ASSESS THE SIGNIFICANCE OF RETURN INTERVAL ON THE ESTIMATION OF SYSTEMATIC RISK IN LISTED COMPANIES TRADING IN THE NAIROBI SECURITIES EXCHANGE.

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APRIL 2013
DECLARATION

Except for references specifically indicated in the text, and such help as I have acknowledged, this research project is my own original work and has not been presented to any college or university for examination purposes.

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Supervisor’s Approval

This research project has been presented for consideration with my approval as the university supervisor.

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This research project is dedicated to my family members; my spouse Titus Masha, daughter Hope Henzo, son Harris Heri and finally my sister Fatuma for their encouragement and overwhelming support they accorded me in the course of compiling this work.
ACKNOWLEDGEMENT

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OPERATIONAL DEFINATION OF TERMS

**Beta** - it measures non diversifiable risk as it shows how the price of a security responds to market forces.

**Capital Asset Pricing Model (CAPM)** - the CAPM explains the risk return relationship with the assumption that investors are risk averse and they will only take risk only if they are compensated for the risk which they bear.

**Capital Markets** - these are financial markets in which financial assets with a term to maturity of typically more than one year are traded.

**Capital Markets Authority (CMA)** – a government agency established by the Capital Markets Authority Act of 1989 that facilitates, regulates and oversees the activities of the capital markets.

**Characteristic line** - regression line that indicates the systematic risk of a risky asset.

**Diversification** - the process of adding securities to a port in order to reduce the portfolio's total risk.

**Dividend** - a payment made by a company to its shareholders for providing share capital. Dividends are paid out of distributable profits and are paid in proportion to the number of shares held.

**Emerging market** - a high growth, volatile, exotic and risky rapidly growing stock market in a developing country.

**Investment** - the sacrifice of certain present value for future value.
Market Capitalization - this is the total market value of a security (share or bond). It is calculated by multiplying the market price per unit of the security with the total number of outstanding units of security.

Market Index - this is a collection of shares and at times bonds, whose prices are averaged to reflect the investment performance of a particular market for financial assets. E.g. NSE 20 share index and the NSE All Share Index (NASI).

Market Portfolio - this is a portfolio consisting of investment in all securities or in securities representative of the market. The proportion invested in each security equals the percentage of the total market capitalization represented by the security.

Market Risk or Systematic risk - is the variation in the return on any scrip due to market movements. There is nothing much one can do about systematic risk of a security because it arises due to some extraneous variables.

The Nairobi Securities Exchange - is the self regulating organization in Kenya dealing with listed instruments and draws its membership from stock brokers, dealers and investment banks.

Ordinary Shares (Or Equity Stock) - this is a financial instrument issued to those individuals and institutions who provide long term finance for companies.

Portfolio- is a combination of securities that have returns and risk characteristics of their own.

Risk- in holding securities is generally associated with the possibility that realized returns will be less than the returns that were expected.

Risk Averse Investor - an investor who prefers an investment with less risk over one with more risk on investments that offer same (identical) return.
**Risk Free Borrowing** - this involve of borrowing funds that are to be repaid with a known rate of interest.

**Risk Free Lending (Investing)** - this involves investing in a risk free asset

**Risk Free Asset** - an asset whose return over a given holding period is certain and known at the beginning of the holding.

**Risk Premium** - the price or compensation for assuming additional risk. Investors tend to avoid risk unless they are rewarded for assuming additional risk.

**Risk Seeking Investor** - is an investor who prefers an investment with more risk, assuming that both investments offer the same expected return.

**Risk Tolerance** - this is the tradeoff between risk and expected return as demanded by a particular investor,

**Risk Neutral Investor** - this is a kind of investor who has no preference between investments with varying levels of risk assuming that the investment offers the same expected return.

**Securities** - this is a financial instrument issued by companies and the government as a means of raising capital and borrowing money. The most commonly used financial securities are Shares, Stocks, Debentures, Treasury Bills and Bonds.

**Shareholders** - these are individuals and institutions that have contributed funds to finance a company in return for shares in that company. They can be ordinary or preference shareholders.

**Stock** - this is a financial security issued by a company or the government as a means of raising long-term capital.
Stock Market or Security market is a public market (a loose network of economic transactions, not a physical facility or discrete entity) for the trading of company securities (Shares and Bonds/Debt Securities) and derivatives at an agreed price; these are securities listed on a stock exchange as well as those only traded privately. The Nairobi Securities Exchange is the only security market in Kenya.

