STOCK PRICE DYNAMICS FOR PRICES IN NAIROBI SECURITY EXCHANGE

by

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Abstract

In this study we analyze the stock prices movement in the Nairobi Security Exchange. The Nairobi Stock Exchange (N.S.E) was founded in 1954 as a voluntary organization of the stock brokers and is now one of the most active capital markets in Africa where market players buy and sell shares and other securities. The stock prices usually vary with time and this can be attributed to factors such as economic growth, climatic changes, government polices and political atmosphere. The trend of prices remains a challenge econometricians and statisticians. The objective of the study was to verify whether the price dynamics follow a random walk process or mean reversion. We used Dickey-Fuller Test for unit root in a simple regression model of prices return and the parameters were estimated by the method of ordinary least squares (O.L.S) estimates. This may help market players understand the dynamics of prices so that they can make meaningful decision.

Chapter 1

Introduction

1.1 Background information

In Kenya, dealing in shares and stock started in the 1920's when the country was still a British colony. However the market was not formal as there did not exist any rules. In 1954 the Nairobi Stock Exchange(N.S.E) was constituted as a voluntary organization of stock broker which is now one of the most active capital markets in Africa where market players buy and sell shares and securities. 1988 saw the first privatization through the N.S.E of the successful sale of 20% government stake in Kenya Commercial Bank. By February 1994 it was rated by the International Finance Corporation as the best performing market in the world with a return of 179% in dollar terms[17]. In July 2011, the Nairobi Stock Exchange limited changed its name to the Nairobi Securities Exchange limited. The change of name reflected the strategic plan of Nairobi Securities Exchange to evolve into a full service securities exchange which supports trading, clearing and settlement of equities, debt and associated instruments.

The thrust of the study was to investigate whether price of stocks in the Nairobi Security Exchange are mean reverting or follow a random walk process. The Nairobi Security Exchange being the heart of business in Kenya is one of the largest stock exchanges in Africa with the fourth largest trading volume across the continent. Its activities have a direct impact on macroeconomic variables such as inflation, Gross Domestic Product, investments and recession. Currently N.S.E. is trading more than 100 million shares each month and plays a large role in the economic growth of the country. Changes in prices of commodities or services are an important aspect of commerce. It is therefore important to study its dynamics during trade. This study compares models of Random Walk process and Mean Reversion for changes in prices of securities by testing historical data received during trade of stock. Such information may help traders to know the dynamics of the market which is paramount in making meaningful decision on the behavior of stock and its equilibrium.

1.2 Statement of the Problem

Forecasting price changes in the N.S.E remains one of the greatest challenges facing econometricians and statisticians. The market players are equally more interested to know trends of prices over time so that they can make wise decisions. No scholar and practioner has studied the data from the N.S.E. to find out if they follow a random walk process or mean reversion.

1.3 Objective of the Study

The main objective of this study is to find out if the change in prices of stock in Nairobi Security Exchange follow a random walk process or are mean reverting.

1.4 Research Methodology

The historical data of stock prices from January 2008 to December 2012 were collected from Nairobi Security Exchange. The data were then organized such that there were columns for change in price against the previous price as required by the use of Dickey-Fuller unit root test and the parameters were estimated by the use of Ordinary Least square methods. So when comparing the computed test statistic and critical value, the null hypothesis is rejected if the computed value is smaller than the critical value. Note that this is a one- tailed test i.e. the null hypothesis is rejected when t-value >critical value.

1.5 Significance of the Study

The study may provide an insight for testing historical data received during trade of securities by market players in understanding the behavior of price changes. They may use valuation techniques to ascertain the true value of security in the market. For example consider the question of investment strategy. If stock price movements contain large transitory component, then for long horizon investors, the stock market may be much less risky.

Chapter 2

Literature Review

The random walk hypothesis is a financial theory stating that stock market prices evolve according to a random walk and thus prices of the stock cannot be predicted. It is consistently with the efficient market hypothesis. The concept can be traced to French broker Jules Regnault who publish a book in 1863 and later by Louis Bachelier in 1900 whose PhD dissertation was titled "Theory of speculation"[1]. Some ideas were later developed by MIT Sloan School of management professor Paul H. Cootner in his book 'The Random character of stock prices [5] The term was popularized by Burton G Malkiel in 1973 [3] in his book entitled A Random walk Down Wall Street.

