

**THE RELATIONSHIP BETWEEN LUNAR CYCLE AND STOCK
RETURNS IN COMPANIES LISTED AT NAIROBI SECURITIES
EXCHANGE**

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DECLARATION

I declare that this research project is my original work and has not been presented for a degree in any other university.

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DEDICATION

This project is dedicated to my wife Christine Owano Odongo for her love, support and encouragement. To my sons Nelson and Andy for their patience. To my friends and colleagues for their prayers and moral support through the period of preparation of this report. To the University of Nairobi School of Business lecturers.

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LIST OF ABBREVIATIONS

APT	Arbitrage Pricing Theory
ATS	Automated Trading System
CAPM	Capital Asset Pricing Model
EMH	Efficient Market Hypothesis
IFC	International Finance Corporation
MPT	Modern Portfolio Theory
NSE	Nairobi Securities Exchange
NASI	NSE All Share Index

ABSTRACT

The belief that lunar cycle affects people's mood and behaviour stems from ancient lore. Various psychological studies and behavioural finance literature provides evidence on the effect of mood on asset prices. Despite the effects of lunar cycle on people's moods attracting research by international researchers, there has been no known study that focuses on the effect of lunar cycle on stock returns in the Nairobi Securities Exchange. The objective of this study is to investigate the relationship between lunar cycle and stock returns in companies listed at Nairobi Securities Exchange. This study adopted descriptive research design using event study model and a sample of NSE 20-Share Index to meet the objective of the study. Secondary data collected from NSE reports between 2010 and 2014 was used and analysis done using event study model and SPSS descriptive statistics and statistical correlation, and the significance of the findings tested using the t statistic at 95% significance level. This study found that that stock returns increased during the New Moon and Full Moon phases of compared to the normal trading days of the lunar cycle. Further analysis found that cumulative stock returns were higher during the New Moon dates. The p-value of -2.72 and -2.404 recorded during New Moon and Full Moon phases respectively significantly deviates from the t-critical value of 1.943 under the degree of freedom of 6 tested at 95% significance level, showing that there is a significant difference in the mean value of stock returns during New Moon/Full Moon phases compared to the mean return during normal trading days. This study recommends that CMA and NSE to develop a policy that will limit the minimum and maximum price levels during FM and NM phases to protect the prices from manipulations and to protect the interest of the investors during the different phases of lunar cycle.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The belief that the phases of the moon, also known as the lunar cycle, affect people's mood and behaviour stems from ancient lore. During ancient times, notable human activities such as religious ceremonies were often timed to coincide with precise phases of the lunar cycle, and calendar years were based on the lunar month. To this day, many popular religious festivals and holidays such as the Easter, Passover and Eid Al Fitr are still timed to coincide with the cycles of the moon (Dichev & Janes, 2001).

This belief that the moon affects behaviour in different ways, has been validated by proof from psychological and biological studies. Various psychological studies support the influence of the moon on human mind and behaviour (de Castro and Pearcey,1995; Tasso and Miller,1976; Lieber,1978; Nael and Colledge,2000). Similarly, biological research also documents the recognisable effects of the moon on the human body (Criss and Marcum,1981; Law,1986). Behavioural finance literature provides evidence on the effect of mood on asset prices (Kamstra, Kramer & Levi,2003; Coral & Shumway,2005). The conclusions from these studies forms the basis of the view now prevalent in some academic circles that lunar phases influence human financial behaviour (Karamchandani & Jani,2014).

A number of empirical studies have been undertaken to understand the effect of lunar cycle on stock returns. For instance, empirical study by Dichev and Janes (2001) done in the U.S. stock indexes showed a strong effect of lunar cycle on stock returns. The study found that stock recorded double returns 15 days around new moon dates compared the

returns recorded during the 15 days around full moon dates. A similar study by Yuan, Zheng & Zhu (2006) that investigated the relationship between lunar phases and stock returns in 48 countries found that stock returns are lower on the days around a full moon than on the days around a new moon with a magnitude return difference of between 3% and 5% per annum.

However, proponents of rational investor theories such as the Efficient Market Hypothesis (EMH), Modern Portfolio Theory (MPT), Capital Asset Pricing Model (CAPM), and Arbitrage Pricing Theory (APT) consider exogenous events, such as the lunar cycle, to have no tangible impact on people's investment choices. Underlying these theories is the assumption that investors are 'rational agents' who seek to maximize their utility by seeking to make the most profit out of their investments (Elton, 2010).

1.1.1 Lunar Cycle

The term "lunar cycle" refers to the moon's continuous orbit around the earth, which takes approximately 29.53 days. The lunar cycle is informed by the comparative positions of the moon, the earth, and the sun. The progress of the moon in the cycle is seen in phases from the new moon when the moon is crescent, to the full moon when the entire illuminated portion of the moon can be seen from the earth (Dichev & Janes, 2001). During the new moon phase, the moon, earth, sun and are in near alignment. The entire lightened part of the moon is on the rear side of the moon, the half that cannot be clearly seen.

A full moon occurs when the earth, moon, and sun are in approximate alignment position and the Moon is on the exact opposite side of the Earth from the Sun. The shadowed portion is entirely hidden from view. The full moon date is halfway the 29.53 days between the two successive new moons in one lunar cycle. The moon phases are observable and predictable cycles. This makes the lunar cycle an appropriate proxy variable for unobservable moods and that influence investors behaviour.

1.1.2 Stock Returns

Stock return is the gain or loss on an investment in a particular market, calculated in terms of absolute profits values or as percentage of the amount invested. Stock return is a function of stock prices. Stock prices reflect the firm's value in the market and show the present value of expected future cash flows. This means that there is high positive relationship between low/high firm value and low/high stock return. This is affirmed by the small-firm effect anomaly that explains that stock price is a factor driving the difference in stock returns. Every investor is motivated by the expected returns on the stock, which is the gain or loss of a security in a particular period (Ilmanen, 2011).

It is noted that stock return is a function of stock prices and trade volumes of a particular stock. In this case, capital gains occur when the stock sell at prices higher than the purchase price, while capital loss is experienced when stock prices sell at a price lower than the purchase price (Ouma & Ochieng, 2015). The changes in stock prices at the securities market is influenced by a number of factors at play such as the technical factors, fundamental factors, and the market sentiment factors which refer to psychological influences of investors mood including the lunar cycle.

1.1.3 Lunar Effect on Stock Returns

The observable phases of the moon have been scientifically proven to affect human beings in different ways. A body of psychological literature supports the influence of the moon on human behaviour (de Castro and Pearcey,1995; Lieber,1978; Tasso and Miller,1976). During a full moon, pressure to accomplish task increases, stress becomes a major factor and people tend to be more pessimistic (Dichev and Janes,2003). A slight set back adds to more frustration and individuals will deal with their own needs instead of focussing on the need of others. Similarly, biological research empirically documents the recognisable effects the moon has on humans (Criss and Marcum,1981; Law,1986).

After a stressful full moon phase, a new moon on the other hand brings a sense of optimism and calmness. People's emotion normalizes and their determination to succeed increases with the feeling that anything can be accomplished. The effects of mood on asset prices has been documented in finance literature (Avery and Chevalier,1999; Coval and Shumway,2005). If lunar phases influence people's mood, then by extension, the new moon and full moon phases may influence investor behaviour, which will consequently influence asset prices and stock returns. If this argument is true, then it is expected that stock prices and asset returns during full moon phases may be different from those during new moon phases of a lunar cycle. This study intends to either confirm or refute this behavioural finance argument by undertaking the study of the relationship between lunar cycle and stock returns in companies listed at Nairobi Securities Exchange.

1.1.4 Nairobi Securities Exchange

Nairobi Securities Exchange was established in 1954, then known as Nairobi Stock Exchange and was formed as a volunteer association of stockbrokers registered under the Societies Act. Over the decades, NSE's performance has gradually improved until it was rated the best performing market in the world with a return of 179% in dollar terms on February 18, 1994 after the NSE 20-Share Index recorded an all-record high of 5030 points by International Finance Corporation (IFC) (Nse.co.ke, 2016). Currently, the NSE operates on the Automated Trading System (ATS) for government bonds.