Unsystematic risk or diversifiable risk - is the variation in the return of a stock due to that stock specific factors or movements. It is going to affect the prices of the stocks of companies which are operating in that sector and not all the stocks.
# LIST OF ABBREVIATIONS AND ACRONYMS

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<td>Arbitrage Pricing Theory</td>
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<td>DCF</td>
<td>Discounted Cash Flow</td>
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<td>IFC</td>
<td>International Finance Cooperation</td>
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<td>IPO</td>
<td>Initial Public Offer</td>
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<td>KU</td>
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ABSTRACT

Systematic risk estimations are broadly used in investment analysis and portfolio management. The popular measure of systematic risk is the CAPM beta. The CAPM states that the expected return on an asset depends upon its level of systematic risk which is measured relative to that of the market portfolio. The estimation of systematic risk poses major challenges to researchers and different economic agents as per which return interval to use. Whereas it is by now widely recognized that risk varies over time, on the other hand, the risk profile of an investor, in terms of investment horizon, makes it crucial to also assess risk at the frequency level. This study proposes a unified approach to measuring market risk by examining the relationship between the return of the stock and its systematic risk at different time intervals. In particular, the study attempts to assess the significance of time intervals in the estimation of systematic risk in an emerging market, the Nairobi Securities Exchange. The proposed procedure is acted on a sample composed of 21 equity stocks that constituted the NSE 20 share index for the period January 1997 to December 2011. Systematic risks of the 21 equity stocks were estimated on the basis of daily, weekly, monthly, and yearly. The study used raw secondary data consisting of the NSE listed companies daily prices for the 15 years under review as obtained from the NSE data centre. The data was then complied and analyzed by means of a secondary data schedule Microsoft Excel form and a regression model. The study used the variance or standard deviation of expected returns as the measure of risk. The individual stock returns and the market return were calculated first followed by the estimation of beta coefficient for each stock using the different return intervals. The analysis of risk and return of all the sampled companies revealed that 99.9% had positive returns that increased with increase in time interval from daily to annual while beta estimation indicated substantial (90%) differences in beta values when different return intervals are employed more so an increase in beta across intervals by 57%. These results confirm that there exist a positive relationship between multi scale returns and systematic risk coefficients, and that beta changes according to time interval. From the two findings therefore, the convincing evidence is that at the NSE, the listed companies with the highest beta also have the highest returns while the companies with the lowest beta also have the lowest return. Finally the study confirmed that return intervals and frequency levels are significantly important in the estimation of systematic risk as evidenced by the substantial differences in returns and beta values when different return intervals are employed. In both cases the results showed an increase in values across return intervals from daily to yearly. The estimates of average return versus average stock beta also revealed an increasing slope as one moves across intervals across intervals from daily to yearly making longer period intervals more stable and therefore usable compared to the rest. This evidence indicates that the NSE is more efficient at longer periods. To maximise returns at the NSE, the study recommends to short-term investors to consider short estimation periods; daily and weekly return intervals to estimate beta for short term expected returns as shorter estimation period reflect recent changes in restructuring, acquisitions, disinvestment and policy issues. On the other hand while making long term investment decisions, investors are advised to consider beta estimated on longer estimation periods since their systematic risk appears to be more stable and therefore usable. All the same, due to rapid changing economic conditions at the NSE, investors are advised to take adequate risk management strategies apart from considering one’s risk tolerance levels so as to cope with risk in a portfolio by quantifying the potential for losses and take suitable actions to minimize these depending on one’s investment objectives.
CHAPTER ONE

1.0 Introduction

1.1 Background of the Study.

The NSE, an emerging market is the self regulating organization in Kenya dealing with listed instruments and draws its membership from stock brokers, dealers and investment banks. The NSE is currently one of the most attractive and promising markets in Africa and many investors want to benefit from the high growth and promising economic outlook and therefore invest in the NSE (World Bank, 2010). Keen to note has been the rising trend in equity stock trading at the NSE, spurred by local investors hence making technical investor educations on risk and return inevitable if the market has to sustain the ever increasing investment appetite by all class of investors (CMA 2010). Whereas most of the Kenyan markets opportunities and risk factors can be derived back to general fundamental conditions, the area of technical risk and return analysis need to be given some consideratations and the returns be estimated for each security being considered with appropriate adjustments for decision making (Fischer, 2003).