Conversely the Mean Reversion hypotheses states that both stocks high and low prices are temporary and that a stock will tend to move to the average price over time. When the current market price is less than the average then the stock is considered attractive for purchase.

Martin Weber a leading researcher in behavior finance observed the stock market for ten years. Throughout that period he looked at the market prices for noticeable trends and found that stocks with high prices increase in the first five years and tended to become under performers in the following five years. According to him, there are trends and other tips to predict the stock market[21].

Scholars and practitioners have long been interested in the time series properties of stock prices, with particular attention on whether stock prices can be characterized as a pure random walk or mean reverting process. These time series properties are not only of interest by themselves, but have important implications for stock market efficiency. If stock prices follow a mean-reverting process, then there exists a tendency for the price level to return to its long run trend path over time, allowing market participants to forecast future returns by using past information on stock prices.

Conversely, if stock prices follow random walk processes, then any shock to stock prices will infinitely occur, so that there is no tendency for the price level to return to its trend over time. This implies that future stock prices are unpredictable based on historical observations.

In recent times, the empirical evidence has rejected the hypothesis that stock prices are random walk processes. Studies by, inter alia, DeBondt W.F.M, and Thaler R (1985) [6], French, K.R. and Roll,R. (1986) [9], O'Brien (1987) [18], Lo and MacKinlay (1988) [16], Fama and French [8] and French and Roll (1988) [9], Cochran S.J. and DeFina R.H (1994) [4], find that stock prices contain a strong mean reverting component. This is in contrast to, inter alia, Granger and Morgenstern (1963) [11], LeRoy (1982) [15], Kim et al. (1991) [13], Richardson and Stock (1989)[20], who find that stock returns are unpredictable, and that stock prices follow a random walk or martingale process.

Much of the extant literature that has tested the hypothesis of mean reversion in stock prices has tended to focus on a single country, particularly the US, or a geographical region, such as Europe. With the exception of a handful of studies, the majority of stock markets around the world have been neglected. Furthermore, only the studies by Poterba and Summers (1988) [19] and Cochran and DeFina (1994) [4] provide some evidence on the behavior of stock prices. However, none of these studies include many of the notable or better performing stock markets, from other regions of the world. The study by Gallagher and Taylor (2000) [10] employs a more sophisticated technique that departs from the extant literature. They use the Kalman filter to decompose real stock price into its permanent, seasonal and temporary components, to measure the size of the transitory, or mean reverting, component in stock prices.

Since then, however, it would appear that scholars and practitioners have not employed this approach to decompose real stock prices into their unobserved components.

Chapter 3

Basic Concepts

3.1 The random walk process

The random walk property is given by

$$P_t = P_{t-1} + \epsilon_t,$$

where P_t is the price of the stock, P_{t-1} is the previous price of the stock, t is the time index, ϵ_t is the disturbance term with distribution $iid(0, \sigma_t^2)$. In statistics, the Dickey-Fuller test is used in testing whether a unit root is present in an autoregression model. It was named after the statistician D.A Dickey and W.A Fuller who developed the test in 1979 [7]. A simple

Autoregression(AR(1)) model is

$$P_t = \alpha P_{t-1} + \epsilon_t,$$

where α is the coefficient of the previous price. A unit root is present if $\alpha = 1$. The model would be non stationary in this case. The regression model can be written as

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

$$= (\alpha - 1)P_{t-1} + \epsilon_t$$

$$\Delta P_t = \beta P_{t-1} + \epsilon_t, \tag{3.1}$$

where $\beta = (\alpha - 1)$. β is the autoregressive parameter. β in this case depicts the rate of change between ΔP_t against P_{t-1}. The slope measures the rate of change of the present price of the stock to that of the immediate past price. The unknown parameter β is estimated by the Method of ordinary least squares.

The significance of β is tested as a one sided t-test because the alternative $\alpha > 1$ or $\beta > 0$ is ruled out as implying unreasonable explosive behavior.