Presently, there are 65 companies trading their stock and bonds at the NSE daily. These companies are divided onto 13 main sectors of the economy. They include; agricultural, energy and petroleum, commercial and services, insurance, banking, investment services, telecommunication and technology, manufacturing and allied, construction and allied, investment, growth enterprise market segment, investment services and automobile and accessories (Appendix II) (Nse.co.ke, 2016). Stock prices at the NSE occasionally rise and fall based on the market factors, investors mood and anticipation of the expected return.

1.2 Statement of the Problem

Behavioural finance theories argue that people are not as rational as traditional finance theory explains about making investment decisions. Behavioural finance is based on the alternative notion that investors are often influenced by emotions and biases that drive their investment choices and share prices. The central idea is that investor psychology

and moods drives stock market movements and prices (Hirshleifer, 2001). This means that anything that is known to have effect on people's mood can influence human financial behaviour in the stock market. Previous global studies have documented effects of lunar cycle on stock returns. For instance, a study by Karamchandani and Jain (2014) in India found statistical significance in the volatility of daily returns of stock prices during the new moon and full moon phases in some of the sectors. A similar study in the United States stock indexes by Dichev and Janes in 2001 also showed that lunar cycle influence stock returns.

Despite the effects of lunar cycle on people's moods attracting research by international researchers, there has been no known study that focuses on the effect of lunar cycle on stock returns in the Nairobi Securities Exchange. This study therefore seeks to fill the gap to understand the direction stock returns take during the new moon and full moon phases of the lunar cycle at NSE. The research question that guides this study is; what is the relationship between lunar cycle and stock returns of companies listed at Nairobi Securities Exchange?

1.3 Research Objective

To investigate the relationship between lunar cycle and stock returns in companies listed at Nairobi Securities Exchange

1.4 Value of the Study

Stock returns within a particular period in a stock market are influenced by a number of factors, investors' psychology, emotions and moods being one of the factors. In this

regard, understanding whether lunar cycle known to have effect on people's moods has influence on investors' financial behaviour and share prices of the companies traded at the NSE will potential investors to know the right moon cycle to invest in order to maximise of their returns. The study will analyse the NSE 20 share index performance between year 2000 and 2015. The findings of the study will assist investors to understand whether to go beyond a rational asset pricing framework to explore the psychological effects of investor behaviour on stock returns.

Investment banks will also benefit from the findings of this study by understanding stock prices movements during different phases of the lunar cycle in order to be able to advise their clients on the right time to buy and sell their stock for maximum returns.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature related to relationship between lunar cycle and stock prices and returns of shares traded in the security markets. The chapter outlines the behavioural finance theories that show the relationship between lunar cycle and share prices and returns, identifies other variables that influence share prices and returns in the stock market and outline the empirical studies that have been carried out by other researchers on effect of lunar cycle on share prices and returns traded in a securities market both locally and at the global stage.

2.2 Theoretical Review

This section outlines four theories on which this study is anchored. These include; Efficient Market Hypothesis, Behavioural Portfolio Theory, Behavioural Corporate Finance Theory, and Adaptive Markets Hypothesis theory.

2.2.1 Efficient Market Hypothesis

In an influential paper, “Efficient Capital Markets: A Review of Theory and Empirical Work “, Eugene Fama (1970) proclaimed the Efficient Market Hypothesis (EMH). This hypothesis is associated with the view that since all information spread quickly, and without delay, subsequent price changes represent random departures from previous returns. Therefore, one cannot study past stock returns in an attempt to predict future returns. Despite the existence of a large body of evidence in support of EMH, all sorts of

anomalies have been documented extensively in financial literature to dispute this theory. The common anomalies include; January anomaly, day of the week effect, holiday anomaly, small size effect, and weekend effect. From another perspective this study seeks to test the efficiency of the Nairobi Securities Exchange and to establish the existence of lunar anomaly.

2.2.2 Behavioural Portfolio Theory

The theory was developed by Shefrin and Statman (2000). The theory argues that behavioural investment portfolios take the shape of distinct layered pyramids in which each layer is aligned to a particular objective. The base layer is formulated in a way that it is meant to avert any financial catastrophe and to protect the investors against poverty, while the upper layer is intended to try maximize returns, and to give hope for riches. Behavioural investors in this case do not consider the covariance existing between the layers as is the case in the capital asset pricing model, arbitrage pricing theory, and the modern portfolio theory that put forward that the ultimate motivation for investors is the profit maximization of their portfolios. In this theory, investors choose their portfolio according to their individual goals either to get returns, based on the access to information, utility of the assets or for loss aversion among other objectives instead of holding a well-diversified portfolio with relatively obvious benefits (Statman, 2004). This theory thus points out that other factors related to investor behaviour influence the choice of investment and the portfolio.

2.2.3 Behavioural Corporate Finance Theory

Behavioural finance theory borrows heavily from cognitive psychologists Daniel Kahneman and Amos Tversky (1974), who related behavioural finance actions by investors to psychological concepts. Thaler (1983) later brought the behavioural theory into perspective by integrating economics and psychology into the study of human judgment and biases in decision making under uncertainty conditions. This theory considers the human tendency to behave irrationally when making investment decisions, and that financial decisions are influenced by how people interpret and act on information, which is not always rational. This is contrary to the traditional economic theory that asserts that people are rational agents who make decisions objectively to take advantage of the opportunities available to maximise their returns (Elton, 2010). According to Thaler (1983), behavioural finance is fundamentally economics founded on the realistic descriptions of people's actual behaviour.

The behavioural corporate finance theory further recognizes that psychological biases that influences investor's decisions and affect financial markets may also influence managers and corporate decisions related to investment appraisal, capital structure and dividends (Adler, 1993). This means that other than the experience and management styles of the managers, personality of the managers that is the basis of their temperament and behaviour is key to the decisions made by managers in challenging and uncertainty conditions. When executives are overconfident or overoptimistic, they tend to push toward optimal behaviour (Eric, 2011).

2.2.4 Adaptive Markets Hypothesis

This theory was proposed by Andrew Lo (2004) in a move to reconcile financial economic theories which are based on the efficient market hypothesis, with the behavioural financial economics, by applying the principles of evolution to financial interactions in relation to adaptation to market environment and conditions, natural selection of investment opportunities and competition. The theory argues that the examples cited by the proponents of behavioural finance touching on economic rationality such as loss aversion, overreaction of investors, overconfidence of investors and managers, and other behavioural biases often displayed by investors are essentially consistent with the evolutionary model of people adapting to a changing environment using simple heuristics (Lo, 2015). With reference to this study, the overreaction and overconfidence associated with the adaptive market hypothesis relate to psychological and personality concepts that explain behavioural finance. The adaptation to market environment and conditions is a behavioural attribute adopted by investors after consistent responses and reinforcements.

2.3 Determinants of Stock Returns

Other than the market sentiment determinants of stock returns that concern the concern the psychology and behaviour of market participants, there are other determinants of stock returns reviewed below.

2.3.1 Economic Factors

These comprise external conditions that impact the supply of and demand for a firm's stock. A number of the external conditions indirectly affect the fundamental

determinants. The factors include; the interest rates, economic outlook, inflation/deflation, economic and political shocks in an economy (Khan & Zuberi, 1999).

In growing and stable economic conditions, investors tend to feel confident and companies are more likely to perform well and deliver strong profits. High performance signals future stability and they are more likely to pay growing dividends. Under such situations, demand for shares in the market rise and prices increase. However, in a depressing economic climate, investors become nervous and the uncertainties surrounding future profits causes reduction of demand for shares, hence fall in stock prices (Aroni, 2011).

Interest rates charged in the economy based on the monetary policy affects the cost of debt. Higher interest rates reduce the company's profits and the dividends it pays to the shareholders. As a result, share prices may fall since investors may prefer other investments that pay interests instead of stocks (Khan & Zuberi, 1999).