The risk and return model that has been in use the longest and is still the standard in most real world analyses is the Capital Asset Pricing Model. The CAPM attempts to explain the relationship between the risk and return on a financial security, and this relationship can then be used to determine the appropriate price for the security. The intuition behind the CAPM is the segmentation of asset risk into two components: systematic, non diversifiable and unsystematic; diversifiable risk. The systematic risk is the only risk that CAPM cares about and it is measured by the beta coefficient. Whereas a security’s historical rates of return can be used to estimate its
systematic risk, it is also widely recognized that risk varies over time and the risk profile of an investor, in terms of investment horizon, makes it crucial to also assess risk at the frequency level. CAPM provides no guidelines on what return interval should be used for the estimation of beta. This study aims at assessing systematic risk at four different time intervals; daily, weekly, month and annual returns for equity stocks trading in the Nairobi Securities Exchange for the period January 1997 to December 2011 using the novel approach, wavelet analysis.

Wavelet analysis constitutes a very promising tool as it represents a refinement in terms of analysis in the sense that both time and frequency domains are taken into account. In particular, one can resort to wavelet analysis to provide a unified framework to measure risk in the time frequency space. As both time and frequency domains are encompassed, one is able to capture the time varying feature of risk while disentangling its behavior at the frequency level. In this way, one can simultaneously measure the evolving risk exposure and distinguish the risk faced by short and long term investors.

1.2 Statement of the Problem

Risk appetite in Kenya has increased tremendously over the years as evidenced by the speculative excesses witnessed in the NSE. The number of investors increased in the NSE after the 2003 - 2007 economic growth experienced and the many IPOs that were floated in the market between 2006 – 2009, that unprecedented interest in the NSE therefore caused more ordinary Kenyans to be interested in the stock market (CMA, 2009). The economy declined in 2008 due to the post election violence and in 2009 it started increasing at a diminishing rate, but those who had experienced good returns hope that the trend would pick up and therefore still flocking the NSE. According to World Bank (2006), the risk inherent in stock market
investments can be adverse especially to most small retail investors who lack adequate technical investment information.

Most studies have also been carried out on the NSE on the existing relationship between risk and return and affirmed that there exists a positive relation between the two variables, but less emphasis has been placed on the effect of return interval on beta estimates on the NSE and traditionally it has been assumed that beta is constant through time. However, empirical research has found evidence that betas are time varying, Blume (1971, 1975). One natural implication of such a result is that risk measurement must be able to account for this time varying feature. Besides the time variation, risk management should also take into account the distinction between the short and long term investor, Candelon et al. (2008)). In fact, the first kind of investor is naturally more interested in risk assessment at higher frequencies, that is, short term fluctuations, whereas the latter focuses on risk at lower frequencies, that is, long term fluctuations. Analysis at the frequency level provides a valuable source of information, considering that different financial decisions occur at different frequencies. Hence, one has to resort to the frequency domain analysis to obtain insights into risk at the frequency level.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the project is to assess the significance of return interval on the estimation of systematic risk for listed companies trading in the Nairobi Securities Exchange for the period January 1997 – December 2011.
1.3.2 Specific Objectives

The project worked towards meeting the following objectives.

i. To establish the holding returns of listed companies trading in the NSE for the period January 1997 – December 2011.

ii. To estimate the systematic risk parameter (beta) of listed companies trading in the NSE for the period January 1997 – December 2011.


1.4 Research Questions

In achieving the objectives of the study, the researcher was guided by the following research questions.

i. What are the holding returns of listed companies trading in the NSE for the period January 1997 – December 2011?

ii. What are the systematic risks (beta) of listed companies trading in the NSE for the period January 1997 – December 2011?

iii. What is the significance of return interval on the estimation of systematic risk for listed companies trading in the Nairobi Securities Exchange for the January 1997 – December 2011?
1.5 Significance of the Study

The findings of the study will be of significance to the NSE equity stock investors, market regulators, policy makers, markets intermediaries and other parties whose knowledge on the significance of return interval on the estimation of systematic risk for listed companies trading in the NSE is important input into investment analysis and portfolio construction.

Investors and their financial advisors will be in a better position to devise trading strategies that minimize risk and maximize the returns on their investment considering time and frequency-varying features in risk assessment, market regulators (NSE and CMA) in establishing the NSE performance against investors’ perception of risks and returns and hence develop ways of building investors confidence, policy makers to review and strengthen the legal and regulatory framework to deepen the capital markets by increasing the product range, market players and protection of investors, market intermediaries to provide professional guidance and clarification to investors important in getting the right investments and timing through understanding both the opportunities and the risks of today's market, as well as fellow scholars who can use this study to do more research on the security market so as to provide investors with as much information as possible in equity investment.

