correlation technique of the data analysis was used to test the independence of successive price movement and the distributive pattern while runs test was used to test for randomness of share price movement. The result of the serial correlation coefficients did not violate the two-standard errors tests. Further, the Box-Ljung statistics shows that none of the serial correlation coefficients was significant and the Box Q statistics shows that the overall significance of the serial correlation test was poor while the results of the distributive pattern shows that the stock price movements are approximately normal on the basis of this finding. They conclude that successive price changes of stocks traded on the floor of the Nigerian capital Market are independent and random; the Nigerian Capital Market is efficient in the weak-form. Emenike (2010) examines the weak-form efficient market across the time for the Nigerian Stock Exchange by hypothesizing normal distribution and random walk in periodic return series. Monthly all-share indices of the Nigerian Stock Exchange were examined for three periods including January 1985 to December 1992, January 1993 to December 1999 and January 2000 to December 2007. Their normality tests were conducted using skewness, kurtosis, kolmogorov-Smirnov, and Q-Q normal chart; whereas random walk is tested using the non-parametric runs test. Results of the normality tests show that returns from Nigerian Stock Exchange do not follow normal distribution in all the periods. Runs test results reject the randomness of the return series of the Nigerian Stock Exchange in the periods studied. Overall results from the tests suggest that the Nigerian Stock Exchange is not weak-form efficient across time periods of this study. The results however, show that improvements in Nigerian Stock Exchange trading system have positive effect in efficiency. Relaxing institutional restrictions on trading securities in the market and strengthening the regulatory capacities of the Nigerian Stock Exchange and overall Nigerian Securities and Exchange Commission [NSEC] to enforce market discipline were recommended.

Necessitated on the belief that investors and firms can outperform the market, Oke and Azeez (2012) conducted a test of strong-form efficiency of the Nigerian Capital Market. The empirical analysis is done employing the Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. Data were collected mainly from Nigerian Stock Exchange, Central Bank of Nigeria statistical bulletin and other published sources. The study covers a period from 1986 to 2010. The findings reveal that the Nigerian Capital Market is weak form efficient, suggesting that current market price of securities reject past or historical information. The study recommends among others that the NSE should be closely monitored to achieve an optimal maturity level; greed and bad choices should not take the place of risk management capacity and market discipline; and the Securities and Exchange Commission (SEC) should take a leading role in regulating abnormal financial activities. Udoka (2012) focused on the information efficiency of the Nigerian Stock Market. It sought to assess the degree of information efficiency of the market. Monthly time series data were obtained, tabulated, analyzed and tested using the ordinary least squares estimate procedure. It was shown that the Nigerian stock market is weak-form efficient. Thus, informed investors could rely on the past prices to predict future prices to their own advantage. To sum up, although the literature on random walk and market efficiency is vast, there is no consensus among the researchers regarding efficiency of the market. The empirical investigation yielded different results. The empirical results of various studies appear to be sensitive to the tests employed for the analysis. However, conventional tests provide evidence in support of the Random Walk Hypothesis. Thin trading or non-synchronous trading, disclosure norms, various restrictions and incomplete reforms are cited as important factors for the rejection of the random walk characterization of returns particularly in emerging markets. The review of literature shows mixed empirical evidence regarding the behavior of stock returns.

Research Methodology

Research Design

This study examines the price of shares traded on the floor of the Nigerian Stock Exchange for a period of time, and observes changes in the shares prices with a view of determining the efficiency of the market, consequently, it is a longitudinal survey. This is consistent with Aghonifoh and Yomere (2010), who see longitudinal survey as one which studies a phenomenon, event, or group over a period of time. Specifically, a careful description of the model specification as well as the method of data analysis is presented below. 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 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 stock prices for 30 companies whose shares form the NSE share index over the period January 2010 to January 2011. Serial correlation test and runs test were used for the independence of successive price series.

Population

The population of the study comprises all the companies quoted at the Nigeria Stock Exchange.

Sample

The sample size consists of 30 companies that continuously constituted the NSE share index and traded for a period of three years.

Data collection

Studies in stock markets rely heavily on historical quantitative data. The data consists of daily stock prices for companies that constituted NSE share index over the period January 2010 to January 2011. The secondary data was obtained from the NSE information Services historical database; which is a reliable source of data for shares price traded at NSE. The use of a series of weekly closing prices of a single stock ensures that one is examining an understandable and clearly defined market. In addition, weekly price observations illustrate reactions to easily available information and inter observational data of fundamental importance that wider interval observations such as monthly cannot reflect.

Data Analysis Method

The study uses two tests to examine the randomness of the Nigerian Stock Exchange stocks prices. The testing methods used are the runs test and Serial correlation test. The methodology was adopted because it mixed both parametric and non-parametric tests. All tests are investigated weekly. The research data were analyzed using descriptive and inferential statistics distribution patterns (test for normality of distribution of price changes), which is a measure of the randomness of price changes, serve as the descriptive statistics while inferential tests consist of testing the All-share index of the Nigerian stock exchange, for independence (using serial correlation test)and randomness (using runs test).

Statistical models

The weak form of EMH implies that current price of stocks are independent on the past prices. In other words, a market is efficient in the weak form if prices follow a random walk process. Therefore, tests of weak form efficiency are naturally based on an examination of the relationship between current and past stock prices (Fawson *et al.,* 1996). Practically, several statistical techniques such as serial correlation, runs test, variance ratio test, etc, have been commonly used for testing weak-form efficiency (mostly in emerging stock markets as a principle method for detecting a random walk, a necessary condition for market efficiency in the weak form). Specifically, the runs test is adopted by Sharima and Kennedy (1997), Barnes (1986), Dickinson and Muuragan (1994), Karemera *et al*, (1991), Wheeler *et al* (2002), Abraham *et al* (2002), while Dockery and Vergari (1997), Karemera *et al* (1999), Alam *et al* (1999), Chang and Tung (2002), Cheung and Couts (2001), Abraham *et al* (2002), and Lima and Ting (2004) apply variance ratio tests as the main methodology to determine the weak form of market efficiency in their study. Lo and McKinley (1988) provided the asymptotic theory for the variance ratio test. Their results, however, are based on Gaussian assumption.

The Runs Test

The runs test is a non-parametric technique to detect statistical dependencies between observations. Runs test determine whether successive price changes are independent, and does not require returns to be normally distributed (Higgs, 2004). When the expected number of runs is significantly different from the observed number of runs, it means the market suffers from under-or-over reaction to information, providing an opportunity to make excess returns for traders (Poshakwale, 1996). Further, a run may be described as a sequence of consecutive positive or negative returns. Using the laws of probability, it is possible to estimate the number of runs that one would expect by chance, given the proportion of the population in each of the two categories and given the sample size. Too many or too few runs in the time series can be a result of autocorrelation. By comparing the total number of runs in the data with the expected number of runs under random walk hypothesis, the test of the random walk hypothesis may be constructed. It has been shown that the distribution of the number of runs converges to a normal distribution asymptotically when properly normalized (see Campbell *et al*. (1997) for extensive discussion). To perform the test, the sampling distribution of the total number of runs in a sample is required. The test statistic used is the standardized normal variable Z (Z ~N(01)). Positive Z indicates that there are too many runs in the sample, negative value of Z that there are less runs that one would expect if the changes were random. The important advantages of this test are its simplicity and independence of extreme values in the sample (Bradley, J. 1968). A runs test examines the tendencies for losses or gains to be followed by further losses or gains, regardless of their size. This test is performed by examining a time series of returns for a security and testing whether the number of consecutive price gains or drops shows a pattern. A price gain is represented by a "+", a price drop is represented by a "-" and "0" shows that return is zero. A run is defined as a return sequence of the same sign.

The variance of R_{exp} is :

$$\delta^2(R_{exp}) = \frac{\sum_{i=1}^{3} n_1^2[\sum_{i=1}^{3} n_1^2 + N(N+1)] - 2N\sum_{i=1}^{3} n_1^3 - N^3}{N^2(N-1)}$$

The sampling distribution of R_{exp} is approximately normal for large N.

The standardized Z is defined as:

$$Z = \frac{\left(R + \frac{1}{2}\right) - R_{exp}}{\delta(R_{exp})}$$

where, R is the real number of runs.

The null hypothesis is that stock returns depict a random walk through time. If the absolute value of Z is greater than $Z(_{a/2})$ (such as $Z(_{a/2})$= 2.576 for α = 0.01) then the null hypothesis that stock returns follow random walk is rejected at the significance level of α.

$$Z = \frac{R - x}{\sigma}$$

Where R = number or runs

X = $x = \frac{2n_1 n_2}{n_1+n_2} + 1$

σ^2 = $\frac{2n_1 n_2(2n_1 n_2 - n_1 - n_2)}{(n_1+n_2)^2(n_1+n_2-1)}$

n_1, n_2 = the number of observations in each category.

Z = standard market variable.

This comes from a normal distribution with a mean of zero and a standard deviation of one. Approximately 95% of distribution lies within two standard deviation of the mean. Z status lies with large absolute values do not often occur by chance.

X = mean number of runs given n_1 *and* n_2

Serial Correlation Test:

The serial correlation test was used to test for independence of successive stock price. Otherwise known as autocorrelation, serial correlation is a nonparametric test for independence. Specifically, it measures the relationship between successive values of a given variable. A stochastic process is said to be strictly stationary if its properties are unaffected by a change in time origin. This implies that the joint probability distribution associated with N observations $Z_{t1}, Z_{t2}, \dots, Z_{tn}$ is the same as that associated with $\boldsymbol{n}$ observations $Z_{t1+k}, t_{2+k}, \dots, Z_{tn+k}$ made at time $t_{1+k}, t_{2+k}, \dots, t_{n+k}$. the serial correlation of N observation at lag k is given by

$$R_t = \frac{\sum[(zt - u)(zt + k - u)]}{\sqrt{[(zt - u)^2 \sum(z_t + k - u)^2]}}$$

i.e. $R_k = \frac{COV(Z_t, Z_{t+k})}{rZ_{t,r}Z_{t+k}}$

and $-1 \leq R_k \leq 1$ in line with Fama (1990) two control limits was computed using the estimates $-2rp < R < 2rp$. If the serial correlation estimates exceed the test limits above, the distribution of price would be termed not normal. That is, current prices are good indicators of future stock price movements. Serial Correlation Tests 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.