The problem is that the test statistic associates with $\hat{\beta}$ is non standard. If P_t is stationary a variable, then $\hat{\beta}$ would asymptotically follow a normal distribution and standard test would be possible. It can be shown that if P_t is a random walk, the distribution of $\hat{\beta}$ is skewed under the null hypothesis. Dickey and Fuller simulated the correct test statistics, $H_0 : \hat{\beta} = 0$ under the assumption of random walk process. Instead of using standard t-table to perform t-test, we use non-standard Dickey-Fuller distribution to obtain critical values. (Note that the Dickey-Fuller distribution changes depending on how the test equation is set up).

In any event, our test of hypothesis is given by

$H_0 : \alpha = 1(or\beta = 0)$

vs

$H_1 : \beta < 0.$

Under null hypothesis H_0, P_t has a unit root i.e Prices follow a random walk process.

The alternative hypothesis is given by

H_1:$\beta < 0$, P_t is stationary i.e Prices follow mean reversion.

3.2 Method of Curve Fitting by the Principal of Ordinary Least Squares.

The principal of least squares provides us an analytical or mathematical device to obtain an objective fit to the trend of the given time series. Most of the data relating to economic and business time series conform to definite laws of growth or decay accordingly. In such a situation analytical trend fitting will be more reliable for forecasting and predictions. This technique can be used to fit linear as well as non linear trends. Let the straight line trend between the given price change ΔP_t and the previous price P_{t-1} be given by equation (3.1)

Let $\mathbf{Y} = \Delta P_t$, $\mathbf{X} = P_{t-1}$ and $\mathbf{e}^* = \epsilon_t$. Let $\hat{\beta}$ be the coefficient since this is a simple linear model. This in turn serves to define a vector of errors, or residuals,

$\mathbf{e}^* = \mathbf{Y}$- $\hat{\beta}\mathbf{X}$. The least squares principle for choosing $\hat{\beta}$ is to minimize the sum of squared residual,

$$\mathbf{e}*^T \mathbf{e}* = (\mathbf{Y} - \hat{\beta}\mathbf{X})^T(\mathbf{Y} - \hat{\beta}\mathbf{X})$$

$$= \mathbf{Y}^T\mathbf{Y} - 2\hat{\beta}^T\mathbf{X}^T\mathbf{Y} + \hat{\beta}'\mathbf{X}^T\hat{\beta}$$

$$\frac{\partial(\mathbf{e}*^T\mathbf{e}*)}{\partial\hat{\beta}} = -2\mathbf{X}^T\mathbf{Y} + 2\mathbf{X}^T\mathbf{X}\hat{\beta} \tag{3.2}$$

Thus the necessary condition for a stationary point requires that we set equation (3.2) equal to the **0** vector. Denoting the resultant O.L.S solution for $\hat{\beta}$,simply by β gives

$$\mathbf{X}^T\mathbf{X}\beta = \mathbf{X}^T\mathbf{Y} \tag{3.3}$$

.

These are referred to as the O.L.S normal equations. The assumption is that$\mathbf{X}^T\mathbf{X}$ is nonsingular. Thus an equivalent expression for $\hat{\beta}$ is

$$\hat{\beta} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T\mathbf{Y} \tag{3.4}$$

.

The vector of O.L.S residuals is likewise denoted by $\mathbf{e}*$, where $\mathbf{e}* = \mathbf{Y}$- $\hat{\beta}$ $\mathbf{X}$. Using the expression to substitute for $\mathbf{Y}$ in equation (3.3) gives

$$\mathbf{X}^T\mathbf{X}\hat{\beta} = \mathbf{X}^T\mathbf{X}\hat{\beta} + \mathbf{X}^T\mathbf{e}*.$$

Thus

$$\mathbf{X}^T\mathbf{e}* = \mathbf{0} \tag{3.5}$$

This is a fundamental O.L.S. results. The first element in this equation gives $\bar{e*} = 0$. That is the residuals from the O.L.S. regression always have zero mean, provided that the equation contains a constant term. The remaining element in equation (3.5) states that the residual has zero sample correlation with each $\mathbf{X}$ variable.