1.6 Scope of the Study.

The NSE equity stocks was initially categorized into four market segments namely; MIMS, which is the main quotation market, The AIMS provided an alternative method of raising capital to small, medium sized and young companies that find it difficult to meet the more stringent listing requirements of the MIMS, the FISMS provides an independent market for fixed income investments and the FOMS segment which is yet to operate after the
establishment of the necessary framework. In July 2011 the NSE changed the categorization of all its equity stocks into ten sectors that describe the nature of their business, as agricultural, automobiles and accessories, banking, commercial and service, construction and allied, energy and petroleum, insurance, investment, manufacturing and allied and telecommunication and technology sectors. The NSE 20 share index was introduced in 1984 to measure the market performance by calculating the weighted average return of 20 best blue chip companies. Due to the increased number of investors in the NSE over time, the NSE has consistently reviewed the index and announced the companies that would constitute the NSE Share Index. In 2008, the NSE All Share Index (NASI) was introduced as an alternative index. Its measure is an overall indicator of market performance as it incorporates all the traded shares of the day.

The study focused on assessing the impact of return interval on the estimation of beta for listed companies trading in the Nairobi Securities Exchange for the period January 1997 – December 2011.
CHAPTER TWO

2.0 Literature Review

2.1 Introduction

This chapter presents a review of the related literature on the subject under study presented by various researchers, scholars, analysts and authors. The research drew materials from books, journal articles, newsletters, internet, newspapers and government of Kenya documents with relevant information and which were closely related to the theme and the objectives of the study. The conceptual framework contained in this chapter is the cornerstone upon which it forms base for the study. The chapter finally concluded with the review of research by summarizing and identifying the gap other researchers had left which is assessing the significance of return intervals in estimation of systematic risk in equity stocks trading in the NSE.

2.2 Review of Theoretical Literature

This section reviewed the concept of risk and return and how they are measured. The study also focused on how assets are valued in the capital markets and more specifically the wider concept of risk and return, the logic of portfolio theory and the use of various equity asset valuation models, risk management and a highlight on return.

2.2.1 Portfolio Theory

Although the measurement of market risk has a long tradition in finance, there is still no universally agreed upon definition of risk. The modern theory of portfolio analysis dates back
to the pioneering work of Harry Markowitz in the 1950s. The starting point of portfolio theory rests on the assumption that investors choose between portfolios on the basis of their expected return, on the one hand, and the variance of their return, on the other. The investor should choose a portfolio that maximizes expected return for any given variance, or alternatively, minimizes variance for any given expected return. The portfolio choice is determined by the investor’s preferred tradeoff between expected return and risk. Hence, in his seminal paper, Markowitz (1952) implicitly provided a mathematical definition of risk, that is, the variance of returns. In this way, risk is thought in terms of how spread out the distribution of returns is.

Markowitz’ work has been vital to portfolio managers making portfolio asset allocation decisions, trying to determine how much of the portfolio that should be invested into different asset classes such as stocks, bonds or real estate based on the risk and return tradeoff (Grinblatt and Titman, 2001).
Source (Reilly and Brown, 2003)

It can be seen from the figure that as the number of securities are increased in a portfolio the systematic risk remains constant while the unsystematic risk reduces and then becomes stagnant. As a result the total risk also decreases initially and then it reaches a minimum point very close to the systematic risk.

One important point to note here is that investors are not rewarded for assuming unsystematic risk because it can be eliminated through diversification. Thus investors are rewarded for assuming only systematic risk.
2.2.1.1 Risk Management

Risk management deals with strategies to cope with risk in a portfolio, it tries to quantify the potential for losses and then take suitable actions to minimize these depending on the investment objectives. (Bodie et. al 2004). Mainly the idea of managing risk has come from the increased volatility of the market interest rate and exchange rate (Grinblatt and Titman, 2001). Within the risk management field, any type of procedure used to control or manage risk aims at limiting the investors’ exposure to risk. Damodaran (2005) however believes risk management today is focusing too much on the risk reduction part, and disregards the fact that risk management is also about increasing the exposure to risk when appropriate to do so.

MacQueen (2002) says that the practice of risk management is slowly coming into play in portfolio management even though it has been around for decades. He believes however that risk management is currently considering the portfolio risk after the portfolio has been put together instead of during the portfolio composition. This is in contrary to Markowitz’ theories that return and risk should be considered together when designing a portfolio and Macqueen believes more work is needed in this area even though the growing popularity of risk management is a positive step.