Increase in inflation results into higher interest rates which in turn bring down share prices but increase in prices of commodities. Deflation on the other hand means lower profits and reduced economic activity (Rawlin, Shanmugam & Bhat, 2015). This makes stock prices and returns to fall and investors to begin offloading their shares to invest into fixed income investments.

Economic and political factors equally influence stock returns. For instance a rise in the cost of energy can lead into lower profits and subsequently lower stock returns. Terrorist

attacks can also result into the slowdown in economic activity including in the stock market hence reduction in stock returns.

2.3.2 Fundamental Factors

These factors comprise; the earnings base of the stock, measured by the earnings per share (EPS), cash flow per share, and the dividends per share; the discount rate, which is itself a subject of inflation; the anticipated growth in the earnings base; and the perceived risk of the stock (Rawlin, Shanmugam & Bhat, 2015). When the earnings base is high or is expected to grow, the demand for the stock by the investors increases, hence pushing up the stock prices. Any news on the company performance stating the fundamental factors influences stock prices in an efficient market (Simanovsky, 2013).

The valuation multiple of the P/E ratio is another fundamental factor that informs the perceived risk of the stock which is a function of inflation. Higher inflation earns a higher discount rate, which earns a lower multiple. This consequently leads to less future stock earnings in inflationary environments hence reduction in the stock prices since demand for the less earning stock reduce (Aroni, 2011). A riskier stock earns a higher discount rate, which in turn earns a lower multiple. Many investors shy away from risky stock, leading to fall in the stock prices.

2.4 Empirical Review

This section outlines the empirical evidences that have been undertaken by different researchers on the relationship between lunar cycle and stock returns.

2.4.1 International Evidence

Dichev and Janes (2001) carried out a study on the effects of lunar cycle on stock returns. The study focussed on four major U.S. Stock Indexes and the stock markets for other 24 countries drawn from North America, Europe, Asia, Africa and South America. The study found significant influence of lunar cycle on stock returns. In an analysis that covered a period of over 100 years, it was found that the stock returns recorded in the 15 days around new moon were about double the returns recorded in the 15 days around full moon dates in all the four major U.S. stock indexes. Similar results were found in nearly all major stock indexes of the 24 other countries included in the study in an analysis that covered a period of over the last 30 years. Further the study found no economically significant evidence of lunar cycle effects on return volatility and volume of trading. The findings in this study points out that people are more enthusiastic to invest during new moon periods compared to full moon periods.

Yuan, Zheng and Zhu (2002) in another empirical study also examined the relation between lunar phases and stock market returns of 48 countries around the world. The study concluded that stock returns are higher around a new moon than on the days around the full moon. Analysis using both the equal-weighted and the value-weighted global portfolios found the magnitude of the difference in return to have range between 3% and 5% per annum. The researchers noted that the lunar effect is not triggered by the announcements of macroeconomic indicators affecting the securities market and is independent of other calendar-related market anomalies such as the day-of-week effect, January effect, holiday effect and the calendar month effect. Based on the findings, the study recommends that it might be valuable to go beyond a rational asset pricing

framework to explore investor behaviour. However, NSE was part of this study, hence the gap to investigate lunar effects at NSE.

Another study by Liu and Tseng (2009) also found that lunar cycle affects stock returns. The objective of the study was the Bayesian analysis of lunar impact on stock returns in twelve countries. Using a two-regime autoregressive model with a GARCH(1,1) to analyse the GARCH volatility and the correlation between consecutive daily returns, and using Bayesian approach to analyse the daily stock returns of 12 countries, including the G7 markets and five emerging markets in Asia, the study found that lunar cycle affects daily stock returns. In some of the G7 markets, the volatility of the stock returns varies based on the lunar phases, with higher volatility recorded in the full moon period. The study concludes that lunar phases influence human financial behaviour.

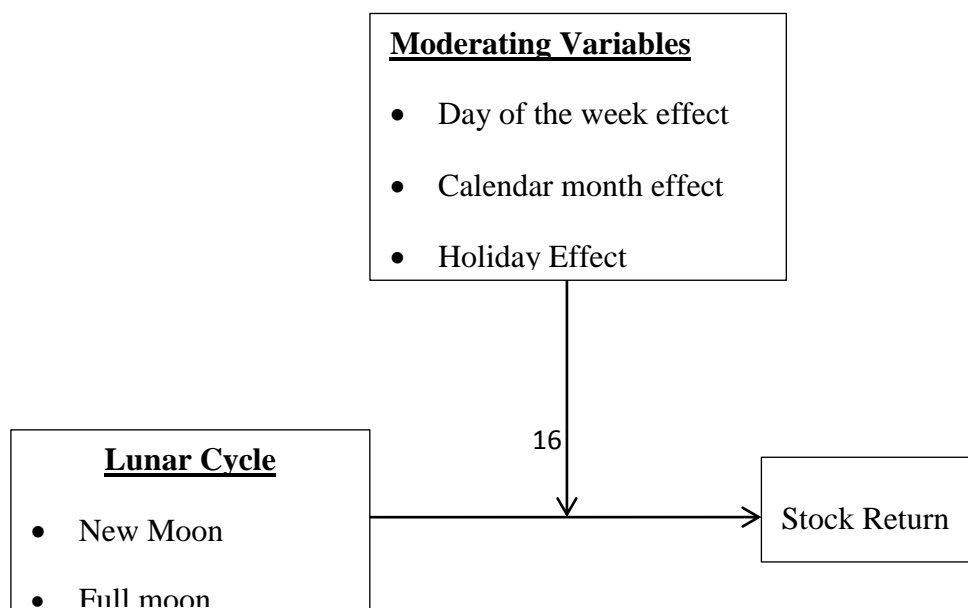
Floros and Tan (2013) studied the Moon Phases with respect to Mood and Stock Market Returns in 59 globally mature and emerging security markets world over to offer evidence of the effect of lunar cycle on their stock market returns. The researchers utilised TGARCH model to determine the link between calendar-related effects, efficient-market theory and investors' mood arising from moon phases. The analysis showed significant full moon phase effects on stock returns in 6 markets, and statistically significant effect of new moon phase on stock returns in 8 markets. Further, the study found significant positive effect of new moon phase on stock market returns particularly in UK, Bangladesh, Switzerland, Cyprus and Chile stock markets, while a negative effect of full moon recorded in the Jordan market. Several markets, especially the emerging markets (Brazil, Cyprus, Chile, Bangladesh, Tunisia, Belgium) showed evidence of

full/new moon effects as well as January and Monday effects on their stock returns. These findings are recommended to financial managers, financial analysts and investors, handling the international stock indices.

Karamchandani¹, Jain and Mohadikar (2014) also did a study on the effects of astrophysical phases in the Indian stock market. Using return calculation and descriptive statistics for analysis of six sectors of the Indian economy for a period between 2008 and 2012, the study found statistically significant difference in aggregate returns and volatility of daily returns of stock prices in some of the sectors particularly between returns of new moon phase and full moon phase.

2.5 Conceptual Framework

The conceptual framework below shows the relationship between the dependent and independent variables of the study. The dependent variable in this study is stock prices. The independent variables are the lunar cycle, particularly the full moon and new moon. The framework also includes the existence of moderating variables which include other market anomalies. The conceptual framework was developed from the review of literature discussed above and assumes a linear relationship between the variables.



2.6 Summary of Literature Review

This chapter outlined the efficient market hypothesis, behavioural portfolio theory, behavioural corporate finance theory and the adaptive markets hypothesis that provides the theoretical foundation of this study. The chapter also discussed fundamental and economic factors that drive stock prices up or down. The review of empirical evidences shows that lunar cycle affects stock prices. For instance Dichev and Janes (2001) found that the stock returns recorded in the 15 days around new moon were about double the returns recorded in the 15 days around full moon dates in all the four major U.S. stock indexes, Liu and Tseng (2009) using Bayesian analysis GARCH(1,1) model lunar cycle to have effect on daily stock returns. Similar results were found by Karamchandani¹, Jain and Mohadikar (2014) and Floros and Tan (2013).