Step 1: Computing the natural logarithm returns difference (μ_{jt})

$$\mu_{jt} = l_n P_{jt-k}$$

Step 2: Computing the auto correlation coefficient

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

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

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

The statistical 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: $\gamma_{jk} = 0$, the correlation coefficient of successive price returns on the NSE at lag k is zero.

H1: $\gamma_{jk} <> 0$, 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$(\alpha = 0.05)$ is $\gamma_{0.95} = \pm \frac{2}{\sqrt{N}}$

Where, N is the sample size.

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

Runs 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.

Step 1: 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;

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

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

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

Where

N = Total number of price changes

ni = Number of price changes of each kind (plus, minus, zero)

r = Observed number of runs

σ_m **=** Standard deviation

m = Mean

Hypothesis

H_0: The successive price returns of a company's shares on the NSE are random

H_1: 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 happen 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 H0	Accept H0	Reject H0

Data Analysis and findings

Summary Statistics

Using natural logarithm return difference of daily stuck prices serial correlation coefficients have been computed for each of the various 30 listed companies and NSE share index split into 5 various lags. 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 -2/√N and +2/√N, where N is the number of return observation. Runs test was conducted for the 30 company's average weekly stock prices and the NSE 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 not random. At 5% level of significance, the computed test statistics (Z-score) is significant if it fall beyond the critical value of -1.96 and +1.96.

Results of the Data Analysis

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

Table 4.1: Correlation Coefficients for Weekly Price Returns Sequence at Lag 1,2,3,4 and 5.

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Average	No SCC
Livestock Feed Plc	.041	**-.110**	-.062	**-.139**	-.017	-0.0572	2
Nigerian Aviation Handling	**.429**	**.148**	**.083**	**.179**	.039	0.1755	4
Okomu Oil Palm Plc	**-.090**	.041	**.330**	-.033	**.110**	0.0716	3
R.T.Brisco	**-.249**	**-.129**	**.175**	-.055	.029	-0.0458	3
ALBAKA Air Plc	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	1.0000	5
Access Bank Plc	-.041	-.040	-.024	-.032	-.010	-0.0295	**0**
First Bank Nigerian Plc	**-.090**	.025	-.062	-.071	-.103	-0.0601	**1**
Union Bank of Nigerian Plc	-.046	-.046	**-.135**	**-.075**	**-.135**	-0.0874	**3**
UBA Plc	-.023	-.022	**.096**	**-.108**	-.027	-0.0168	**2**
Nigerian Breweries Plc	**.318**	**-.114**	**.081**	**.074**	**-.112**	0.0497	**5**
Guiness Nigerian Plc	**-.294**	**.100**	**.194**	**.107**	**-.135**	-0.0053	5
International Breweries Plc	-.030	-.008	.006	.000	-.005	-0.0075	**0**
Ashaka Cement Company	**.266**	-.035	**-.089**	**.181**	**-.169**	0.0308	4
Benue Cement Company	.060	.027	.027	-.034	**-.085**	-0.0010	**1**

Nigerian Ropes Plc	-.041	**.467**	-.020	-.021	-.004	0.0760	**1**
Berger Paints	**-.122**	**-.105**	**.147**	-.038	**-.102**	-0.0439	**4**
African Paints (Nig.)	-.020	-.021	-.021	-.022	-.022	-0.0212	0
IPWA Plc	-.036	-.056	**.301**	-.049	-.050	0.0221	1
National Sports Lottery	-.020	-.021	-.001	-.002	-.002	-0.0092	0
Red Star Express	**.363**	**.355**	**.179**	.000	.019	0.1832	3
Hallmark Papers Production	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.0000**	5
Thomas Wyatt Nigerian Plc	**-.093**	**-.095**	**-.097**	**.472**	.014	0.0403	4
SCOA Nigerian Plc	**-.500**	.000	.000	.000	.000	-0.1000	1
UACN Plc	.000	**.235**	.031	-.016	-.003	0.0492	1
Unilever Nigerian Plc	-.031	**.174**	-.025	**-.150**	-.004	-0.0070	2
Costain (WA) Plc	**-.490**	.052	.011	.010	.009	-0.0816	1
Glaxo Smithline	.053	**-.077**	-.040	-.039	.073	-0.0061	1
May & Baker Nigeria Ltd	**-.468**	.006	.004	-.019	-.011	-0.0974	1
AIICO Insurance Plc	.018	**.187**	.040	**.363**	-.016	0.1183	2
Lennards (Nig.) Plc	**.376**	**.277**	**.333**	**.211**	.021	0.2438	4

Significant if Correlation I > 0.07303
Source: Authors compilation
SPSS 22 OUTPUT

Results of the Serial Correlation Test

The summarized results of the serial correlation coefficient are presented in table 4.1. The table shows the serial correlation coefficient 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 period. Positive serial correlations suggest a tendency for price 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, 8 companies have negative serial correlation and 6 positive serial correlations. 16 out of the 30 companies have absolute serial correlation between 0.078 and 0.493 and above, (Nigerian Aviation Handling, Okomu Oil Palm Plc , R.T. Brisco, ALBAKA Air Plc, First Bank Nigerian Plc, Nigerian Breweries Plc, Guinness Nigerian Plc, Ashaka Cement Company, Berger Paints, Red Star Express, Hallmark Papers Production, Thomas Wyatt Nigerian Plc, SCOA Nigerian Plc, Costain (WA) Plc , May & Baker Nigerian Ltd, Lenard's (Nig.) Plc,). These values are statistically different from zero at 5% level of significance. The NSE index has positive serial correlation (0.481), which is also statistically different from zero at 5% level of significance. This means at lag 1, we can reject the independence hypothesis for 14 out of 30 companies and also for NSE 30 index at 5% level of significance. At lag 2, 8 companies have negative serial correlation and 8 positive serial correlations. 14 out of 30 companies (Nigerian Aviation Handling, Livestock Feed Plc R. T. Brisco, ALBAKA Air Plc, Nigerian Breweries Plc, Guinness Nigerian Plc, Nigerian Ropes Plc, Berger Paints, Red Star Express, Hallmark Papers Production, Thomas Wyatt Nigerian Plc, UACN Plc, Unilever Nigerian Plc, Glaxo Smithline, AIICO Insurance Plc, Lenard's (Nig.) Plc) have serial correlation coefficient statistically different from zero at 5% level of significance. The NSE index has positive (0.016) which is not statistically different from zero. At lag 2 we fail to reject null hypothesis for 14 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 14 companies (Nigerian Aviation Handling, Okomu Oil Palm Plc, R.T.Brisco, ALBAKA Air Plc, UBA Plc, Nigerian Breweries Plc, Guinness Nigerian Plc, Ashaka Cement Company, Berger Paints, IPWA Plc, Red Star Express, Hallmark Papers Production, Thomas Wyatt Nigerian Plc, Lennards (Nig.) Plc) 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 (-0.008) 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 12 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 which is not significant from zero and therefore fail to reject null hypothesis. At lag 5, only 9 companies with statistically significant serial correlation and there fail to reject null hypothesis for 21 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 4 out of 30 companies at any lag. 9 companies have only one significant coefficient. 4 companies have two significant coefficients and three significant coefficients, 5 companies have four significant coefficient and 4 have absolute significant coefficient through all five lags. 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 the first lag price return value which only applies to about 16 companies in lag 1. Higher lags values cannot be used to predict future price returns of most listed companies.

Table 4.2: Runs Test Results

		Negative	Positive		Zero		Total	Actual Number of Runs	Z – Score	
	Total Number of Observation (weeks)	Expected	Actual	Expected	Actual	Expected	Actual	Expected		
Livestock Feed Plc	52	9	2	16	4	26	7	51	13	-3.737
Nigerian Aviation Handling	52	10	1	20	2	21	2	51	5	-6.124
Okomu Oil Palm Plc	52	11	0	9	0	31	1	51	2	-6.984
R.T.Brisco	52	20	1	0	0	31	1	51	2	-7.001
ALBAKA Air Plc	52	0	0	0	0	51	51	51	1[c]	
Access Bank Plc	52	6	0	9	0	36	1	51	2	-7.001
First Bank Nigerian Plc	52	14	2	8	1	29	3	51	6	-5.748
Union Bank of Nigerian Plc	52	12	1	3	0	26	3	41	4	-6.438
UBA Plc	52	11	1	5	0	35	3	51	4	-6.443
Nigerian Breweries Plc	52	6	0	10	0	35	1	51	2	-7.001
Guiness Nigerian Plc	52	0	0	26	1	25	1	51	2	-7.003
International Breweries Plc	52	7	0	14	1	30	1	51	2	-6.999
Ashaka Cement Company	52	1	0	42	2	8	0	51	2	-7.003
Benue Cement Company	52	0	0	25	1	26	1	51	2	-5.095
Nigerian Ropes Plc	52	2	0	0	0	49	2	51	2	-6.735
Berger Paints	52	1	0	37	1	13	1	51	2	-7.003
African Paints (Nig.)	52	1	0	0	0	50	2	51	2	-7.003
IPWA Plc	52	5	0	1	0	45	2	51	2	-7.003