To establish that the stationary point does indeed correspond to a minimum of the sum of squares, differentiate equation (3.4) with respect to $\hat{\beta}$ to obtain

$$\frac{\partial^2(\mathbf{e}*^T \mathbf{e}*)}{(\partial\hat{\beta}^2)} = 2\mathbf{X}^T\mathbf{X} \tag{3.6}$$

This gives a minimum provided $\mathbf{X}^T\mathbf{X}$ is positive definite. Hence results to equation (3.4).

3.3 Augmented Dickey-Fuller test

The text books exposition of unit root testing vary widely in character, I have chosen ADF t- Test of α-1 =0 by testing β=0. The test statistics for augmented Dickey -Fuller test is

$$t_{\alpha=1} = \frac{\hat{\beta}-1}{S.E(\hat{\beta})}, \tag{3.7}$$

where $\hat{\beta}$ is the least square estimate and S.E($\hat{\beta}$) is the standard error of estimate which is given by

$$S.E(\hat{\beta}) = \sqrt{\frac{\sum(Y - \hat{Y})^2}{n-2}} \tag{3.8}$$

where n-2 is the degree of freedom.

The critical value tabulated in Dickey -Fuller distribution table of 1976 for the model under study without drift at 5% level is -1.95 (see fig.1). So when comparing the computed test statistics and the critical value, the null hypothesis is rejected if the computed value is smaller than the critical value .i.e if Computed t value > ADF Critical t value,do not reject the null hypothesis.

3.4 The disturbance term

The disturbance term ϵ_t denotes a stochastic variable with some specified probability distribution. The purpose of the ϵ_t term is to characterize the discrepancies that emerge between the actual observed values of Y and the values that would be given by an exact functional relationship.

We cannot predict the specific value of ϵ_t that will emerge in any single observation,but we can make proposition about the main features of its probability distribution. The first assumption of ϵ_t is that its average or expected value is zero, that is

$$E(\epsilon_t) = 0$$

3.5 The theory of Dickey-Fuller test

In Statistics, the Dickey-Fuller test tests whether a unit root is present in an autoregressive model. It is named after the statistician D.A Dickey and W.A. Fuller who developed the test in 1979. A Simple Autoregression (AR (1)) model is

$$P_t = \alpha P_{t-1} + \epsilon_t, \tag{3.9}$$

where P_t is the variable of interest, t is the time index, α is a coefficient and ϵ_t is the error term. A unit root is present if α =1. The model would be non-stationary in this case. The regression model can be written as

$$\Delta P_t = (\alpha - 1)P_{t-1} + \epsilon_t \tag{3.10}$$

$$= \beta P_{t-1} + \epsilon_t, \qquad (3.11)$$

where Δ is the first operator. This model can be estimated and testing for a unit root is equivalent to testing $\beta = 0$ (where $\beta = \alpha$-1). Since the test is done over residual term rather than raw data, it is not possible to use t-distribution to provide critical values. Therefore this statistic t has specific distribution table known as Dickey-Fuller table. There are three main version of the test namely:

1. Test for a unit root.

$$\Delta P_t = \beta P_{t-1} + \epsilon_t$$

2. Test for a unit root with a drift.

$$\Delta P_t = \beta P_{t-1} + a_0 + \epsilon_t$$

3. Test for unit root with drift and deterministic time trend

$$\Delta P_t = \beta P_{t-1} + a_0 + a_1 t + \epsilon_t$$

where a_0 denote a drift and $a_1 t$ is the deterministic time trend. Each version of the test has its own critical value which depends on the size of the sample. In each case, the null hypothesis is that there is a unit root,i.e $\beta = 0$. The three tests have low statistical power in that they often can not distinguish between true unit root processes ($\beta = 0$) and near unit root processes (β is close to zero). This is called the near observation problem.

The intuition behind the test is that if the series P_t is stationary (or trend stationary), then it has a tendency to return to a constant (or deterministically trending mean). Therefore large values tend to be followed by smaller values (negative changes) and small values tend to be followed by larger values (positive changes). Accordingly, the level of the series will be a significant predictor of the next period change and will have a negative coefficient. If on the other hand, the series is integrated, then positive changes will occur with probability that do not depend on the current series, i.e in a random walk.