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the design and methodology that was used to conduct the study. It expounds on the research design, the population of the study, sample size, data collection process and highlighting how data was analysed.

3.2 Research Design

This study adopted descriptive research design using event study model to investigate the general behaviour of stock returns during different phases of the lunar cycle for companies listed at NSE. Descriptive design is a scientific technique which encompasses observing and describing the behaviour of the subjects without any form of manipulation (Christensen, Johnson & Turner, 2011). This design was preferred by the researcher since the collected data of stock returns around the new and full moon phases was analysed as

they are without influencing the data, in order to determine natural behaviour of stock returns around the lunar cycle.

3.3 Population

The study population comprised all the NSE All Share Index (NASI) as at December 31, 2015 comprising all the 13 sectors of the economy. The publicly quoted companies are targeted in this study since they are all affected by the market anomalies and their stock prices and returns are potentially subjects to lunar cycle effect if any. All the listed companies and investors trading at the NSE may considerably benefit from the findings of this study, to identify when to buy and when to sell stocks to maximise their returns.

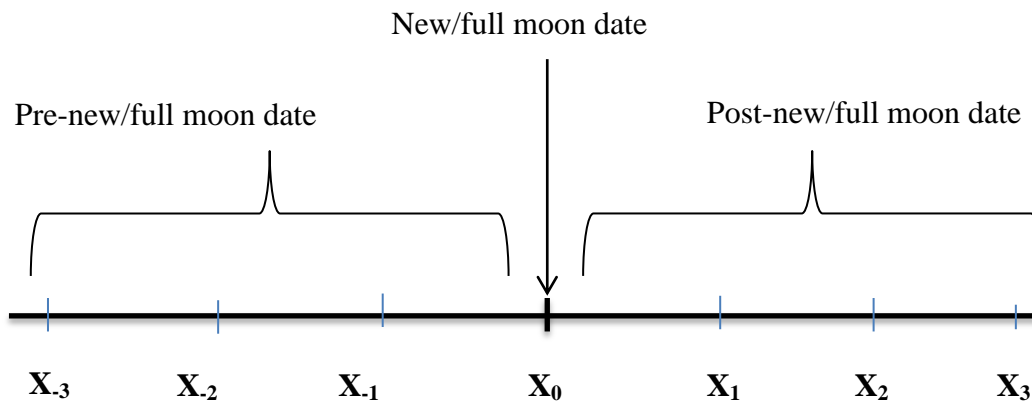
3.4 Sample

This study used the NSE 20 Share Index as a sample of the study. This index currently contains six sectors which include; banking, agricultural, energy and petroleum, commercial and services, automobiles and accessories, and manufacturing and allied. The chosen sectors make key sectors of the trade at the Nairobi Security Exchange. The period under study was 6 years from 2010 to 2015. The movement of stock returns during the lunar cycle of the sampled companies was analysed independently, then cumulatively for each sector of the economy sampled and then generalized to make conclusion.

3.5 Data Collection

The study utilized secondary data collected from publications and stock returns figures generated from the NSE reports relating to the period of study between 2010 and 2015. The required data include daily stock prices for all the sampled listed firms and sectors of

the economy at the NSE. The researcher identified the new and full moon dates in the lunar cycle and the data collection included stock returns around the new moon and full moon dates, particularly for 3 days before the new/full moon dates and 3 days after the new/full moon dates. Finally, the data also included the volumes of shares traded by the sampled firms within the study window of six days. This is represented in the figure below.



3.6 Data Analysis

Data analysis in this study involved determining any abnormal stock returns around the new and full moon phases on the lunar cycle and to investigate whether any difference between the mean returns over new/ full moon phases and other normal days is statistically significant.

3.6.1 Analytical Model

Step One: This step involved price calculation by determining the actual daily closing returns within the window period of the study. The raw series of daily closing prices was converted into percentage change in order to determine the stock price volatility around

the new and full moon phases of the lunar cycle. The change in returns was calculated by following market model:

$$CG_i = \frac{(P_1 - P_0)}{P_0} \dots\dots\dots i$$

Where;

CG_{it} = Expected capital gains/loss for security i at time t

P_1 = Actual price during the new/full moon phase

P_0 = required stock price based on normal days of lunar cycle

Step Two: Mean returns. The descriptive statistics for the daily closing returns for the sectors under study including; banking, agricultural, energy and petroleum, commercial and services, insurance, and the manufacturing and allied sectors was carried out for the period from 2010 to 2014 in order to investigate any mean changes in stock returns during the new moon and full moon phases of the lunar cycle. The mean returns was calculated for the window period covering 3 days before the new/ full moon date (X_{-3}) and 3 days after the new/ full moon dates (X_{+3}).

Mean values was calculated using the following equation:

$$\pi = \frac{1}{N} \sum_{i=1}^N X_i \dots\dots\dots ii$$

Where;

X_i = daily price series of respective sectors for full moon and new moon.

N = Number of days in the study window, which is 7

Step three: This involved determining the standard deviation in order to inspect volatility in investors' investing decisions based on the lunar cycle. This was calculated covering between X_{-3} and X_{+3} for both the new moon and full moon.

$$SD_t = \sqrt{\frac{1}{t} \sum_{i=1}^N (X_i - \pi)^2} \dots\dots\dots iii$$

Where π = mean return for new/full moon phases

3.6.2 Test of Significance

The study employed paired samples t-test to determine whether there is a significant difference in the mean value of returns during new moon, full moon phases and compared to other normal days. This was done at 95% significance level.

Using these models, the researcher was able to determine the effects of lunar cycle on stock returns for the companies listed at the NSE.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The objective of the study was to investigate the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange. To meet this objective, stock returns during different phases of the lunar cycle for the NSE 20 Share Index companies listed at NSE were collected and analysed monthly for a period between 2010 and 2014. The new moon and full moon dates were identified and the mean returns were calculated for the window period covering 3 days before the new/ full moon date ($X-3$) and 3 days after the new/ full moon dates ($X+3$). The returns during the window period were then compared to the returns during the other normal trading days of the lunar cycle to observe any difference in returns. This section uses descriptive statistics to outline the relationship of risk and return.

4.2 Descriptive Statistics

The study analyzed the monthly behaviour of stock return around the New Moon and Full Moon dates and then cumulated to yearly returns for a period of five years. The analyses found that stock return were higher during the New Moon and Full Moon dates compared to the Normal trading days. Table 4.1 to table 4.5 gives the summary of descriptive statistics including; minimum, maximum, mean, standard deviation and variance of stock returns during the lunar cycle.

Table 4.1: 2010 Descriptive Statistics

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	20	-.01252	.02111	.0046913	.00846844	.000
Mean Return Full Moon	20	-.01312	.04008	.0128169	.01455494	.000
Valid N (listwise)	20					

Source: Research Findings

The 2010 results showed that during the New Moon window period, the mean of stock returns was 0.0046913 (0.469%) higher than the normal trading days with as minimum return of -0.01252 and a maximum of 0.02111. Similarly, mean of stock returns during the Full Moon window period was 0.0128169 (1.282%) higher than the return on normal trading days, with a minimum of -0.01312 and a maximum of 0.04008. Further, the standard deviation of 1.455% was recorded during full moon period, indicating that there is higher volatility in investors' investing decisions during full moon compared to new moon period, which recorded 0.85%. Based on the results, the study finds that stock returns are higher during Full Moon window period of the lunar cycle.

Table 4.2: 2011 Descriptive Statistics

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	20	-.00088	.08326	.0205690	.01886732	.000
Mean Return Full Moon	20	-.02626	.01588	-.003610	.00980113	.000
Valid N (listwise)	20					

Source: Research Findings

The 2011 results show that during New Moon period, the mean stock return was 0.020569 (2.06%) higher than the returns reported during the normal trading days, with minimum of -0.00088, a maximum of 0.08326 and standard deviation of 1.8867% during the New Moon window period. Conversely, mean return for Full Moon period was much lower than the returns recorded during normal returns by -0.00361 (-0.36%) with a minimum of -0.0262, a maximum of 0.01588 and standard deviation of 0.98%. This results show that in 2010, stock returns are higher during New Moon period, but negative during Full Moon period.