National Sports Lottery	52	1	0	0	0	50	2	51	2	-6.479
Red Star Express	52	14	1	20	2	17	2	51	5	-6.149
Hallmark Papers Production	52	0	0	0	0	51	51	51	1[c]	
Thomas Wyatt Nigerian Plc	52	5	0	0	0	46	2	51	2	-6.988
SCOA Nigerian Plc	52	3	0	1	0	47	4	51	4	-5.059
UACN Plc	52	3	0	6	1	42	4	51	5	-6.149
Unilever Nigerian Plc	52	2	0	5	0	44	2	51	2	-6.735
Costain (WA) Plc	52	4	0	16	1	31	1	51	2	-6.992
Glaxo Smithline	52	3	0	10	0	38	1	51	2	-5.836
May & Baker Nigerian Ltd	52	9	1	10	1	32	3	51	5	-6.058
AIICO Insurance Plc	52	6	0	9	1	36	2	51	3	-6.722
Lennards (Nig.) Plc	52	20	1	3	0	28	1	51	2	-6.908

Significant if -1.96 < computed Z score < 1.96

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 downward trend. Two out of the thirty companies have average length of two minus signs for negative runs and eight have average length of one negative sign. over fifteen companies have four and above negative runs. This indicates that there were short-term downward trends in prices returns and the NSE index. Positive runs shows increase in price returns. Cluster of positive price returns results or long positive runs correspond to upward trend. 3 out of the 30 companies have positive runs of average length of 2 positive sign and 9 have positive runs of average length of 1 positive sign. This indicates that there were short terms upward trends in prices returns and the NSE index. 17 companies have runs of zeros. The price returns 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 into 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 twenty eight out of the thirty companies. The Z value for the remaining two listed companies couldn't be ascertained due to the stable price listed. This means that we reject the randomness hypothesis for 28 companies and the NSE 20 share index at the 5% significance level.

Findings of the Study

This study attempted to answer the following question; Are successive share price returns on the Nigerian 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 30 companies, whose shares consistently constituted in the NSE share index in the year 2010, was used. This study answered the question by testing the following null hypotheses: H0: 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 January 2010 to December 2010, 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:H_0: The successive price returns of a company's shares on the Nigerian Stock Exchange 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 30 companies. The computed Z values were less that – 1.96 for the 11 companies.

Summary, conclusion and recommendation

Summary of findings

This study attempted to answer the following question; Are successive share price returns on the Nigerian 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 for independence of successive price series. Historical price series for 30 companies, whose shares consistently constituted the Nigerian Stock Exchange share index for the period of three (3) years, was used. This study answered the question by testing the following null hypotheses. The second null hypothesis tested to answer the question: H_0 : The successive price returns of a company's share on the Nigerian stock Exchange are random. The hypothesis was tested using the run test. The results of the run test indicate the prices series of the majority of the companies were nonrandom.

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.

Recommendation for Further Research

What will be the appropriate investment strategy for investors in the Nigerian 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 Implication

With the aforementioned writing, the implication of these results is that the Nigeria 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 Nigerian 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.

References

Abdmoulah, W., (2009). Testing the Evolving Efficiency of 11 Arab Stock Markets, *Working Papers 0907*, Arab Planning Institute, Kuwait, Information Center in API-working Series.

Abdul Haque, Hung-Chuu L. and Fakhar-Un-Nisa (2011). Testing the Weak form Efficiency of Pakistani Stock Market 2000-2010. *International Journal of Economics and Financial Issues,* Vol. 1(4), pp.153-162.

Abeysekera, S. P., (2001). Efficient Market Hypothesis and the Emerging Capital Market in Sri Lanker: Evidence from Colombo stock exchange.

Adelegan, O. J. (2004). How efficient is the Nigerian Stock Market? Further Evidence. *African Review OF Money, Finance and Bank*, 145-165.

Afego, Pyemo (2012). Weak-Form Efficiency on the Nigerian Stock Market: Empirical Analysis (1984-2009). *International Journal of Economics and Finance 2* (3), 340-347.

Aga, M., and B. Kocaman, (2008). Efficient Market Hypothesis and Emerging Capital Markets: Empirical Evidence from Istanbul Stock Exchange. *International* Research *Journal of Finance and Economics, 13,* 131-144.

Agbonifoh, B. A. and Yomere, G. O. (2002). Research Methodology in the Social Sciences and Education, Benin City: Centre Piece Consultancy Limited.

Agwuogbon, S. O. N; A. P. Adewole and A. N. Maduegbuna (2010). A Random Walk Model for Stock Market Prices, *Journal of Mathematics and Statistics 6*(3), 342-346.

Ajao, M. G. and Osayuwu, Richard (2012). Testing the Weak Form and Efficient Market Hypothesis in Nigerian Capital Market. *Accounting and Finance Research Journal 1*(1, 169-179).

Al-Ashikh, Abdulllah I. (2012). Testing the Weak-Form of Efficient Market Hypothesis and Day-of-the-Week Effect in Saudi Stock Exchange: Linear Approach. *International Review of Business Papers, 8,(* 6), pp. 27-54.

Alexander, S. S. (1964). *Price Movements in Speculative Markets: Trends or Random Walks.* M. I. T. Press.

Al-Khazali, O.M., D.K. Ding, and C.S. Pyun, (2007). A New Variance Ratio Test of Random Walk in Emerging Markets: A Revisit, *The Financial Review,* 42, 303-317.

Allen, D. (1985). *Finance: A Theoretical Introduction.* Third Edition: UK, Basil Blackwell Ltd.

Ang, J.S. and Pohlman, R.A. (1978) A Note on the Price behaviour of Far Eastern Stocks, *Journal of International Business Studies,* 9, 103-107.

Angelov, Nikolay (2009). Testing the Weak-Form Efficiency of the Bulgarian Sock Market. Discussion Papers DP|71|2009, Bulgarian National Bank.

Ayodeji, R. (1999) Weak Form Efficiency of the Nigerian Stock Market: Further Evidence, African Development Bank, *Blackwell Publisher*, 54-68.

Bachelier, L. (1964) Theory of Speculation, Gautheir-Villars, Paris 1900, in: *The Random Character of Stock Market Prices,* Cootner, P., MIT Press, Cambridge Mass, 17-78.

Barnes, P. (1986) Thin Trading and Stock Market Efficiency: The Case of the Kuala Lumpur Stock Exchange, *Journal of Banking Finance and Accounting*, 13(4), 609-617.

Bernstein, P. L. and D. Bostian (1974). *How to Forecast the Stock Market.* First Edition; Prentice-Hall, Inc., Englewood Cliff, New Jersey.

Black, F. and M. Scholes (1974). The effect of Dividend Yield and Dividend Policy on Common Stock Prices and Returns. *Journal of Financial Economics,* pp. 1-22.

Black, F., (1971). Implications of the Random Walk Hypothesis for Portfolio Management. *Financial Analysis Journal* 27, 16-22. http:/www,jstor.org/pss/4470785

Black, F., (1986) "Noise", *Journal of Finance*, 41 (3), 529-543.

Blake, D. (1990). *Financial Market Analysis.* Europe: McGraw Hill Book Company.

Bodie, Z., Keane, A., and Marcus, A. J. (2009). *Investments*. 8th Edition. United States of America: McGraw Hill.

Borges, M.R., (2008). Efficient Market Hypothesis European Stock Market. *Working Papers* 2008/20. Technical University of Lisbon, Department of Economics and Management (ISEG).

Brealey, R. A. and S. C. Myers (1996). *Principles of Corporate Finance*, Fifth edition, McGraw-Hill International Edition.

Brooks, C. (2002). *Introductory Econometrics for Finance.* Second edition, Mexico City: Cambridge University Press.

Brooks, C. (2008). Introductory Econometrics for Finance. Second edition, Mexico City: Cambridge University Press.

Buhlmann, H. (2005). *Mathematical methods in risk theory.* First edition, Springer, Oxford.

Campbell, J.Y., A.W. Lo, and A.G. MacKinlay, (1997). *The Econometrics of Financial markets,* Princeton, New Jersey: Princeton University Press.

Chopra, N; J. Lakonishok and J. Ritter (1992). Measuring Abnormal Performance, *Journal of Financial Economics*, pp. 235-268.

Chrest, G. (1978). Dividend Information, Stock Returns and Market Efficiency-11. *Journal of Financial Economics,* pp. 297-330.

Cooper, J. C. (1983). The Korean Stock Exchange: A qualitative and Quantitative Assessment, the Investment Analyst, 70. Pp. 5-12.

Cootner, P. H. (1964). The Random Character of Stock Market Prices. Cambridge, Mass; MIT Press.

Correia, C. Flynn, D. Uliana, E. and Wormald, M. (2011). Financial Management. Cape Town: Juta & Company.

Cuthbertson, Keith (1996). *Quantitative Financial Economic*, John Wiley & Sons, New York.

D'Ambrosio, C.A. (1980) Random Walk and the Stock Exchange of Singapore, *Financial Review*, 15, 1-12.

Elton, E. J. and M. J. Gruber(1991*). Modern Portfolio Theory and Investment Analysis.* Forth edition, John-Wiley and Sons, Inc; New York.

Emenike, Kalu, O. (2010). Efficiency from the Nigerian Stock Exchange. *International Journal of Management Science 1*(2).

Errunza, V. and E. Losq (1985). The behavior of Stock Prices on LDC Markets. Journal of Banking and Finance, 561-575.

Fama, E. F and K. R. French (1988). Permanent and Temporary Components of Stock Prices. *Journal of Political Economy 96*, 246-273.

Fama, E. F. (1970). Efficient Capital Market: A review of Theory and Empirical Work. *The Journal of Finance, 25*, 383-417.

Fama, E. F. (1991). Efficient Capital Market 11. *The Journal of Finance,* XLVI, 5.

Fama, E. F. (1995). Random Walks in Stock Market Prices*. Finance Analysis Journal 21,* 55-59.

Fama, E. F. (1995). Size and Book to Market factors in Earnings and Returns. *Journal of Finance, 25,* 383-714.