2.2.1.2 Hedging

One option investors have within risk management is using hedging. Risk Hedging encapsulates all the activities required to ensure that the exposure, one is having, on account of the risk, doesn’t transform into loss. That is, the exposure is only a notional loss, which might transform into actual loss on happening of a particular event, but if necessary steps are taken to
control, manage and diversify away the risk, this exposure can be controlled. It can be used in any type of investment where risk is judged to be great and a procedure is needed for managing this. Hedging can work as insurance to the investor, making sure he/she is covered if the market moves opposite to the planned future. This way the investor is covered if potential declines occur (Bodie et al. 2004). Hedging does not provide an ultimate risk management since it only can combat market risk and not firm specific risk through derivative contracts, these are according to Grinblatt and Titman (2001) best covered by regular insurances.

### 2.2.1.3 Risk Diversification

The classical expression “Don’t put all your eggs in one basket” is exactly what diversification is all about, i.e. reducing the portfolio risk without necessarily sacrificing return by investing in different assets that are behaving differently in different market conditions. The reasoning behind this is that if some assets are performing poorly some other assets will counteract and perform well instead. Diversification eliminates the unsystematic risk and lowers the total risk down to the market risk or the systematic risk which cannot be diversified away. (Grinblatt and Titman, 2001). Accordingly Alexander and Chervany (1980) found that beta was more stable in more diversified portfolios and beta stability occurred by the point where there more securities in the portfolio.

### 2.2.1.4 Return

Since risk is something an investor has to face when investing it is impossible to talk about risk without talking about the return as well. According to standard portfolio theory, these two are connected in any decision that one make, a higher risk must mean a potential higher return. If
this does not hold no one would purchase a risky security if it would not offer a higher reward. What most market participants try to do is to minimize the risk in a portfolio while increasing the expected return (Biglova et al. 2004 and Bodie et al. 2004). To understand the concept of risk the expected return must be understood.

The return depends on the increase/decrease in the price of the share over the investment horizon as well as dividend income the share has provided. This is called the holding period return (HPR) and can also be explained by the following formula.

\[
HPR = \frac{\text{Ending Price} - \text{Beginning Price}}{\text{Beginning Price}} + \text{Dividend Yield}
\]

**Formula 1: Holding Period Return (Reilly and Brown, 2002)**

The idea behind diversification is that the diversifiable risk, which is the company specific risk, decreases as we increase the number of holdings. However, the market related risk depends on general market conditions that apply to all companies and may therefore not be reduced by purchasing assets in different companies. Despite this, the diversification strategy is still meaningful as the total risk (standard deviation) decreases as well.

### 2.2.2 The Capital Asset pricing Model

The risk and return model that has been in use the longest and is still the standard in most real-world analyses is the Capital Asset Pricing Model, which attempts to explain the relationship between the risk and return on a financial security, and this relationship can then be used to determine the appropriate price for the security. The Capital Asset Pricing Model (CAPM)
emerged through the contributions of Sharpe (1964) and Lintner (1965a, 1965b) and Mossin (1966). According to the CAPM, the relevant risk measure in holding a given asset is the systematic risk, since all other risks can be diversified away through portfolio diversification. The systematic risk, measured by the beta coefficient, is a widely used measure of risk. In statistical terms, it is assumed that the variability in each stock’s return is a linear function of the return on some larger market with the beta reflecting the responsiveness of an asset to movements in the market portfolio.

The CAPM is important because it was the first equilibrium asset pricing model that hinges on a mean variance portfolio selection under uncertainty. It provides the relationship between investment’s systematic risk and its expected return. Therefore, given the general risk aversion of the market, investments with high levels of systematic risk can be expected to produce a high return, and vice versa. The model is built upon a number of assumptions, some of which are realistic, others of which are not. These assumptions may be divided into two groups about investors and capital markets. According to the CAPM, investors are rational, risk averse and utility maximizers; they perceive utility via return and measure risk by the standard deviation of returns; they have a single period investment time horizon and have the same expectations about what the uncertain future holds. In addition, the model assumes that capital markets are perfect and, particularly, that there are no taxes as well as transaction costs and investors can both lend and borrow at the risk free rate of return (Aydoğan, 1989; Ho et al, 2000; Karan and Karadagli, 2001; Perold, 2004; Tang and Shum, 2007; Gursoy and Rejepova, 2007; Galagedera, 2007; Misirli and Alper, 2008).