Table 4.3: 2012 Descriptive Statistics

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	20	-.03285	.01689	.0046640	.01068685	.000
Mean Return Full Moon	20	-.01520	.04251	.0127556	.01650241	.000
Valid N (listwise)	20					

Source: Research Findings

The 2012 results show higher performance in stock returns during Full moon period with a mean of 0.0127556 (1.276%) above the normal days return and standard deviation of 1.65%. indicating that there is higher volatility in investors' investing decisions during full moon compared to New Moon period. Based on the findings, lunar cycle, particularly the New Moon and Full Moon periods positively influences the stock returns, with the Full Moon period recording higher returns.

Table 4.4: 2013 Descriptive Statistics

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	20	-.01797	.02732	.0057674	.00993857	.000
Mean Return Full Moon	20	-.01858	.02925	.0074842	.01442762	.000
Valid N (listwise)	20					

Source: Research Findings

The 2013 results show that during the New Moon window period, the mean of stock returns was 0.0057674 (0.58%) higher than the normal trading days with as minimum return of -0.01797 and a maximum of 0.02732. The mean of stock returns during the Full Moon window period was 0.074842 (0.748%) higher than the return on normal trading days, with a minimum of -0.01858 and a maximum of 0.02925. The standard deviation of 1.44% for Full Moon and 0.99% for New Moon show that investment decisions are more during full moon period of the lunar cycle. Based on the results, the study finds that the 2013 stock returns are higher during Full Moon window period of the lunar cycle.

Table 4.5: 2014 Descriptive Statistics

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	12	-.00229	.03232	.0060392	.01004003	.000
Mean Return Full Moon	12	-.01706	.02214	.0065859	.01187785	.000
Valid N (listwise)	12					

Source: Research Findings

The analysis in table 4.5 shows similar directions of stock returns during the New Moon and Full Moon window periods as in 2010, 2012, and 2013, which had positive stock returns. The New Moon results show 12 month mean of 0.0060392 (0.6%) above the return for normal trading days, and Full Moon mean of 0.0065859 (0.67%) above the normal days trading returns. Similarly the volatility in investor decisions for investment is higher for the Full Moon at 1.19% compared to 1% recorded during the New Moon. This finding leads to a conclusion that lunar cycle positively influences investment and returns, with more returns being recorded around the Full Moon dates.

4.3 Correlation Analysis

The correlation analysis was undertaken to establish the degree to which stock returns during a New Moon window moves together with the stock returns on Full Moon window. This helped to investigate if there is a relationship between investors' decisions in relation to full moon phase and new moon phase of the lunar cycle. This is presented in table 4.6.

Table 4.6; Cumulative Correlation

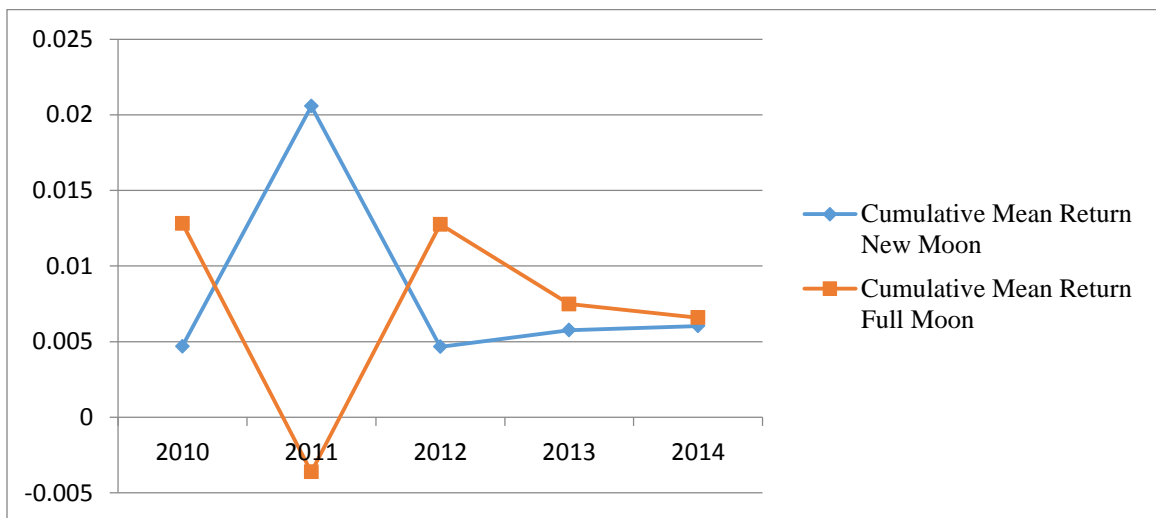
		Correlations	
		Mean Return New Moon	Mean Return Full Moon
Mean Return New Moon	Pearson Correlation	1	-.937*
	Sig. (2-tailed)		.019
	N	5	5
Mean Return Full Moon	Pearson Correlation	-.937*	1
	Sig. (2-tailed)	.019	
	N	5	5

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Research Findings

Table 4.6 shows that there is a negative cumulative correlation of the mean returns of -0.937 for the five years under analysis. This means that cumulatively, as the mean return during the new moon increases, the mean return during the Full Moon phase decreases. This relationship is also presented by figure 4.1 below, which shows that as cumulative return on new moon increases, the cumulative mean return on full moon decreases.

Figure 4.1: Cumulative Mean Return



Source: Research Finding

4.4 Test of Significance

The test of significance was performed using paired samples t-test to determine whether there is a significant difference in the mean value of returns during new moon, full moon phases and compared to other normal days. This was done at 95% significance level and result presented in Table 4.7.

Table 4.7: Test of Significance

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Mean Return Normal Days - Mean Return New Moon	-.00834618	.00686090	.00306829	-.01686511	.00017275	-2.720	6	.053
Pair 2	Mean Return Normal Days - Mean Return Full Moon	-.00720634	.00670349	.00299789	-.01552982	.00111714	-2.404	6	.074

Source: Research Findings

The t-test value that compares the cumulative mean return during the New Moon phase of the lunar cycle found p-value to be -2.720. The p-value is less than the t-critical value of 1.943 at degree of freedom of 6 tested at 95% significance level. The p-value shows that there is a significant difference in the mean value of returns during new moon phases compared to the normal days. Similarly, the p-value for the Full Moon phase of the lunar cycle is -2.404, which is much lower than the t-critical value of 1.943 an the degree of freedom of 6 tested at 95% significance level. This shows that there is a significant difference in the mean value of stock returns during full moon phases compared to the mean stock during normal trading days.

4.5: Summary and Interpretations of the Findings

Table 4.8 summarises the finding of the study that focussed investigate the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange. The results contained in table 4.8 were generated from the cumulative mean stock return for 2010 to 2014 within the study event window of t-3 to t+3.

Table 4.8: Summary of Cumulative Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mean Return New Moon	5	.00466	.02057	.0083462	.00686090	.000
Mean Return Full Moon	5	-.00361	.01282	.0072063	.00670349	.000
Valid N (listwise)	5					

Source: Research Findings

The New Moon results show mean of 0.0083462 (0.83%) above the return for normal trading days, and Full Moon mean of 0.0072063 (0.72%) above the normal days trading returns. Similarly the volatility in investor decisions for investment is higher for the New Moon at 0.69% compared to 0.67% recorded during the Full Moon. This finding leads to a conclusion that lunar cycle positively influences investment and returns, with more returns being recorded around the New Moon dates. This means that increase in returns recorded during the new moon is sustained to the Full Moon phase of the lunar cycle.

The study also finds that there is a negative cumulative correlation of the mean returns of -0.937 for the five years under analysis. This means that cumulatively, as the mean return during the new moon increases, the mean return during the Full Moon phase decreases,

leading to the marginal difference in the volatility of investor decisions from 0.69% during the New Moon phase to 0.67% during the Full Moon phase. This relationship is also presented by figure 4.1 which shows that as cumulative return on new moon increases, the cumulative mean return on full moon decreases.