Fama, E.F. (1965) The Behaviour of Stock Markets Prices, *Journal of Business,* XXXVIII, 34-105.

Fama, E.F. (1976) Foundations of Finance. Basic Books, Nueva York.

Frimpong, Joseph Magnus (2008). Capital market efficiency: An analysis of weak-form efficiency on the Ghana stock exchange, *Journal of Money, Investment and Banking,5*; 6-12.

Gimba, V. K. (2011). Testing the weak-form efficiency market hypothesis: Evidence from Nigeria stock market. *CBN Journal of Applied Statistics 3*(1), 117-136.

Godwin. C. O. (2010). Stock market prices and the random walk hypothesis: further evidence from Nigeria. *Academic Journals.*

Grossman, S. J. and J. E. Stiglitz (19980). On the impossibility of informational efficient markets. *Journal of Financial Economics*, pp. 393-406.

Gujarati, D. N. (2003). *Basic Econometrics,* fourth Edition. TATA McGRAW-HILL EDITION.

Gupta, R. and J. Yang (2011). Testing weak-form efficiency in the Indian Capital Market. *International Research Journal of Finance and Economics*,75, pp. 108-119.

Gupta, R., and P.K. Basu, (2007)Weak Form Efficiency in Indian Stock Markets, *International Business & Economics Research Journal,* 6 (3), 57-64.

Gupta, Rakesh and Junhao Yang (2011). Testing weak form efficiency in the Indian Capital Market International Research. *Journal of Finance and Economics,* 75

Harris, L. (1989). A day-end transaction price anomally. *journal of Finance and Quantitative Analysis,* pp. 29-46

Harvey, C. (1993). Portfolio enhancement using emerging markets and conditioning information. *Working Paper World Bank.*

Hong, H. (1978) The Random Walk in Stock Markets: Theory and Evidence, *Securities Industry Review*, 25-29 in Othman, Y. and Ismail, I. (1993) Understanding the Behavioural Patterns of Stock Prices, Leeds Publication.

Ikenberry, D; J. Lakonnishok; and T. Vermaelen (1995). Market underreaction to open market share repurchases. *Journal of financial Economics;* pp. 23-54.

Ippolito, R. (1989). Efficiency with costly information: A study of mutual fund performance. *Quarterly Journal of Econometrics,* pp. 1-23.

Jegadeesh, N. (1990). Evidence of predictable behavior of security returns. *Journal of Finance, 45*, 881-898.

Jegadeesh, N. and S. Titman (1993). Returns to buying winners and selling losers: Implication for stock market efficiency. *Journal of Finance,* pp. 65-91.

Jensen, M. (1978). Some anomalous evidence regarding market efficiency. *Journal of Financial Economics, 6,* 95-101.

Karkmaz, M. and G. Akman (2010). Testing the weak form market efficiency on Istanbul Stock Exchange. *Trakia Journal of Science, 8* (3) pp. 39-49.

Kendall, M. G. (1953). The analysis of economic time series, part 1: prices. *Journal of the Royal Statistical Society,96,* 11-25.

Khan, A. Q. Sana, Ikram and Mariyam Mehtab (2011). Testing weak form efficiency of Indian Capital Market: A case of National Stock Excange (NSE) and Bombay Stock Exchange (BSE). *African Journal of Marketing Management,* 3(6), pp. 115-127.

Khandokar, S. H; Nur Alam Siddik and Md. Azam (2011). Test of weak form market efficiency of Dhaka Stock Exchange: Evidence from Bank sector of Bangladesh. *Interdisciplinary Journal of Research in Business, Vol. 1,* No. 9, pp. 47-60.

Khrakko, Vladimir (2013). Testing the weak form efficiency hypothesis in the Ukrainian Stock Market versus those of the USA, RUSSIA and POLAND. *ECONOMIKA, 9*(2).

Lim, K.P. and R.D. Brooks (2009) On the validity of conventional statistical tests given evidence of non-synchronous trading and non-linear dynamics in returns generating process: a further note, *Applied Economics Letters*, 16 (6), 649-652.

Lo, A.W., (2004) "The adaptive markets hypothesis: market efficiency from an evolutionary perspective", *Journal of Portfolio Management*, 30, 15-29.

Lo, A.W., and A.C. MacKinlay (1988) Stock market prices do not follow random walks: Evidence from a simple specification test, *The Review of Financial Studies,* 1, 41-66.

Lo, A.W., and A.C. MacKinlay, (1999) A non-random walk down Wall Street, Princeton University Press.

Malkiel, B. G. (2003). The efficient market hypothesis and its critics. *Journal of Economic Perspectives, 17*(1), 59-82.

Malkiel, B.G., (1999) *A Random Walk Down Wall Street*, W.W. Norton & Company, New York.

Mandelbrot, B. B. (1963). New methods in statistical economics. *Journal of Political Economy, Vol. 71*, No. 5, pp. 421-440.

Mandelbrot, B. B. (1966). Forecast of future prices, unbiased markets and martingale models. *Journal of Business, 30,* (S1), pp. 242-255.

Mikailu, A. and Sandra, A. U. (2007). Are stock returns randomly distributed? New evidence from Nigerian stock exchange. *Journal of Accounting and Finance, V.*

Mojekwu, J. N. and Ogege, Samson (2012). Econometric investigation of the random walk hypothesis in the Nigerian stock market.

Moore, E, (1964). Some characteristics of changes in common stock prices, in Cootner, Editor, *The Random Character of Stock Market Prices*, MIT Press, Cambridge, MASS.

Moustafa, M. A. (2004). Testing the weak form efficiency of the United Arab Emirates Stock Market. *International Journal of Business, 9*(3), pp. 309-325.

Nikata, M. P. and S. Soekarno (2012). Testing on weak-form market efficiency: the evidence from Indonesia Stock Market. *Second International Conference on Business, Economics, Management and Behavioural Science*, BEMBS, PP. 56-60.

Nisar, Saqip and Mohammad Hanif {2012). Testing weak form of efficient market hypothesis: Empirical evidence from South Asia. *World Applied science Journal 17*, (4), pp. 414-427.

Nwaolisa, E. F. and Kazie, E. G. (2012). Efficient market hypothesis: A historical perspective. (A study of Nigerian capital market). *Kuwait chapter of Arabian Journal of business and Management Review 1*(18), 76-86.

Nwosa, P. I. and Oseni, I. O. (2011). Efficient market hypothesis and Nigerian stock market. *Research journal of Finance and Accounting 2*(12), 38-56.

Odife, D. O. (1990). Improving the operational efficiency of the Nigerian Capital Market. Securities and Exchange Commission on the years of securities regulation in Nigeria, Lagos.

Ogege, Samson and J. N. Mojekwu (2013). Econometric investigation of the random walk hypothesis in the Nigeria stock market. Journal of Emerging *Issues in Economics, Finance and Banking 1*(5), 381-400.

Oke, M. O. and Azeez, B. A. (2012). A test of strong form efficiency of the Nigerian Capital Market. *Business systems Review.*

Okpara, G. C. (2010). Analysis of weak-form efficiency of the Nigerian stock market: further evidence from GARCH model. *The International Journal of Applied Economics and Finance, 4*(2), 62-66.

Osborne, M,. (1959). Brownian motion in stock market. *Operational Research,* 7(2), pp. 145-173.

Otaniyi, O. and Makina, Daniel (2010). Price behavior of new share listings in Nigeria. *International Business and Economics Research Journal, 9* (4).

Popoulis, A. (1984). Brownian movement and Markoff processes, chapter 15 in *Probability Random Variables And Stochastic Processes,* 2nd ed., New York, McGraw- Hill, 515-553.

Poshakwale, S. (1996), Evidence of weak-form efficiency and day of the week effect in the Indian stock market. *Finance India 10*(3), 605-616.

Poterbo, J. M. and L. H. Summer (1988). Mean reversion in stock returns: Evidence and implications, *Journal of Financial Economics, 22*,pp. 27-60.

Rapuchukwu, E. U. (2010). The efficient market hypothesis: Realities from the Nigerian stock market. *Global Journal of Finance and Management 2*(2), 321-331.

Robert, H. V. (1959). Stock market patterns and financial analysis: Methodological suggestions. *Journal of Finance,* 1-10.

Rutterford, J. (1983). *Introduction to stock exchange investment*. Second edition, 281-308. The Macmillan Press Ltd, London.

Saadi, S., D. Gandhi, and K. Elmawazini (2006) On the validity of conventional statistical tests given evidence of non-synchronous trading and non-linear dynamics in returns generating process, *Applied Economics,* 13 (5), 301-305.

Samuel, S. E. and Oko, R. U. (2010). Efficiency of the Nigerian Capital Market: implications for investment and analysis and performance. *Transactional Corporations Review, Vol. 2* No. 1, pp. 42-51.

Samuelson, P. A. (1973). Proof that properly discounted present values of assets vibrate randomly. *Bell Journal of Economics and Management Science,6*, 369-402.

Samuelson, P.A. (1965) Proof that properly anticipated prices fluctuate randomly, *Industrial Management Review*, 6 (2), 41-49.

Sandra, U. A, (2009). Test for random walk hypothesis on the Nigeria stock market. *Journal of Accounting and Finance, VII.*

Seiler, M.J. and W. Rom (1997) A historical analysis of market efficiency: Do historical returns a random walk? *Journal of Financial and Strategies Decisions,* 10 (2), 49-57.

Seppi, D. (1992) Block trading and information revelation around quarterly earnings announcements, *Review of Financial Studies*, pp. 281-309.

Shaker, Abu T. M. (2013). Testing the weak-form efficiency of the INNISH and SWEDISH Stock Markets. *European Journal of Business and Social Service, Vol 2* No. 9., pp. 176-185.

Sharpe,W. F. (2004). *Investments,* sixth edition, Prentice hall-India.

Siegel. J. J. (1998). *Stock for the long run. The definitive guide to financial market returns and long-term investment strategies.* McGraw- Hill. New York.