Hence for case [2]

$$\Delta P_t = a_o + \epsilon_t$$

has a random walk property. When it is integrated, it is written as

$$P_t = P_o + \sum_{i=1}^{t} \epsilon_i + a_o t$$

which has a deterministic trend coming from $a_o t$ and a stochastic intercept coming from $P_o + \sum_{i=1}^{t} \epsilon_i$ resulting in what is referred to as a stochastic trend. It implies that where you are now does not affect which way you will go next. For example the price today does not affect the price tomorrow.

3.6 Mean reversion process

Mean reversion is equivalent to stationary.Shock to prices are temporary,so that returns are negatively autocorrelated at certain horizon. Mean reversion thus implies that returns are predictable based on lagged prices. Conversely, predictability of returns based on lagged prices need not imply mean reverting, for example predictable explosive process are not mean reverting.

Markets are the result of many decisions made by people every day and if one can discover patterns in the people making these decisions, there is the potential to profit from this predictability. Many people overweigh recent data when making forecasts and this behavioral bias can create trading opportunity.

Chapter 4

Data Analysis

In this chapter, we give results from the analysis of data for the Nairobi Security Exchange for stock prices of five companies namely Sasini Ltd, Access Kenya, Kenya Commercial Bank, Mumias Sugar Company and Express Ltd. The period covered in this study is five years from January 2008 to December 2012. The companies have been chosen from five different categories based on highest volume of capital shares handled in their respective categories. These categories are Agricultural, Commercial and Services, Finance and Investment, Industrial and Allied, Alternative investment market segment. These companies must have taken five years. The stock price of the day is obtained by getting the average of the lowest price and highest price. The monthly price is obtained by summing up daily prices of the month divided by the number of days obtained in their respective months. The average monthly data is then group into three (Quarterly). The data used is for the mean of successive three months (P_{t-1}) and their respective change in price (ΔP_t). The model for Dickey-Fuller is

$\Delta P_t = \beta P_{t-1} + \epsilon_t$ where

$\Delta P_t = P_t - P_{t-1}$, P_{t-1} is the previous price of the stock and P_t is the current price of the stock.

4.1 Results

The mean of successive three months (P_{t-1}) and change in stock prices (ΔP_t) for Sasini limited were computed and are displayed on Table 4.1 between January 2008 and December 2012.

Let ΔP_t be represented by Y and P_{t-1} be X. Using ordinary least square estimate to determine $\hat{\beta}$ we get

$$X^T X = 2598.84$$

and

$$X^T Y = -9.275$$

These give

$$\hat{\beta} = (X^T X)^{-1}(X^T Y) = -0.00357.$$

But

$$Y = \beta X + \epsilon_t$$

and hence the estimate is given by

$$\hat{Y} = \hat{\beta} X$$

Therefore

$$\Sigma(Y - \hat{Y})^2 = 70.6832.$$

where

$$n - 2 = 18.$$

The standard error is given by

$$S.E(\hat{\beta}) = \sqrt{\frac{\sum(Y - \hat{Y})^2}{n - 2}} \tag{4.1}$$

$$= 1.98162.$$

The test statistic is given by

$$t_{\alpha=1} = \frac{\hat{\beta} - 1}{S.E(\hat{\beta})} = \frac{-1.00357}{1.98162} = -0.50644.$$

Since the computed t value is greater than tabulated critical value of -1.95, we fail to reject the null hypothesis. The prices of Sasini limited do follow a random walk process.

The mean of successive three months (P_{t-1}) and change in stock prices (ΔP_t) for Access Kenya limited were computed and are displayed on Table 4.2 between January 2008 and December 2012.

Using ordinary least square estimate to determine $\hat{\beta}$.

$$(X^T X) = 6789.3325$$

and

$$X^T Y = -189.4275$$

The estimate of the coefficient is therefore given by

$$\hat{\beta} = (X^T X)^{-1} X^T Y$$

$$= -0.0279$$

To get the standard error of $\hat{\beta}$, since

$$\sum(Y - \hat{Y})^2 = 203.6798$$

then from equation (3.5)

$$S.E(\hat{\beta}) = \sqrt{\frac{203.6798}{18}}$$

$$= 3.363859$$

The computed statistical t value is

$$t_{\alpha=1} = \frac{-1.0279}{3.363859}$$

$$= -0.30557.$$

Since the computed t value is larger than the A.D.F critical value, we fail to reject the null hypothesis. i.e unit root exist. The prices of Access Kenya limited follow a random walk process

The Kenya Commercial Bank is categorized under Finance and investment in Nairobi Security Exchange. The mean of successive three months (P_{t-1}) and change in stock (ΔP_t) are displayed on Table 4.3.