Finally, the test of significance showed that the calculated p-value of the New Moon of -2.72 is less than the t-critical value of 1.943 at degree of freedom of 6, tested under 95% significance level. The p-value shows that there is a significant difference in the mean value of returns during new moon phases compared to the normal days. Similar direction also found during the Full Moon phase of the lunar cycle with a p-value of -2.404, which is much lower than the t-critical value of 1.943 an the degree of freedom of 6 tested at 95% significance level. The study concludes that there is a significant difference in the mean value of stock returns during full moon phases compared to the mean stock during normal trading days.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter outlines the summary and conclusion of the results of the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange. The chapter also gives the recommendations to the stakeholders and for future research.

5.2 Summary

This study looked at the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange. In order to arrive at the findings, the researcher identified astrophysical New and Full moon dates in the lunar cycle and determined the changes in stock prices and returns around the New moon and Full moon dates, particularly for 3 days before the new/full moon dates and 3 days after the new/full moon dates for all the NSE 20 Share Index companies. The results were calculated monthly and then cumulated to yearly returns for the study period of between 2010 and 2014.

From the results of the study on the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange, it was found that in the 20 Share Index firms at the NSE, lunar cycle had significant influence on the stock returns. Share prices and stock returns for the 20 companies involved in the study recorded a positive growth of 0.83% above the normal trading days during the New Moon and 0.72% return above the normal trading days during Full Moon phases of the lunar cycle. The cumulative stock mean return for the five years (2010-2014) under study found that stock returns

were marginally higher on the days around New Moon date compared to the days around the Full Moon phase of the lunar cycle.

The p-value of -2.72 and -2.404 recorded during New Moon and Full Moon phases respectively significantly deviates from the t-critical value of 1.943 under the degree of freedom of 6 tested at 95% significance level showing that there is a significant difference in the mean value of stock returns during full moon phases compared to the mean stock during normal trading days.

5.3 Conclusion

The objective of the study was to investigate the relationship between lunar cycle and stock return in companies listed at Nairobi Securities Exchange. The study found positive movement of stock prices and stock returns during the New Moon and Full Moon phases on the lunar cycle, with more returns experienced during the New Moon phases. This study therefore, concludes that lunar cycle positively influences investor decisions and results into an increase in stock returns particularly around the New Moon and Full Moon phases compared to the normal trading days of the of the lunar cycle. Further, the study concludes that stock returns are higher around the New Moon dates.

This study is consistent with other studies such as Kamstra, Kramer and Levi,2003, Dichev and Janes (2001) done in the U.S. stock indexes that found that stock recorded double returns 15 days around new moon dates compared the returns recorded during the 15 days around full moon dates and the study by Yuan, Zheng & Zhu (2006) that investigated the relationship between lunar phases and stock returns in 48 countries and

found that stock returns are higher on the days around a new moon than on the days around a full moon.

5.4 Recommendations for Policy

Investment banks need to understand the direction of stock returns during different phases of lunar cycle in order to accurately advise their clients on the best phases to invest at the NSE. It is therefore recommended that Capital Markets Authority and NSE to develop a policy that recognizes how investors' psychology, mood and behaviour affect asset prices will limit the minimum and maximum price levels, especially during Full Moon and New Moon phases to protect the prices from manipulations and to protect the interest of the investors. This will limit how low or high prices can go during the different phases of the lunar cycle.

5.5 Limitations of the Study

The study faced the limitation of having some firms in the 20Share index trading for less than 20 days in a month. This left the researcher with few normal days outside the window period of 7 days around the New Moon and 7 days around the Full Moon date. The study also notes that there are other market anomalies such as day of the week effect, calendar month effect and holiday effect anomalies that are likely to influence stock return but was not considered in this study. The study also faced a limitation of in accessibility of data particularly for the year 2015.

5.6 Areas for Further Research

For further study, it is recommended that look at the relationship of lunar cycle on the All Share Index (NASI) of NSE and to consider a much longer study period, in order to understand the relationship of lunar cycle on all firms traded at the NSE.

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APPENDIX I: LISTED COMPANIES AT NSE BY SECTOR AS AT DECEMBER 31, 2015

AGRICULTURAL

Eaagads Ltd

Kapchorua Tea Co. Ltd

Kakuzi

Limuru Tea Co. Ltd

Rea Vipingo Plantations Ltd

Sasini Ltd Ord 1.00

Williamson Tea Kenya Ltd

AUTOMOBILES AND ACCESSORIES

Car and General (K) Ltd

CMC Holdings Ltd

Sameer Africa Ltd

Marshalls (E.A.) Ltd

BANKING

Barclays Bank Ltd

CFC Stanbic Holdings Ltd

I&M Holdings Ltd

Diamond Trust Bank Kenya Ltd

Housing Finance Co Ltd

Kenya Commercial Bank Ltd

National Bank of Kenya Ltd

NIC Bank Ltd

Standard Chartered Bank Ltd

Equity Bank Ltd

The Co-operative Bank of Kenya Ltd

COMMERCIAL AND SERVICES

Express Ltd

Kenya Airways Ltd

Nation Media Group

Standard Group Ltd

TPS Eastern Africa (Serena) Ltd

Scangroup Ltd

Uchumi Supermarket Ltd

Hutchings Biemer Ltd

Longhorn Kenya Ltd

CONSTRUCTION AND ALLIED

Athi River Mining

Bamburi Cement

Crown Berger Ltd

E.A.Cables Ltd

E.A.Portland Cement Ltd 57

ENERGY AND PETROLEUM

Kenol Kobil Ltd

Total Kenya Ltd

KenGen Ltd

Kenya Power & Lighting Co Ltd

Umeme Ltd

INSURANCE

Jubilee Holdings Ltd

Pan Africa Insurance Holdings Ltd

Kenya Re-Insurance Corporation Ltd

Liberty Kenya Holdings Ltd

British-American Investments Company (Kenya) Ltd

CIC Insurance Group Ltd

INVESTMENT

Olympia Capital Holdings Ltd

Centum Investment Co Ltd

INVESTMENT SERVICES

Nairobi Securities Exchange Ltd

MANUFACTURING AND ALLIED

B.O.C Kenya Ltd

British American Tobacco Kenya Ltd

Carbacid Investments Ltd

East African Breweries Ltd

Mumias Sugar Co. Ltd

Unga Group Ltd

Eveready East Africa Ltd

Kenya Orchards Ltd

A.Baumann CO Ltd

TELECOMMUNICATION AND TECHNOLOGY

Safaricom Ltd

GROWTH ENTERPRISE MARKET SEGMENT

Home Afrika Ltd

Source: NSE Handbook 2014.

**APPENDIX II: ANNUAL CUMULATIVE STOCK RETURNS
DURING NEW/FULL MOON 2010**

CUMULATIVE STOCK RETURN				
TEAR 2010				
NSE 20 SHARE INDEX	MEAN RETURN-NEW MOON	MEAN RETURN- FULL MOON	CRITICA L VALUE	Df
Mumias Sugar,	0.014088264	0.02334369	1.943	6
Express Kenya,	-0.00210367	-0.00574804	1.943	6
Rea Vipingo,	0.021108887	0.032558743	1.943	6
Sasini Tea,	0.015631425	0.018857693	1.943	6
CMC Holdings,	0.00515276	0.005290677	1.943	6
Kenya Airways,	0.008202205	0.009295969	1.943	6
Safaricom,	0.005215193	-0.01311929	1.943	6
Nation Media Group,	0.001005914	0.008362409	1.943	6
Barclays Bank Kenya,	0.006342459	0.00549367	1.943	6
Equity Bank,	-0.00542644	0.022262004	1.943	6
Kenya Commercial Bank,	-0.0125223	0.02001584	1.943	6
Standard Chartered Bank,	-0.00479995	0.040083523	1.943	6