\[ 2.2.2.1 \quad \text{Beta} \]
CAPM builds on the theory that the total risk of a stock, measured by the variance of stock returns, can be broken down into two categories; unsystematic risk and systematic risk. The systematic risk is the only risk that CAPM cares about and it is measured by the beta coefficient. The higher the beta the larger is the portfolio’s volatility compared to the market, and vice versa. (Suhe, 2003). The contribution of the non diversifiable risk, beta, to the portfolio and its formula.

\[
\beta = \frac{\text{Cov (Security, Market)}}{\text{Var (Market)}}
\]

**Formula 2: Beta equation, source (Reilly and Brown, 2002)**

Since the firm specific risk of each stock can be diversified away, the only risk investors are rewarded for is the overall portfolio risk and the more systematic risk someone is willing to take on the higher the expected return becomes. An implication of the possibility of diversifying away unsystematic risk is that a stock with a high standard deviation, hence risky on its own, could actually lower the risk of a portfolio if the stock has low correlation with the portfolio itself. Beta is the appropriate risk measure according to CAPM since it is proportional to the risk a stock contributes with to the entire portfolio. The beta of a stock shows how much it moves in relation to the market. The higher the beta the more volatile the stock is compared to the market index. Hence, the risk premium of a security is proportional to its beta, the larger the beta the higher the expected return. (Bodie et al. 2004) .The way beta is used in the CAPM formula is seen in formula 2 and it is clear that the higher the beta of the stock the higher is the expected return.
The CAPM explains the risk return relationship with the assumption that investors are risk averse and they will only take risk only if they are compensated for the risk which they bear. Since unsystematic risks can be eliminated through diversification, investors will be compensated for assuming systematic risks. The market prices securities in a manner that yield expected returns than the risk free security. Investors can thus be induced to hold risky securities when they are offered a risk premium. This relationship is defined as the Capital Market Line (CML). The equation for the CML is:

\[
E(R_p) = (R_f) + \left[ \frac{E(R_m) - (R_f)}{\sigma_m} \right] \sigma_p
\]

Where:

\(E(R_p)\) = Portfolio Return
\((R_f)\) = Risk Free Return
\(E(R_m)\) = Return on Market Portfolio
\(\sigma_m\) = Standard Deviation of market portfolio
\(\sigma_p\) = Standard Deviation of the portfolio

**Formula 3: CAPM equation, source (Reilly and Brown, 2002)**

The CAPM provides that in well functioning capital markets, the risk premium varies in direct proportion to risk. The CAPM provides a measure of risk and a method of estimating the markets risk return line. The market (systematic) risk line is measured in terms of its sensitivity to the market movements. This sensitivity is referred to as the security’s beta (\(\beta\)). Beta reflects the systematic risk which cannot be reduced. Investors can eliminate their risks if they invest
their wealth in well diverse market portfolios. A beta of 1.0 indicates average level of risk while a beta of more than 1.0 means that the security’s return fluctuates more than that of the market portfolio. A zero beta means no risk. Thus the expected return on a security is given by the following equation.

\[
E(R_j) = (R_f) + E(R_m - R_f) \beta_j
\]

Where:

\(E(R_j)\) = Expected return on security j

\(R_f\) = Risk free rate

\(R_m\) = Market portfolio return

\(\beta_j\) = Measure of the security’s systematic risk (non diversifiable risk) relative to the returns of a market portfolio

**Formula 3, Expected return, Source (Reilly and Brown, 2002)**

This equation gives a line called the Security Market Line (SML).