Siriopoulos, K. (1998). *Analysis and control of univariate financial time series,* Tipothito, Athens.

Stiglitz, J. E. (1981). The allocation role of the stock market pare to optimality and competition. *The Journal of Finance 36* (2), 235-251.

Sunde, T. and Zivanomoyo, J. (2008). The random walk hypothesis for the Zimbabwe stock exchange. *Journal of social science: Science Publication Audience,* Vol. 4 Issue 3.

Udoka, C. O. (2012). Weak form market efficiency: Dynamic effects of information on the Nigerian stock market. *Interdisciplinary Journal of Contemporary Research in Business 4*(7), 417-429.

Wong, K.A., and Kwong, K.S. (1984) The Behaviour of Hong Kong Stock Prices, *Applied Economics*, 905-917 in Othman, Y. and Ismail, I. (1993) Understanding the Behavioural Patterns of Stock Prices, Leeds Publications.

Wooldridge, Jeffrey M. (2006). *Introductory Econometrics.* Third Edition, (students edition), Thomson, South-West.

Appendix A
List of Stocks

Agric/Agro Allied
1. Livestock Feed Plc
2. Okomu Oil Palm Plc

Airline Services
3. Nigerian Aviation Handling

Automobile & Tyre
4. R.T. Briscoe Plc

Aviation
5. Albaka Air Plc

Banking
6. Access Bank Plc
7. First Bank of Nig. Plc
8. Union Bank Nig. Plc
9. UBA Plc

Breweries
10. Nig. Brew. Plc
11. Guinness Nig. Plc
12. International Brew. Plc

Building Materials
13. Ashaka Cement Coy.
14. Benue Cement Company
15. Nig. Ropes Plc

Chemical & Paints
16. Berger Paints
17. African paints (Nig.)
18. IPWA Plc

Commercial Services
19. National Sports Lottery
20. Red Star Express

Computer & Office Equipment
21. Hallmark Papers Production
22. Thomas Wyatt Nig. Plc

Conglomerates

23. SCOA Nig. Plc
24. UACN Plc
25. Unilever Nig. Plc

Construction

26. Costain (WA) Plc
27. Julius Berger Nig. Plc

Health

28. Glaxo Smith Line
29. May Baker Nig. Ltd

Information & Communication Technology (ICT)

30. Starcomms Plc

Insurance

31. AIICO Insurance Plc
32. Equity Assurance Plc

Media

33. Afromedia

Footwear

34. Lennards (Nig.) Plc

APPENDIX B
Sample Stock

S/NO.	STOCKS
1.	Livestock Feed Plc
2.	Nigerian Aviation Handling
3.	Okomu Oil Palm Plc
4.	R.T. Brisco
5.	ALBAKA Air Plc
6.	Access Bank Plc
7.	First Bank Nigeria Plc
8.	Union Bank of Nigeria Plc
9.	UBA Plc
10.	Nigerian Breweries Plc
11.	Guinness Nigeria Plc
12.	International Breweries Plc
13.	Ashaka Cement Company
14.	Benue Cement Company
15.	Nigerian Ropes Plc

16. Berger Paints
17. African Paints (Nig.)
18. IPWA Plc
19. National Sports Lottery
20. Red Star Express
21. Hallmark Papers Production
22. Thomas Wyatt Nigeria Plc
23. SCOA Nigeria Plc
24. UACN Plc
25. Unilever Nigeria Plc
26. Costain (WA) Plc
27. Glaxo Smithline
28. May & Baker Nigeria Ltd
29. AIICO Insurance Plc
30. Lennards (Nig.) Plc

APPENDIX C

<u>Figure 1: News Filter by Source and Subject</u>

1. Source:

The Wall Street Journal, The Wall Street Journal Online, The Economist Nigeria, The Nigerian Stock Exchange Journal, Business Week, Financial Times, Business Times, Financial Punch, This Day Business.

2. Company: Nigeria Stock Exchange
3. Subject:

Analysis or Commentary/Opinion or Corporate Digest, News or Economic Predictions/Forecasts or Personal announcements or Press Release, Ranking or Routine Market/Industrial News.

4. Country: NIGERIA
5. Industry: All Industries
6. Language: English
7. Date Range: Within one year (From January 2010 to January 2011)

APPENDIX D

S/ NO.	**WEEKS**	Livestock Feed Plc **P1**	Nigerian Aviation Handling **P2**	Okomu Oil Palm Plc **P3**	R.T. Brisco **P4**	ALBAKA Air Plc **P5**
1	06/01/10 – 13/01/10	0.59	7.18	22.75	6.5	0.58
2	13/01/10 – 20/01/10	0.59	7.18	22.75	6.23	0.58
3	20/01/10 –	0.59	8.1	22.75	6.23	0.58

	27/01/10					
4	27/01/10 – 03/02/10	0.59	8.81	22.75	6.23	0.58
5	03/02/10 – 10/02/10	0.61	9.1	22.75	6.2	0.58
6	10/02/10 – 17/02/10	0.61	9.1	21.2	6.2	0.58
7	17/02/10 – 24/02/10	0.64	9.3	21.2	6.2	0.58
8	24/02/10 – 03/03/10	0.63	9.41	21.2	6	0.58
9	03/03/10 – 10/03/10	0.63	9.41	20	6	0.58
10	10/03/10 – 17/03/10	0.65	9.5	20	6	0.58
11	17/03/10 – 24/03/10	0.61	9.6	20	5.83	0.58
12	24/03/10 – 31/03/10	0.61	9.53	19.85	5.83	0.58
13	31/03/10 – 07/04/10	0.62	9.56	19.85	5.8	0.58
14	07/04/10 – 14/04/10	0.64	9.56	19.85	5.8	0.58
15	14/04/10 – 21/04/10	0.62	10	18	5	0.58
16	21/04/10 – 28/04/10	0.63	10.05	18	5	0.58
17	28/04/10 – 05/05/10	0.62	10.05	18	5	0.58
18	05/05/10 – 12/05/10	0.62	10.2	15.57	4.85	0.58
19	12/05/10 – 19/05/10	0.65	10.23	15.57	4.85	0.58
20	19/05/10 – 26/05/10	0.65	10.2	15.57	4.5	0.58
21	26/05/10 – 02/06/10	0.66	10.25	14.8	4.5	0.58
22	02/06/10 – 09/06/10	0.66	10.5	14.8	4.45	0.58
23	09/06/10 – 16/06/10	0.68	10.5	14	4.45	0.58
24	16/06/10 – 23/06/10	0.68	10.5	14	4.4	0.58
25	23/06/10 – 30/06/10	0.68	10.7	14	4.4	0.58

26	30/06/10 – 07/07/10	0.7	10.8	14	4.4	0.58
27	07/07/10 – 14/07/10	0.7	10.85	13.57	4.28	0.58
28	14/07/10 – 21/07/10	0.7	10.5	13.57	4.28	0.58
29	21/07/10 – 28/07/10	0.66	10.5	13.57	4.28	0.58
30	28/07/10 – 04/08/10	0.6	10.36	12.2	3.76	0.58
31	04/08/10 – 11/08/10	0.6	10.36	12.2	3.76	0.58
32	11/08/10 – 18/08/10	0.61	10.2	12.2	3.76	0.58
33	18/08/10 – 25/08/10	0.61	10.2	12.56	3.5	0.58
34	25/08/10 – 01/09/10	0.62	10.15	12.56	3.5	0.58
35	01/09/10 – 08/09/10	0.62	10.18	12.56	3.45	0.58
36	08/09/10 – 15/09/10	0.62	10.2	13.1	3.45	0.58
37	15/09/10 – 22/09/10	0.6	10.2	13.1	3.4	0.58
38	22/09/10 – 29/09/10	0.61	10	13.1	3.4	0.58
39	29/09/10 – 06/10/10	0.61	10	13.43	3.33	0.58
40	06/10/10 – 13/10/10	0.62	10	13.43	3.33	0.58
41	13/10/10 – 20/10/10	0.64	9.85	14.43	3.3	0.58
42	20/10/10 – 27/10/10	0.64	9.8	13.8	3.3	0.58
43	27/10/10 – 03/11/10	0.61	9.8	13.9	3.2	0.58
44	03/11/10 – 10/11/10	0.61	9.8	13.57	3.2	0.58
45	10/11/10 – 17/11/10	0.64	9.85	13.57	3.2	0.58
46	17/11/10 – 24/11/10	0.64	9.85	13.8	3	0.58
47	24/11/10 – 01/12/10	0.64	9.85	13.8	3	0.58

48	01/12/10 – 08/12/10	0.64	9.85	13.9	3	0.58
49	08/12/10 – 15/12/10	0.63	9.8	14.1	3	0.58
50	15/12/10 – 22/12/10	0.63	9.8	15	2.9	0.58
51	22/12/10 – 29/12/10	0.63	9.8	15	2.9	0.58
52	29/12/10 – 05/01/11	0.63	9.8	15	2.9	0.58

S/NO.	WEEKS	Access Bank Plc P6	First Bank Nig. Plc P7	Union Bank of Nig. Plc P8	UBA Plc P9	Nig. Breweries Plc P10
1	06/01/10 – 13/01/10	7.55	14	6.25	10.81	53
2	13/01/10 – 20/01/10	7.55	14.1	6.25	10.81	53
3	20/01/10 – 27/01/10	7.55	14.05	6.25	10.81	53
4	27/01/10 – 03/02/10	8.22	14.7	6.55	11.86	55.01
5	03/02/10 – 10/02/10	8.22	14.7	6.55	11.86	55.01
6	10/02/10 – 17/02/10	8.22	14.7	6.55	11.86	55.01
7	17/02/10 – 24/02/10	8.22	14.5	6.55	11.86	55.01
8	24/02/10 – 03/03/10	8.22	14.5	6.3	11.8	55.3
9	03/03/10 – 10/03/10	8.18	14.5	6.3	11.8	55.3
10	10/03/10 – 17/03/10	8.18	14.1	6.3	11.8	55.3
11	17/03/10 – 24/03/10	8.18	14.1	6.3	11.8	55.3
12	24/03/10 – 31/03/10	8.18	14.1	6.2	11.8	55.5
13	31/03/10 – 07/04/10	8.1	14.3	6.2	11.5	55.5
14	07/04/10 – 14/04/10	8.1	14.3	6.2	11.5	55.5