Bamburi Cement,	0.006232398	0.011967003	1.943	6
British American Tobacco,	-0.00413867	0.019640362	1.943	6
Kengen,	0.016629717	0.014776928	1.943	6
Centum Investment Company,	0.009364964	0.027508485	1.943	6
East African Breweries,	0.00710677	-0.0080647	1.943	6
EA Cables,	0.003132401	0.020452269	1.943	6
Kenya Power & Lighting Company Ltd. and	0.006867049	-0.01305594	1.943	6
Athi River Mining	-0.00326378	0.016417532	1.943	6
CAAR	0.004691279	0.012816941		

Source: Research Findings

**APPENDIX III: ANNUAL CUMULATIVE STOCK RETURNS
DURING NEW/FULL MOON 2011**

CUMULATIVE STOCK RETURN				
YEAR 2011				
NSE 20 SHARE INDEX	MEAN RETURN- NEW MOON	MEAN RETURN- FULL MOON	CRITICA L VALUE	Df
Mumias Sugar,	0.026423351	-0.01028114	1.943	6
Express Kenya,	0.038167611	-0.01416191	1.943	6
Rea Vipingo,	0.016257133	0.015883728	1.943	6
Sasini Tea,	0.004987614	-0.0262581	1.943	6
CMC Holdings,	0.005274274	-0.00258081	1.943	6
Kenya Airways,	0.044160086	0.004065651	1.943	6
Safaricom,	0.011187353	-0.00817461	1.943	6
Nation Media Group,	0.005360841	0.00183581	1.943	6
Barclays Bank Kenya,	0.083256557	-0.0199149	1.943	6
Equity Bank,	0.031470091	0.001583694	1.943	6
Kenya Commercial Bank,	0.01145005	-0.00163932	1.943	6
Standard Chartered Bank,	0.027208919	0.000865883	1.943	6
Bamburi Cement,	0.015477443	0.003000848	1.943	6

British American Tobacco,	-0.00088076	-0.0093785	1.943	6
Kengen,	0.024112284	0.002003296	1.943	6
Centum Investment Company,	0.006404175	-0.00114119	1.943	6
East African Breweries,	0.01419767	0.009773409	1.943	6
EA Cables,	0.016190322	-0.01075047	1.943	6
Kenya Power & Lighting Company Ltd. and	0.009911186	-0.00198069	1.943	6
Athi River Mining	0.020764794	-0.00496813	1.943	6
CAAR	0.02056905	-0.00361087		

Source: Research Findings

**APPENDIX IV: ANNUAL CUMULATIVE STOCK RETURNS
DURING NEW/FULL MOON 2012**

CUMULATIVE STOCK RETURN				
YEAR 2012				
NSE 20 SHARE INDEX	MEAN RETURN- NEW MOON	MEAN RETURN- FULL MOON	CRITICAL VALUE	Df
Mumias Sugar,	0.009293439	1.62237E-05	1.943	6
Express Kenya,	0.005708714	-0.00028516	1.943	6
Rea Vipingo,	0.010170748	0.014300597	1.943	6
Sasini Tea,	-0.00823959	-0.00269881	1.943	6
CMC Holdings,	0.005274274	-0.00258081	1.943	6
Kenya Airways,	-0.00184168	-0.01225389	1.943	6
Safaricom,	0.012105634	0.026079551	1.943	6
Nation Media Group,	-0.00130678	0.028455064	1.943	6
Barclays Bank Kenya,	6.29032E-05	0.012467209	1.943	6
Equity Bank,	0.007486694	0.02135891	1.943	6
Kenya Commercial Bank,	0.007041911	0.035326802	1.943	6
Standard Chartered Bank,	-0.03285199	0.024768695	1.943	6
Bamburi Cement,	0.014602659	0.027307043	1.943	6

British American Tobacco,	0.006283742	0.042514263	1.943	6
Kengen,	0.016891	0.017874	1.943	6
Centum Investment Company,	0.009416	0.029248	1.943	6
East African Breweries,	0.013201	-0.00479	1.943	6
EA Cables,	0.008817	0.010311	1.943	6
Kenya Power & Lighting Company Ltd. and	0.003419	-0.0152	1.943	6
Athi River Mining	0.007745	0.002893	1.943	6
CAAR	0.004663984	0.012755584		

Source: Research Findings

**APPENDIX V: ANNUAL CUMULATIVE STOCK RETURNS
DURING NEW/FULL MOON 2013**

CUMULATIVE STOCK RETURN				
YEAR 2013				
NSE 20 SHARE INDEX	MEAN RETURN- NEW MOON	MEAN RETURN- FULL MOON	CRITICA L VALUE	Df
Mumias Sugar,	-0.00332928	-0.01858002	1.943	6
Express Kenya,	-0.01797259	-0.00402106	1.943	6
Rea Vipingo,	0.003926962	0.009905352	1.943	6
Sasini Tea,	0.007403287	0.006803188	1.943	6
CMC Holdings,	-0.00356	0.006448	1.943	6
Kenya Airways,	-0.00775421	-0.01583922	1.943	6
Safaricom,	0.006111436	0.015104805	1.943	6
Nation Media Group,	0.019191094	0.027520575	1.943	6
Barclays Bank Kenya,	0.000437744	0.007489316	1.943	6
Equity Bank,	0.027320582	0.028813596	1.943	6
Kenya Commercial Bank,	0.01289865	0.022935541	1.943	6
Standard Chartered Bank,	0.009143522	0.00229749	1.943	6
Bamburi Cement,	0.005059115	0.004258897	1.943	6

British American Tobacco,	0.003283706	0.007485382	1.943	6
Kengen,	0.016891097	0.017873571	1.943	6
Centum Investment Company,	0.009416315	0.02924778	1.943	6
East African Breweries,	0.013201083	-0.00478811	1.943	6
EA Cables,	0.002515422	0.019035846	1.943	6
Kenya Power & Lighting Company Ltd. and	0.003419191	-0.01520129	1.943	6
Athi River Mining	0.00774498	0.002893442	1.943	6
CAAR	0.005767405	0.007484154		

Source: Research Findings

**APPENDIX VI: ANNUAL CUMULATIVE STOCK RETURNS
DURING NEW/FULL MOON 2014**

CUMULATIVE STOCK RETURN 2014				
NSE 20 SHARE INDEX				
NEW MOON/FULL MOON DATES 2014	MEAN RETURN- NEW MOON	MEAN RETURN- FULL MOON	CRITICAL VALUE	Df
1/16 Jan	0.032319143	0.014490155	1.943	6
31 Jan /15 Feb	0	0.020089946	1.943	6
1/16 march	0	0.000142807	1.943	6
30 March/15 April	-0.00067023	0.007244271	1.943	6
29 April/14 May	0.000767563	-0.00893702	1.943	6
28 May/13 June	-0.00229381	0.001761468	1.943	6
27 June/12 July	0.003371056	0	1.943	6
27 July/10 Aug	0.012443649	0.022141741	1.943	6
25 Aug/9 September	0.001778959	-0.01706258	1.943	6
24 Sept/8 Oct	0.001031	0.0123	1.943	6
24 Oct/ /7 Nov	0.016543	0.00956	1.943	6
22 Nov/6 Dec	0.00718	0.0173	1.943	6
CAAR	0.006039194	0.006585899		

Source: Research Findings

APPENDIX VII: MOON PHASES FOR NAIROBI, KENYA IN 2010

Lunation	New Moon		First Quarter		Full Moon		Third Quarter		Duration
1076							7 Jan	13:39	29d 19h 09m
1077	15 Jan	10:11	23 Jan	13:53	30 Jan	09:17	6 Feb	02:48	29d 19h 40m
1078	14 Feb	05:51	22 Feb	03:42	28 Feb	19:37	7 Mar	18:41	29d 18h 10m
1079	16 Mar	00:01	23 Mar	14:00	30 Mar	05:25	6 Apr	12:36	29d 15h 28m
1080	14 Apr	15:28	21 Apr	21:19	28 Apr	15:18	6 May	07:14	29d 12h 35m
1081	14 May	04:04	21 May	02:42	28 May	02:07	5 Jun	01:13	29d 10h 10m
1082	12 Jun	14:14	19 Jun	07:29	26 Jun	14:30	4 Jul	17:35	29d 8h 26m
1083	11 Jul	22:40	18 Jul	13:10	26 Jul	04:36	3 Aug	07:58	29d 7h 28m
1084	10 Aug	06:08	16 Aug	21:13	24 Aug	20:04	1 Sep	20:21	29d 7h 22m
1085	8 Sep	13:29	15 Sep	08:49	23 Sep	12:17	1 Oct	06:52	29d 8h 15m
1086	7 Oct	21:44	15 Oct	00:27	23 Oct	04:36	30 Oct	15:45	29d 10h 07m
1087	6 Nov	07:51	13 Nov	19:38	21 Nov	20:27	28 Nov	23:36	29d 12h 44m
1088	5 Dec	20:35	13 Dec	16:58	21 Dec	11:13	28 Dec	07:18	29d 15h 27m