### 2.3 Empirical Literature Review

#### 2.3.1 Empirical results of CAPM and beta

The CAPM has been subject of several empirical tests based on three implications of the relation between expected return and market beta implied by the model. First, expected returns on all assets are linearly related to their betas, and no other variable has marginal elucidatory power. Next, the beta premium is positive, meaning that the expected return on the market
portfolio exceeds the expected return on assets whose returns are uncorrelated with the market return. Last, assets uncorrelated with the market have expected returns equal to the risk free interest rate, and the beta premium is the expected market return minus the risk free rate (Fama and French, 2004). Some early empirical studies (Black, Jensen and Sholes, 1972; Fama and MacBeth, 1973; Sharpe and Cooper, 1972; Litzenberger and Ramaswamy, 1979; Gibbons, 1982; Chan and Lakonishok, 1993) on the CAPM are reasonably supportive of the basic tenet of the model. Black, Jensen and Sholes (1972) found over the period 1931-1965 that the higher beta risk and higher return go together. Fama and MacBeth (1973) also found over the period 1935-1968 that beta and returns were positively related for entire period and for eight of nine sub periods as well as the relationship to be linear, and unsystematic risk did not affect returns. Chan and Lakonishok (1993) pointed out over the period 1926-1991 that betas are a useful guide to risk in extreme market conditions, with the riskiest firms performing far worse than the market as a whole, in the ten worst months for the market between those years. A more recent paper for the CAPM and beta is by Kothari, Shanken and Sloan (1995) found by using annual returns contrary to monthly returns for computing betas over the period 1927-1990 that there was a strong relationship between beta and returns. Yet, a number of studies (Basu, 1977; Roll, 1977; Banz, 1981; Fama and French, 1992, 1993, 1996, 2004, 2006) showed that variables such as low P/E ratios, size and past sales growth explained returns even after controlling for systematic risk. Roll (1977), in a seminal critique, argued that CAPM is not a reasonable model, because a true market portfolio consisting of all risky assets can’t be observed or owned by investors. Furthermore, empirical tests of CAPM are infeasible because proxies for the market portfolio may not be mean variance efficient, even if the true market portfolio is, and vice versa.
Fama and French (1992) reported that no relationship in the US between beta and returns over the period 1963-1990 and only a weak relationship over the 1941-1990 period.

Traditionally, it is assumed that beta is constant through time. However, empirical research has found evidence that betas are time varying, Blume (1971, 1975). Such a finding led to a surge in contributions to the literature (Fabozzi and Francis (1977, 1978), Sunder (1980), Alexander and Benson (1982), Collins et al. (1987), Harvey (1989, 1991), Ferson and Harvey (1991, 1993) and Ghysels (1998) among others). One natural implication of such a result is that risk measurement must be able to account for this time varying feature. Besides the time variation, risk management should also take into account the distinction between the short and long term investor, Candelon et al. (2008)). In fact, the first kind of investor is naturally more interested in risk assessment at higher frequencies, that is, short term fluctuations, whereas the latter focuses on risk at lower frequencies, that is, long term fluctuations. Analysis at the frequency level provides a valuable source of information, considering that different financial decisions occur at different frequencies. Hence, one has to resort to the frequency domain analysis to obtain insights into risk at the frequency level.

Global financial markets being more complex and mathematical techniques have contributed to the formation of alternative single factor models. In this paper, the researcher re-examined risk measurement through a novel approach, wavelet analysis. Wavelet analysis constitutes a very promising tool as it represents a refinement in terms of analysis in the sense that both time and frequency domains are taken into account. In particular, one can resort to wavelet analysis to provide a unified framework to measure risk in the time frequency space. As both time and frequency domains are encompassed, one is able to capture the time varying feature of risk while disentangling its behavior at the frequency level. In this way, one can simultaneously
measure the evolving risk exposure and distinguish the risk faced by short and long term investors.

Although wavelets have been more popular in fields such as signal and image processing, meteorology, and physics, among others, such analysis can also shed fruitful light on several economic phenomena, for example the pioneering work of Ramsey and Zhang (1996, 1997) and Ramsey and Lampart (1998a, 1998b)). Recent work using wavelets includes that of, Kim and In (2003, 2005), who investigate the relationship between financial variables and industrial production and between stock returns and inflation, Gençay et al. (2003, 2005) and Fernandez (2005, 2006), who study the CAPM at different frequency scales.

In this scope, wavelets analysis is stated to be used in the modelling phase of financial data. This study reveals the importance of time scale issue. Cohen, Hawawin, Mayer, Schwartz and Witcomb (1986) and Handa, Kothari and Wasley (1989; 1993) stated that the beta as the systematic risk coefficient would change according to the time scale. Lynch and Zumbach (2003), in the same way, accentuate the importance of the multi scale framework in the analysis of absolute price changes to accommodate the underlying heterogeneity with intraday, daily, weekly and monthly components. These studies became base articles showing that the beta were sensitive to returns intervals.