15	14/04/10 – 21/04/10	8.1	14.3	6.2	11.5	55.7
16	21/04/10 – 28/04/10	8.07	14.1	6	11.5	55.7
17	28/04/10 – 05/05/10	8.07	14.1	6	11.35	58.1
18	05/05/10 – 12/05/10	8.07	14.05	6	11.35	58.1
19	12/05/10 – 19/05/10	8.05	14.05	5.7	11.35	58.1
20	19/05/10 – 26/05/10	8.05	14.05	5.7	11	58.1
21	26/05/10 – 02/06/10	8.05	13.9	5.7	11	60
22	02/06/10 – 09/06/10	8.03	13.75	5.23	11	60
23	09/06/10 – 16/06/10	8.03	13.75	5.23	10.4	60
24	16/06/10 – 23/06/10	8.03	13.5	5.23	10.4	61.13
25	23/06/10 – 30/06/10	8.08	13.1	5	10.4	61.13
26	30/06/10 – 07/07/10	8.02	13	5	10.45	61.13
27	07/07/10 – 14/07/10	8.02	12.8	4.99	10.37	63.05
28	14/07/10 – 21/07/10	8.02	12.8	4.99	10.37	63.05
29	21/07/10 – 28/07/10	8.02	13.4	4.99	10.37	63.05
30	28/07/10 – 04/08/10	9.2	13.96	5.65	10.99	70.3
31	04/08/10 – 11/08/10	9.2	13.96	5.65	10.99	77.3
32	11/08/10 – 18/08/10	9.2	13.96	5.65	10.99	77.3
33	18/08/10 – 25/08/10	9.2	13.94	5	10.99	77.3
34	25/08/10 – 01/09/10	9.25	13.94	5	10.23	77.3
35	01/09/10 – 08/09/10	9.25	13.94	5	10.23	77.25
36	08/09/10 – 15/09/10	9.27	13.94	5.1	10.23	77.25

37	15/09/10 – 22/09/10	9.27	13.9	5.1	10.11	77.25
38	22/09/10 – 29/09/10	9.27	13.9	5.1	10.11	77.13
39	29/09/10 – 06/10/10	9.27	13.9	5.1	10.11	77.13
40	06/10/10 – 13/10/10	9.3	13.9	4.9	10.11	77.13
41	13/10/10 – 20/10/10	9.3	13.92	4.9	9.93	77.1
42	20/10/10 – 27/10/10	9.3	13.92	4.9	9.93	77.1
43	27/10/10 – 03/11/10	9.31	13.92	4.5	9.93	77.1
44	03/11/10 – 10/11/10	9.31	13.92	4.5	9.3	77.08
45	10/11/10 – 17/11/10	9.31	13.93	4.5	9.3	77.08
46	17/11/10 – 24/11/10	9.31	13.93	4.5	9.3	77.08
47	24/11/10 – 01/12/10	9.31	13.93	4.5	9.3	77.08
48	01/12/10 – 08/12/10	9.33	12.93	4.45	9.09	77.06
49	08/12/10 – 15/12/10	9.33	13.7	4.45	9.09	77.06
50	15/12/10 – 22/12/10	9.33	13.7	4.45	9.1	77.06
51	22/12/10 – 29/12/10	9.33	13.7	4.45	9.1	77
52	29/12/10 – 05/01/11	9.64	13.70	4.29	9.15	77

S/NO.	WEEKS	Guinness Nig. Plc P11	Internal. Breweries Plc P12	Ashaka Cement Plc P13	Benue Cement Company P14	Nig. Ropes P15
1	06/01/10 – 13/01/10	127.5	2.25	11.58	43.01	9.14
2	13/01/10 – 20/01/10	127.5	2.25	12.1	43.5	9.14
3	20/01/10 – 27/01/10	128	5.01	13.5	44	9.14

4	27/01/10 – 03/02/10	128.7	5.01	14.07	50	9.14
5	03/02/10 – 10/02/10	128.7	5.01	14.1	50.11	9.14
6	10/02/10 – 17/02/10	130	5.01	14.1	50.11	9.14
7	17/02/10 – 24/02/10	130	5.01	14.5	50.21	9.14
8	24/02/10 – 03/03/10	130	5.01	14.59	50.23	9.14
9	03/03/10 – 10/03/10	131.2	5.2	14.59	50.23	9.14
10	10/03/10 – 17/03/10	131.2	5.2	14.59	50.27	9.14
11	17/03/10 – 24/03/10	132	5.2	15.13	50.3	9.14
12	24/03/10 – 31/03/10	132	5.2	15.2	50.3	9.14
13	31/03/10 – 07/04/10	132	5.26	15.37	50.36	9.14
14	07/04/10 – 14/04/10	136.2	5.26	15.4	50.37	9.14
15	14/04/10 – 21/04/10	136.2	5.26	16.1	51.1	9.14
16	21/04/10 – 28/04/10	136.2	5.5	16.11	51.39	9.14
17	28/04/10 – 05/05/10	140	5.5	16.11	51.43	9.14
18	05/05/10 – 12/05/10	140	5.5	16.2	53	9.14
19	12/05/10 – 19/05/10	140	5.78	17	53.38	9.14
20	19/05/10 – 26/05/10	141	5.78	17.1	55	9.14
21	26/05/10 – 02/06/10	145.2	5.78	17.3	57.1	9.14
22	02/06/10 – 09/06/10	145.2	5.78	17.5	59.3	9.14
23	09/06/10 – 16/06/10	150	6	18.03	60.17	9.14
24	16/06/10 – 23/06/10	150	6.25	18.05	61.17	9.14
25	23/06/10 – 30/06/10	153	6.3	18.6	61.8	9.14

26	30/06/10 – 07/07/10	154	6.3	18.9	61.89	9.14
27	07/07/10 – 14/07/10	158.51	6.84	19.79	62	9.14
28	14/07/10 – 21/07/10	158.6	6.87	19.83	62	9.14
29	21/07/10 – 28/07/10	159	6.87	19	63	9.14
30	28/07/10 – 04/08/10	162	6.99	19.15	63	9.14
31	04/08/10 – 11/08/10	162	6.99	19.15	63	9.14
32	11/08/10 – 18/08/10	162	7	19.18	-	9.14
33	18/08/10 – 25/08/10	165	7	19.21	-	9.14
34	25/08/10 – 01/09/10	165	6.78	20	-	9.14
35	01/09/10 – 08/09/10	166	6.78	20	-	9.14
36	08/09/10 – 15/09/10	167	6.56	20.03	-	9.14
37	15/09/10 – 22/09/10	167	6.56	20.05	-	9.14
38	22/09/10 – 29/09/10	167	6.56	20.11	-	9.14
39	29/09/10 – 06/10/10	170	6.4	20.11	-	9.14
40	06/10/10 – 13/10/10	170	6.4	20.5	-	9.14
41	13/10/10 – 20/10/10	170	6.4	22.1	-	9.14
42	20/10/10 – 27/10/10	171	6.36	23.11	-	9.14
43	27/10/10 – 03/11/10	171	6.36	23.9	-	9.14
44	03/11/10 – 10/11/10	171	6.23	24.13	-	9.14
45	10/11/10 – 17/11/10	175	6.15	25.11	-	9.14
46	17/11/10 – 24/11/10	175	6.15	26.01	-	9.14
47	24/11/10 – 01/12/10	175	6.15	26.15	-	9.14
48	01/12/10 –	177	6	26.19	-	8.89

	08/12/10					
49	08/12/10 – 15/12/10	180	6	26.4	-	8.89
50	15/12/10 – 22/12/10	185	6.4	26.44	-	8.59
51	22/12/10 – 29/12/10	185	6.4	26.51	-	8.59
52	29/12/10 – 05/01/11	190.58	6.42	26.51	-	8.59

S/NO.	WEEKS	Berger Paints P16	African Paints Nig. P17	IPWA Plc P18	National Sports Lottery P19	Red Star Express P20
1	06/01/10 – 13/01/10	3.2	3.49	1.45	4.35	2.15
2	13/01/10 – 20/01/10	3.23	3.49	1.45	4.35	2.23
3	20/01/10 – 27/01/10	3.3	3.49	1.45	4.35	2.4
4	27/01/10 – 03/02/10	3.36	3.49	1.38	3.57	2.59
5	03/02/10 – 10/02/10	3.6	3.49	1.35	3.57	3.15
6	10/02/10 – 17/02/10	3.6	3.49	1.35	3.57	3.17
7	17/02/10 – 24/02/10	3.61	3.49	1.35	3.57	3.33
8	24/02/10 – 03/03/10	3.61	3.49	1.35	3.57	3.4
9	03/03/10 – 10/03/10	3.61	3.49	1.35	3.57	3.17
10	10/03/10 – 17/03/10	3.7	3.49	1.35	3.57	3.11
11	17/03/10 – 24/03/10	3.77	3.49	1.35	3.57	3.09
12	24/03/10 – 31/03/10	3.77	3.49	1.35	3.57	3.18
13	31/03/10 – 07/04/10	3.77	3.49	1.35	3.57	3.2
14	07/04/10 – 14/04/10	4	3.49	1.35	3.57	3.22