The least squares results for K.C.B are given as follows:

$$X^T X = 10592.465.$$

and

$$X'Y = 161.985.$$

From equation(3.3) the coefficient therefore becomes

$$\hat{\beta} = \frac{161.985}{10592.465} = 0.01529.$$

Using equation (3.5) gives the standard error of $\hat{\beta}$

$$S.E(\hat{\beta}) = \sqrt{\frac{188.2992627}{18}}$$

$$= 3.234357742.$$

The computed statistical t value using equation (3.5) becomes

$$t_{\alpha=1} = \frac{-0.98471}{3.234357742}$$

$$= -0.304453.$$

The computed t-statistic is larger than the critical value (at the 5% level i.e -1.95). We conclude that the test statistic is not significant. We accept the null hypothesis. Prices of stock for Kenya commercial bank follow a random walk process

Mumias Sugar Company is categorized under industrial and Allied in the Nairobi Security Exchange. The mean of successive three months (P_{t-1}) and change in stock (ΔP_t) for Mumias Sugar limited were computed and are displayed on Table 4.4.

Using ordinary least square estimates gives

$$X^T X = 1181.825.$$

and

$$X^TY = -41.75.$$

The coefficient is given by

$$\hat{\beta} = \frac{-41.75}{1181.825}$$

$$= -0.0353.$$

using equation (3.3),

From equation(3.6) we get the standard error of $\hat{\beta}$ as

$$S.E(\hat{\beta}) = \sqrt{\frac{48.7861031}{18}}$$

$$= 1.64336.$$

The computed test statistic is given by

$$t_{\alpha=1} == \frac{-1.0353}{1.64336}$$

$$= -0.629990$$

using equation(3.5).

For a one sided test with 18 degrees of freedom, the critical value for t is -1.95 (at the 5% level). We will accept H_0 since $t_{\alpha=1} >$ -1.95 and conclude that prices of Mumias Sugar company follow a random walk process

Express Kenya limited company is categorized under Alternative investment market segment in the Nairobi Security Exchange. The data for Express Kenya limited was analyzed to get the results on Table 4.5.

The ordinary least square estimates are given as follows:

$$\hat{\beta} = (X^T X)^{-1} X^T Y$$

$$X^T X = 2296.7375.$$

and

$$X^T Y = -90.8075$$

The coefficient is given by

$$\hat{\beta} = \frac{-90.8075}{2296.7375}$$

$$= -0.0395376$$

using equation (3.3).

Since

$$\sum(Y - \hat{Y})^2 = 50.85455$$

then

$$S.E(\hat{\beta}) = \sqrt{\frac{50.825253}{18}}$$

$$= 1.680848827$$

using equation (3.6) The computed t-test statistic is given by

$$t_{\alpha=1} = \frac{-1.0395376}{1.680848827}$$

$$= -0.6184599$$

from equation (3.5).

For a one sided test with 18 degrees of freedom, the critical t value is -1.95 (at the 5% level). Since computed t value is larger than the critical value, we will accept H_0 and conclude that prices of Express Kenya limited follow a random walk process

Table 4.1: Change in price against the previous price for Sasini limited.

$YEAR$	$QUARTER$	P_{t-1}	ΔP_t
2008	1	14.95	0
	2	14.80	-0.15
	3	11.90	-2.90
	4	7.30	-4.60
2009	1	5.65	-1.65
	2	5.90	0.25
	3	6.35	0.45
	4	7.25	0.9
2010	1	10.25	3.00
	2	14.4	4.15
	3	13.90	-0.50
	4	13.40	-0.5
2011	1	11.65	-1.75
	2	10.85	-0.80
	3	11.05	0.2
	4	13.05	2.00
2012	1	11.70	-1.35
	2	11.85	0.15
	3	12.65	0.80
	4	11.55	-1.10

Table 4.2: Change in price against the previous price for Access Kenya limited.