Source: Gregorian calendar

APPENDIX VIII: MOON PHASES FOR NAIROBI, KENYA IN 2011

Lunation	New Moon		First Quarter		Full Moon		Third Quarter		Duration
1089	4 Jan	12:02	12 Jan	14:31	20 Jan	00:21	26 Jan	15:57	29d 17h 28m
1090	3 Feb	05:30	11 Feb	10:18	18 Feb	11:35	25 Feb	02:26	29d 18h 15m
1091	4 Mar	23:45	13 Mar	02:44	19 Mar	21:10	26 Mar	15:07	29d 17h 46m
1092	3 Apr	17:32	11 Apr	15:05	18 Apr	05:44	25 Apr	05:46	29d 16h 18m
1093	3 May	09:50	10 May	23:32	17 May	14:08	24 May	21:52	29d 14h 12m
1094	2 Jun	00:02	9 Jun	05:10	15 Jun	23:13	23 Jun	14:48	29d 11h 51m
1095	1 Jul	11:53	8 Jul	09:29	15 Jul	09:39	23 Jul	08:01	29d 9h 46m
1096	30 Jul	21:39	6 Aug	14:08	13 Aug	21:57	22 Aug	00:54	29d 8h 24m
1097	29 Aug	06:04	4 Sep	20:39	12 Sep	12:26	20 Sep	16:38	29d 8h 05m
1098	27 Sep	14:08	4 Oct	06:15	12 Oct	05:05	20 Oct	06:30	29d 8h 47m
1099	26 Oct	22:55	2 Nov	19:38	10 Nov	23:16	18 Nov	18:09	29d 10h 14m
1100	25 Nov	09:09	2 Dec	12:52	10 Dec	17:36	18 Dec	03:47	29d 11h 57m
1101	24 Dec	21:06							29d 13h 33m

Source: Gregorian calendar

APPENDIX IX: MOON PHASES FOR NAIROBI, KENYA IN 2012

Lunation	New Moon		First Quarter		Full Moon		Third Quarter		Duration
1101			1 Jan	09:14	9 Jan	10:30	16 Jan	12:07	29d 13h 33m
1102	23 Jan	10:39	31 Jan	07:09	8 Feb	00:53	14 Feb	20:03	29d 14h 55m
1103	22 Feb	01:34	1 Mar	04:21	8 Mar	12:39	15 Mar	04:25	29d 16h 03m
1104	22 Mar	17:37	30 Mar	22:40	6 Apr	22:18	13 Apr	13:49	29d 16h 41m
1105	21 Apr	10:18	29 Apr	12:57	6 May	06:35	13 May	00:46	29d 16h 29m
1106	21 May	02:47	28 May	23:16	4 Jun	14:11	11 Jun	13:41	29d 15h 15m
1107	19 Jun	18:02	27 Jun	06:30	3 Jul	21:51	11 Jul	04:47	29d 13h 22m
1108	19 Jul	07:23	26 Jul	11:56	2 Aug	06:27	9 Aug	21:55	29d 11h 30m
1109	17 Aug	18:54	24 Aug	16:53	31 Aug	16:58	8 Sep	16:15	29d 10h 16m
1110	16 Sep	05:10	22 Sep	22:40	30 Sep	06:18	8 Oct	10:33	29d 9h 52m
1111	15 Oct	15:02	22 Oct	06:31	29 Oct	22:49	7 Nov	03:35	29d 10h 05m
1112	14 Nov	01:08	20 Nov	17:31	28 Nov	17:45	6 Dec	18:31	29d 10h 34m
1113	13 Dec	11:41	20 Dec	08:19	28 Dec	13:21			29d 11h 02m

Source: Gregorian calendar.

APPENDIX X: MOON PHASES FOR NAIROBI, KENYA IN 2013

Lunation	New Moon		First Quarter		Full Moon		Third Quarter		Duration
1113							5 Jan	06:57	29d 11h 02m
1114	11 Jan	22:43	19 Jan	02:45	27 Jan	07:38	3 Feb	16:56	29d 11h 37m
1115	10 Feb	10:20	17 Feb	23:30	25 Feb	23:26	5 Mar	00:52	29d 12h 31m
1116	11 Mar	22:50	19 Mar	20:26	27 Mar	12:27	3 Apr	07:36	29d 13h 44m
1117	10 Apr	12:35	18 Apr	15:30	25 Apr	22:57	2 May	14:14	29d 14h 53m
1118	10 May	03:28	18 May	07:34	25 May	07:24	31 May	21:58	29d 15h 28m
1119	8 Jun	18:56	16 Jun	20:23	23 Jun	14:32	30 Jun	07:53	29d 15h 18m
1120	8 Jul	10:14	16 Jul	06:18	22 Jul	21:15	29 Jul	20:43	29d 14h 36m
1121	7 Aug	00:50	14 Aug	13:56	21 Aug	04:44	28 Aug	12:34	29d 13h 45m
1122	5 Sep	14:36	12 Sep	20:08	19 Sep	14:12	27 Sep	06:55	29d 12h 58m
1123	5 Oct	03:34	12 Oct	02:02	19 Oct	02:37	27 Oct	02:40	29d 12h 15m
1124	3 Nov	15:50	10 Nov	08:57	17 Nov	18:15	25 Nov	22:27	29d 11h 32m
1125	3 Dec	03:22	9 Dec	18:11	17 Dec	12:28	25 Dec	16:47	29d 10h 52m

Source: Gregorian calendar.

APPENDIX VI: MOON PHASES FOR NAIROBI, KENYA IN 2014

Lunation	New Moon		First Quarter		Full Moon		Third Quarter		Duration
1126	1 Jan	14:14	8 Jan	06:39	16 Jan	07:52	24 Jan	08:18	29d 10h 24m
1127	31 Jan	00:38	6 Feb	22:22	15 Feb	02:52	22 Feb	20:15	29d 10h 21m
1128	1 Mar	10:59	8 Mar	16:26	16 Mar	20:08	24 Mar	04:46	29d 10h 45m
1129	30 Mar	21:44	7 Apr	11:30	15 Apr	10:42	22 Apr	10:51	29d 11h 30m
1130	29 Apr	09:14	7 May	06:14	14 May	22:15	21 May	15:59	29d 12h 26m
1131	28 May	21:40	5 Jun	23:38	13 Jun	07:11	19 Jun	21:38	29d 13h 28m
1132	27 Jun	11:08	5 Jul	14:58	12 Jul	14:24	19 Jul	05:08	29d 14h 33m
1133	27 Jul	01:41	4 Aug	03:49	10 Aug	21:09	17 Aug	15:25	29d 15h 31m
1134	25 Aug	17:12	2 Sep	14:11	9 Sep	04:38	16 Sep	05:04	29d 16h 01m
1135	24 Sep	09:13	1 Oct	22:32	8 Oct	13:50	15 Oct	22:12	29d 15h 43m
1136	24 Oct	00:56	31 Oct	05:48	7 Nov	01:22	14 Nov	18:15	29d 14h 36m
1137	22 Nov	15:32	29 Nov	13:06	6 Dec	15:26	14 Dec	15:50	29d 13h 04m
1138	22 Dec	04:35	28 Dec	21:31					29d 11h 38m

Source: Gregorian calendar.