15	14/04/10 – 21/04/10	4.01	3.49	1.35	3.57	3.29
16	21/04/10 – 28/04/10	4.01	3.49	1.35	3.57	3.31
17	28/04/10 – 05/05/10	4.93	3.49	1.35	3.57	3.43
18	05/05/10 – 12/05/10	4.93	3.49	1.35	3.57	3.48
19	12/05/10 – 19/05/10	4.93	3.49	1.35	3.57	3.54
20	19/05/10 – 26/05/10	5	3.49	1.35	3.57	3.7
21	26/05/10 – 02/06/10	5.15	3.49	1.35	3.57	3.77
22	02/06/10 – 09/06/10	5.15	3.49	1.35	3.57	4.01
23	09/06/10 – 16/06/10	5.23	3.49	1.35	3.57	4.01
24	16/06/10 – 23/06/10	5.26	3.49	1.35	3.57	4.07
25	23/06/10 – 30/06/10	6	3.49	1.35	3.57	4.07
26	30/06/10 – 07/07/10	6.17	3.49	1.35	3.57	4.12
27	07/07/10 – 14/07/10	6.29	3.32	1.09	3.57	4.12
28	14/07/10 – 21/07/10	6.37	3.32	1.09	3.57	4.09
29	21/07/10 – 28/07/10	6.41	3.32	1.09	3.57	4
30	28/07/10 – 04/08/10	6.52	3.32	0.99	3.57	3.5
31	04/08/10 – 11/08/10	6.57	3.32	0.99	3.57	3.46
32	11/08/10 – 18/08/10	6.77	3.32	0.99	3.57	3.46
33	18/08/10 – 25/08/10	6.8	3.32	0.99	3.57	3.46
34	25/08/10 – 01/09/10	6.8	3.32	0.99	3.57	3.3
35	01/09/10 – 08/09/10	6.83	3.32	0.99	3.57	3.3
36	08/09/10 – 15/09/10	7	3.32	0.99	3.57	3.11
37	15/09/10 –	7.21	3.32	0.99	3.57	3.11

	22/09/10					
38	22/09/10 – 29/09/10	7.27	3.32	0.99	3.57	3.11
39	29/09/10 – 06/10/10	7.9	3.32	0.99	3.57	3.07
40	06/10/10 – 13/10/10	7.92	3.32	0.99	3.57	3.07
41	13/10/10 – 20/10/10	7.99	3.32	0.99	3.57	3.07
42	20/10/10 – 27/10/10	8.77	3.32	0.99	3.57	3.05
43	27/10/10 – 03/11/10	8.79	3.32	0.99	3.57	3.05
44	03/11/10 – 10/11/10	8.83	3.32	0.99	3.57	3.05
45	10/11/10 – 17/11/10	8.88	3.32	0.95	3.57	3.05
46	17/11/10 – 24/11/10	8.93	3.32	0.95	3.57	3.05
47	24/11/10 – 01/12/10	8.97	3.32	0.95	3.57	3.05
48	01/12/10 – 08/12/10	9	3.32	0.95	3.57	3
49	08/12/10 – 15/12/10	9	3.32	0.95	3.57	2.9
50	15/12/10 – 22/12/10	9	3.32	0.95	3.57	2.88
51	22/12/10 – 29/12/10	9	3.32	0.95	3.57	2.88
52	29/12/10 – 05/01/11	8.8	3.32	0.99	3.57	2.88

S/NO.	WEEKS	Hallmark Paper Production P21	Thomas Wyatt Nig. Plc P22	SCOA Nig. Plc P23	UACN Plc P24	Unilever Nig. Plc P25
1	06/01/10 – 13/01/10	3.22	1.84	8.81	36.75	19
2	13/01/10 – 20/01/10	3.22	1.84	8.81	36.75	20.25
3	20/01/10 – 27/01/10	3.22	1.84	8.81	36.75	20.25

4	27/01/10 – 03/02/10	3.22	1.84	8.71	40	23.96
5	03/02/10 – 10/02/10	3.22	1.84	8.71	40	24
6	10/02/10 – 17/02/10	3.22	1.7	8.71	40	24
7	17/02/10 – 24/02/10	3.22	1.7	8.71	40	24
8	24/02/10 – 03/03/10	3.22	1.7	8.71	40	24
9	03/03/10 – 10/03/10	3.22	1.7	8.71	40	24
10	10/03/10 – 17/03/10	3.22	1.63	8.71	40	24
11	17/03/10 – 24/03/10	3.22	1.63	8.71	40	24
12	24/03/10 – 31/03/10	3.22	1.63	8.71	40	24
13	31/03/10 – 07/04/10	3.22	1.63	8.71	40	24
14	07/04/10 – 14/04/10	3.22	1.63	8.71	40	24
15	14/04/10 – 21/04/10	3.22	1.57	8.71	40	24
16	21/04/10 – 28/04/10	3.22	1.57	8.71	40	24
17	28/04/10 – 05/05/10	3.22	1.57	8.71	40	24
18	05/05/10 – 12/05/10	3.22	1.57	8.71	41	24
19	12/05/10 – 19/05/10	3.22	1.43	8.71	41	24
20	19/05/10 – 26/05/10	3.22	1.43	8.71	41	24
21	26/05/10 – 02/06/10	3.22	1.43	8.71	41	24
22	02/06/10 – 09/06/10	3.22	1.43	8.71	41	24
23	09/06/10 – 16/06/10	3.22	1.38	8.71	41	24
24	16/06/10 – 23/06/10	3.22	1.38	1.38	41.5	24
25	23/06/10 – 30/06/10	3.22	1.38	8.71	41.5	24
26	30/06/10 –	3.22	1.38	8.71	41	24

	07/07/10					
27	07/07/10 – 14/07/10	3.22	1.38	8.71	41.5	23.5
28	14/07/10 – 21/07/10	3.22	1.38	8.71	42.1	23.5
29	21/07/10 – 28/07/10	3.22	1.38	8.71	42.1	23.5
30	28/07/10 – 04/08/10	3.22	1.38	8.71	44	24
31	04/08/10 – 11/08/10	3.22	1.38	8.71	44	24
32	11/08/10 – 18/08/10	3.22	1.38	8.71	44	24
33	18/08/10 – 25/08/10	3.22	1.38	8.71	44	24
34	25/08/10 – 01/09/10	3.22	1.38	8.71	44	24
35	01/09/10 – 08/09/10	3.22	1.38	8.71	44	24
36	08/09/10 – 15/09/10	3.22	1.38	8.71	44	24
37	15/09/10 – 22/09/10	3.22	1.38	8.71	44	24
38	22/09/10 – 29/09/10	3.22	1.38	8.71	44	24
39	29/09/10 – 06/10/10	3.22	1.38	8.71	44	24
40	06/10/10 – 13/10/10	3.22	1.38	8.71	44	24
41	13/10/10 – 20/10/10	3.22	1.38	8.71	44	24
42	20/10/10 – 27/10/10	3.22	1.38	8.71	44	24
43	27/10/10 – 03/11/10	3.22	1.38	8.71	44	24
44	03/11/10 – 10/11/10	3.22	1.38	8.71	44	24
45	10/11/10 – 17/11/10	3.22	1.38	8.71	44	24
46	17/11/10 – 24/11/10	3.22	1.38	8.71	44	24
47	24/11/10 – 01/12/10	3.22	1.38	8.71	44	24
48	01/12/10 –	3.22	1.38	8.71	40	27.31

	08/12/10					
49	08/12/10 – 15/12/10	3.22	1.38	8.28	40	27.31
50	15/12/10 – 22/12/10	3.22	1.38	8.28	38	27.31
51	22/12/10 – 29/12/10	3.22	1.38	8.28	38	27.31
52	29/12/10 – 05/01/11	3.22	1.38	8.28	38	25.94

S/NO.	WEEKS	Costain (WA) Plc P26	Glaxo Smithline P27	May & Baker Plc P28	AIICO Insurance Plc P29	Lennards Nig. Plc P30
1	06/01/10 – 13/01/10	3.8	22.4	3.85	0.82	4.26
2	13/01/10 – 20/01/10	4	22.4	3.9	0.82	4.26
3	20/01/10 – 27/01/10	2.5	23	4.37	0.82	4.26
4	27/01/10 – 03/02/10	4.85	25.47	5.5	0.91	-
5	03/02/10 – 10/02/10	4.85	25.47	5.5	0.91	4.26
6	10/02/10 – 17/02/10	4.85	25.47	5.5	0.91	4.28
7	17/02/10 – 24/02/10	4.85	25.47	5.5	0.91	4.28
8	24/02/10 – 03/03/10	4.9	25.47	5.7	0.93	4.28
9	03/03/10 – 10/03/10	4.91	26	5.7	0.93	4.25
10	10/03/10 – 17/03/10	4.93	26	5.7	0.93	4.25
11	17/03/10 – 24/03/10	4.93	26	6	0.93	4.23
12	24/03/10 – 31/03/10	5.1	26	6	0.97	4.23
13	31/03/10 – 07/04/10	5.1	26.43	6	0.97	4.23
14	07/04/10 – 14/04/10	5.1	26.43	6	0.97	4.17
15	14/04/10 –	5.1	26.43	6.13	0.97	4.09