$YEAR$	$QUARTER$	P_{t-1}	ΔP_t
2008	1	24.65	0
	2	32.00	7.35
	3	31.50	-0.50
	4	21.55	-9.95
2009	1	21.20	-0.35
	2	21.40	0.20
	3	23.10	1.70
	4	22.05	-1.05
2010	1	21.20	-0.85
	2	18.45	-2.75
	3	18.35	-0.10
	4	16.40	-1.95
2011	1	11.70	-4.70
	2	9.50	-2.20
	3	6.20	-3.30
	4	5.25	-0.95
2012	1	4.50	-0.75
	2	4.75	0.25
	3	4.75	0.0
	4	4.45	-0.30

Table 4.3: Change in price against the previous price for Kenya Commercial Bank.

$YEAR$	$QUARTER$	P_{t-1}	ΔP_t
2008	1	26.45	0
	2	30.65	4.20
	3	28.75	-1.90
	4	22.50	-6.25
2009	1	18.75	-3.75
	2	19.90	1.15
	3	21.85	1.95
	4	20.10	-1.75
2010	1	21.55	1.45
	2	21.30	-0.25
	3	18.80	-2.50
	4	21.85	3.05
2011	1	23.20	1.35
	2	25.40	-2.20
	3	20.85	-4.55
	4	16.15	-4.70
2012	1	19.20	3.05
	2	23.05	3.85
	3	25.30	2.25
	4	28.70	3.40

Table 4.4: Change in price against the previous price for Mumias sugar company.

$YEAR$	$QUARTER$	P_{t-1}	ΔP_t
2008	1	12.85	0
	2	12.35	-0.50
	3	10.35	-2.00
	4	6.95	-3.40
2009	1	4.70	-2.25
	2	5.95	1.25
	3	6.65	0.70
	4	6.75	0.10
2010	1	9.60	2.85
	2	7.60	-2.00
	3	6.55	-1.05
	4	5.70	-0.85
2011	1	8.50	2.80
	2	7.60	-0.90
	3	6.55	-1.05
	4	5.70	-0.85
2012	1	4.90	-0.80
	2	5.70	0.80
	3	6.55	0.85
	4	5.60	-0.95

Table 4.5: Change in price against the previous price for Express Kenya.

$YEAR$	$QUARTER$	P_{t-1}	ΔP_t
2008	1	21.90	0
	2	20.45	-1.45
	3	17.90	-2.55
	4	13.20	-4.70
2009	1	11.30	4.35
	2	9.25	-2.05
	3	9.55	0.30
	4	8.80	-0.75
2010	1	9.35	0.55
	2	9.70	0.35
	3	9.55	-0.15
	4	9.05	-0.50
2011	1	7.15	-1.90
	2	4.70	-2.45
	3	4.25	-0.45
	4	3.95	-0.30
2012	1	4.05	0.10
	2	3.90	-0.15
	3	3.90	0.00
	4	3.75	-0.15

Conclusions and Recommendations

Our study was to find out if the prices of stock in Nairobi Security Exchange follow a random walk process or are mean reverting. Five companies were selected from different categories according to the volume of their shares between January 2008 and December 2012. The Stock prices for Nairobi Security Exchange was analyzed for five years using Dickey-Fuller t test. Since the computed t values for all the companies namely Sasini limited (-0.50644), Access Kenya (-0.30557), Kenya Commercial Bank (-0.304453), Mumias Sugar Company (-0.629990) and Express Kenya limited (-0.6184599) is more than the critical value of -1.95 at 95% confidence level, we fail to reject the null hypothesis. The study found that the prices of stock for Nairobi Security Exchange do follow random walk processes. They do not follow a mean-reverting process. Therefore the future returns cannot be predicted based on historical movement in stock prices and that the volatility in stock market will increase in the long run without bound.

We recommend that other possible diffusion processes like mean reversion with jump diffusion be used to model price processes because such processes may take into consideration the effects of economic recession and economic peaks.

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