	21/04/10					
16	21/04/10 – 28/04/10	5.1	26.43	6.13	0.97	4
17	28/04/10 – 05/05/10	5.77	27	6.13	0.99	3.93
18	05/05/10 – 12/05/10	5.77	27	6.13	0.99	3.77
19	12/05/10 – 19/05/10	5.77	27	6.13	0.99	3.77
20	19/05/10 – 26/05/10	6.31	27.17	6.21	1.11	3.77
21	26/05/10 – 02/06/10	6.31	27.17	6.21	1.11	3.7
22	02/06/10 – 09/06/10	6.8	27.17	6.21	1.11	3.66
23	09/06/10 – 16/06/10	6.8	27.76	6.21	1.11	3.66
24	16/06/10 – 23/06/10	7.18	27.76	6.27	1.23	3.66
25	23/06/10 – 30/06/10	7.18	27.76	2.27	1.23	3.66
26	30/06/10 – 07/07/10	7.18	27.76	6.3	1.23	3.66
27	07/07/10 – 14/07/10	7.21	28	6.3	1.28	3.65
28	14/07/10 – 21/07/10	7	28.5	6.3	1.33	3.65
29	21/07/10 – 28/07/10	7	28.5	6.33	1.33	3.65
30	28/07/10 – 04/08/10	6.45	30	6	1.26	3.66
31	04/08/10 – 11/08/10	6.45	30	5.6	1.26	3.65
32	11/08/10 – 18/08/10	6.45	30	5.6	1.26	3.64
33	18/08/10 – 25/08/10	6.4	30	5.6	1.26	3.63
34	25/08/10 – 01/09/10	6.4	30	5.6	1.26	3.63
35	01/09/10 – 08/09/10	6.4	30	5.57	1.26	3.62
36	08/09/10 – 15/09/10	6.4	29.67	5.57	1.23	3.6
37	15/09/10 –	6.4	29.67	5.57	1.23	3.56

	22/09/10					
38	22/09/10 – 29/09/10	6.4	29.67	5.57	1.23	3.56
39	29/09/10 – 06/10/10	6.4	29.61	5.4	1.15	3.51
40	06/10/10 – 13/10/10	6.4		5.4	1.15	3.51
41	13/10/10 – 20/10/10	6.43		5.4	1.15	3.51
42	20/10/10 – 27/10/10	6.43		5	1.15	3.5
43	27/10/10 – 03/11/10	6.43		5	1.1	3.5
44	03/11/10 – 10/11/10	6.5		5	1.1	3.48
45	10/11/10 – 17/11/10	6.5		5	1	3.48
46	17/11/10 – 24/11/10	6.61		4.6	1	3.48
47	24/11/10 – 01/12/10	6.61		4.6	0.88	3.48
48	01/12/10 – 08/12/10	6.61		4.6	0.88	3.48
49	08/12/10 – 15/12/10	6.61		4.6	0.88	3.48
50	15/12/10 – 22/12/10	6.7		4.5	0.9	3.48
51	22/12/10 – 29/12/10	6.7		4.5	0.9	3.48
52	29/12/10 – 05/01/11	6.75		4.2	0.9	3.48

APPENDIX E
ACF
P1
Autocorrelations
Series: P1

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.041	.136	.093	1	.760
2	-.110	.135	.755	2	.686
3	-.062	.133	.973	3	.808
4	-.139	.132	2.082	4	.721
5	-.017	.130	2.099	5	.835

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P2
Autocorrelations
Series: P2

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.429	.136	9.945	1	.002
2	.148	.135	11.151	2	.004
3	.083	.133	11.539	3	.009
4	.179	.132	13.375	4	.010
5	.039	.130	13.464	5	.019

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P3
Autocorrelations
Series: P3

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.090	.136	.434	1	.510
2	.041	.135	.527	2	.768
3	.330	.133	6.650	3	.084
4	-.033	.132	6.712	4	.152
5	.110	.130	7.418	5	.191

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P4
Autocorrelations
Series: P4

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.249	.136	3.343	1	.068
2	-.129	.135	4.268	2	.118
3	.175	.133	5.984	3	.112
4	-.055	.132	6.158	4	.188
5	.029	.130	6.209	5	.286

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P6
Autocorrelations
Series: P6

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.041	.136	.092	1	.762
2	-.040	.135	.180	2	.914
3	-.024	.133	.213	3	.975
4	-.032	.132	.271	4	.992
5	-.010	.130	.277	5	.998

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P7
Autocorrelations
Series: P7

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.090	.136	.438	1	.508
2	.025	.135	.474	2	.789
3	-.062	.133	.690	3	.876
4	-.071	.132	.981	4	.913
5	-.103	.130	1.601	5	.901

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P8
Autocorrelations
Series: P8

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.046	.136	.115	1	.734
2	-.046	.135	.230	2	.891
3	-.135	.133	1.260	3	.739
4	-.075	.132	1.580	4	.812
5	-.135	.130	2.658	5	.753

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P9
Autocorrelations
Series: P9

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.023	.136	.028	1	.868
2	-.022	.135	.055	2	.973
3	.096	.133	.570	3	.903
4	-.108	.132	1.242	4	.871
5	-.027	.130	1.284	5	.937

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P10
Autocorrelations
Series: P10

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.318	.136	5.483	1	.019
2	-.114	.135	6.198	2	.045
3	.081	.133	6.571	3	.087
4	.074	.132	6.890	4	.142
5	-.112	.130	7.630	5	.178

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P11

Autocorrelations

Series: P11

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.294	.136	4.667	1	.031
2	.100	.135	5.218	2	.074
3	.194	.133	7.347	3	.062
4	.107	.132	8.010	4	.091
5	-.135	.130	9.074	5	.106

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P12

Autocorrelations

Series: P12

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.030	.136	.049	1	.824
2	-.008	.135	.053	2	.974
3	.006	.133	.055	3	.997
4	.000	.132	.055	4	1.000
5	-.005	.130	.057	5	1.000

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P13

Autocorrelations

Series: P13

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.266	.136	3.825	1	.050
2	-.035	.135	3.892	2	.143
3	-.089	.133	4.338	3	.227
4	.181	.132	6.214	4	.184
5	-.169	.130	7.890	5	.162

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P14
Autocorrelations
Series: P14

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.060	.174	.119	1	.730
2	.027	.171	.145	2	.930
3	.027	.168	.171	3	.982
4	-.034	.165	.215	4	.995
5	-.085	.161	.494	5	.992

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P15
Autocorrelations
Series: P15

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.041	.136	.091	1	.762
2	.467	.135	12.103	2	.002
3	-.020	.133	12.126	3	.007
4	-.021	.132	12.152	4	.016
5	-.004	.130	12.153	5	.033

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P16
Autocorrelations
Series: P16

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.122	.136	.801	1	.371
2	-.105	.135	1.410	2	.494
3	.147	.133	2.630	3	.452
4	-.038	.132	2.715	4	.607
5	-.102	.130	3.322	5	.650

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P17
Autocorrelations
Series: P17

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.020	.136	.022	1	.881
2	-.021	.135	.046	2	.977
3	-.021	.133	.072	3	.995
4	-.022	.132	.098	4	.999
5	-.022	.130	.127	5	1.000

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P18
Autocorrelations
Series: P18

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.036	.136	.072	1	.789
2	-.056	.135	.245	2	.885
3	.301	.133	5.355	3	.148
4	-.049	.132	5.492	4	.240
5	-.050	.130	5.637	5	.343

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P19
Autocorrelations
Series: P19

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.020	.136	.022	1	.881
2	-.021	.135	.046	2	.977
3	-.001	.133	.046	3	.997
4	-.002	.132	.047	4	1.000
5	-.002	.130	.047	5	1.000

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P20

Autocorrelations

Series: P20

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.363	.136	7.124	1	.008
2	.355	.135	14.065	2	.001
3	.179	.133	15.877	3	.001
4	.000	.132	15.877	4	.003
5	.019	.130	15.898	5	.007

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P22

Autocorrelations

Series: P22

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.093	.136	.467	1	.494
2	-.095	.135	.962	2	.618
3	-.097	.133	1.486	3	.685
4	.472	.132	14.301	4	.006
5	.014	.130	14.312	5	.014

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P23

Autocorrelations

Series: P23

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.500	.136	13.505	1	.000
2	.000	.135	13.505	2	.001
3	.000	.133	13.505	3	.004
4	.000	.132	13.505	4	.009
5	.000	.130	13.505	5	.019

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P24
Autocorrelations
Series: P24

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.000	.136	.000	1	.999
2	.235	.135	3.035	2	.219
3	.031	.133	3.088	3	.378
4	-.016	.132	3.104	4	.541
5	-.003	.130	3.104	5	.684

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P25
Autocorrelations
Series: P25

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.031	.136	.053	1	.818
2	.174	.135	1.722	2	.423
3	-.025	.133	1.756	3	.624
4	-.150	.132	3.045	4	.550
5	-.004	.130	3.045	5	.693

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P26
Autocorrelations
Series: P26

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.490	.136	12.964	1	.000
2	.052	.135	13.113	2	.001
3	.011	.133	13.120	3	.004
4	.010	.132	13.125	4	.011
5	.009	.130	13.130	5	.022

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

P27

Autocorrelations

Series: P27

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic Value	df	Sig.[b]
1	.053	.156	.114	1	.735
2	-.077	.154	.366	2	.833
3	-.040	.152	.435	3	.933
4	-.039	.150	.504	4	.973
5	.073	.147	.749	5	.980

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P28

Autocorrelations

Series: P28

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic Value	df	Sig.[b]
1	-.468	.136	11.836	1	.001
2	.006	.135	11.838	2	.003
3	.004	.133	11.839	3	.008
4	-.019	.132	11.859	4	.018
5	-.011	.130	11.867	5	.037

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P29

Autocorrelations

Series: P29

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic Value	df	Sig.[b]
1	.018	.136	.017	1	.896
2	.187	.135	1.938	2	.380
3	.040	.133	2.030	3	.566
4	.363	.132	9.611	4	.048
5	-.016	.130	9.627	5	.087

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

P30

Autocorrelations

Series: P30

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.376	.137	7.518	1	.006
2	.277	.134	11.769	2	.003
3	.333	.134	17.938	3	.000
4	.211	.134	20.418	4	.000
5	.021	.133	20.444	5	.001

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Reference to this paper should be made as follows: Agbam, Azubuike S. (2014), Tests of Random Walk and Efficient Market Hypothesis in Developing Economies: Evidence from Nigerian Capital Market. *J. of Business and Organizational Development Vol. 6, No. 2, Pp. 59 – 125.*