2.3.2 Empirical studies on the effect of return interval on beta estimates.

Empirical studies on the effect of return interval on beta estimates point out the significance of the time scale issue. Gençay et.al. (2002) report that the estimated beta of the stock increased with increased time intervals. They also point out that it is not only the time interval which makes a difference in beta estimation, but also the sampling rule employed to construct a
particular time series. Levhari and Levy (1977) shows that if the analyst uses a time horizon shorter than the true one, the beta estimates are biased. Damodaran (2001) found a sizeable difference in beta estimates when different time scales are used. Hawawini (1983) argues that a security’s beta may vary substantially depending upon whether it is estimated on the basis of daily, weekly, or monthly returns. Handa et al., (1989) report that different beta estimates are possible for the same stock if different return intervals are considered. Daves et al., (2000) suggest that daily return interval should be used to estimate the beta. Because, daily return intervals increases its precision. Beta estimates may also vary depending upon proxy for the market used for the estimation. Damodaran (2001) report different beta values for the same security when different proxies for the market are used. Hawawini (1983) proposes that the direction and strength of a beta shift can be predicted with the help of q-ratio and market value of shares outstanding (MVSO). When a security’s q-ratio is larger than the market’s, the beta will decrease as return interval is shortened from monthly to daily. On the other hand whenever, a security’s q-ratio is smaller than the market’s, the beta will increase as the return interval shortens. When return interval is shortened, securities with a smaller MVSO than the average of all securities outstanding will generally have a decreasing beta, whereas securities with a larger MVSO than the average of all securities outstanding will generally have an increasing beta. This study examines the impact of four return intervals: daily, weekly, monthly and annual on the estimation of beta. Earlier, studies were conducted using data from developed countries.

There are only a limited number of studies covering emerging markets data. The new equity markets that have emerged around the world have received considerable attention in the last two decades, leading to extensive recent literature on this topic like Harvey (1995), Bekaert and Harvey (1995, 1997, 2000, 2002, 2003), Garcia and Ghysels (1998), Estrada (2000), De
Jong and De Roon (2005), Chambet and Gibson (2008), Dimitrakopoulos et al. (2010), among others. The fact that the volatility of stock prices changes over time has long been known by researchers’ like Fama (1965)), and such features have also been documented for the emerging markets. The time variation of risk comes even more naturally in these countries due to the changing economic environment resulting from capital market liberalizations or the increasing integration with world markets and the evolution of political risks. In fact, several papers have acknowledged time varying volatility and betas for the emerging markets (Bekaert and Harvey (1997, 2000, 2002, 2003), Santis and Imrohoroglu (1997), and Estrada (2000)). Moreover, the process of market integration is a gradual one, as emphasized by Bekaert and Harvey (2002). Therefore, methods that allow for gradual transitions at changing speeds, such as wavelets, are preferable to segmenting the analysis into various sub periods. Hence, the emerging markets case makes an interesting example for measuring risk with the continuous wavelet transform. This paper aims to contribute financial literature by providing empirical evidence from the Kenya NSE.

2.3.3 Alternatives to Beta

Sharpe et al. (1999) believe the reason why few other variables have got any attention in the financial world as relevant risk factors is because they become too complex. Beta is built on the variability of returns and does not take into consideration that a large beta might be good when the overall stock market is increasing in value, (this stock’s return will in this case increase more than the market). Sharpe et al. (1999) argue that even though beta has this flaw of discriminating upside volatility it has become popular because it is computed with such ease. Below however are some alternatives to CAPM’s beta presented. Specifically, whereas the
CAPM designated a single risk factor to account for the volatility inherent in an individual security or portfolio of securities, the study will focus on the intuition and application of multifactor explanations of risk and return. The chief difference between the CAPM and the multifactor models is that the latter specifies several risk factors, thereby allowing for a more expansive definition of systematic investment risk than that implied by the CAPM’s single market portfolio (Ross, 1976).

2.3.3.1 Arbitrage Pricing Theory

The Arbitrage Pricing Theory was developed by Ross in 1976. In contradiction to CAPM, which has beta as solely risk variable, the APT relates the various types of risk associated with a security such as changes in interest rates, inflation and productivity with the expected return of that same security. The APT is less restrictive compared to CAPM, and has three major assumptions being; capital markets are perfectly competitive, investors always prefer more wealth to less wealth with certainty and the stochastic process generating asset returns can be expressed as a linear function of a set of a number of underlying risk factors (or indexes).

In contrast to the CAPM, the primary practical problem associated with implementing the APT is that neither the identity nor the exact number of the underlying risk factors are developed by theory and therefore must be specified in an ad hoc manner (Shanken, 1982)

2.3.3.2 The Multiple Factor Models

A different approach to developing an empirical model that captures the essence of the APT relies on the direct specification of the form of the relationship to be estimated is, in a multifactor model, the investor chooses the exact number and identity of risk factors. The
model is a generalization of the single index market model. Due to the fact that returns of securities in such a model are influenced by factors other than just the movement in the market as a whole as in the case of the single index model, this model may yield better predictions of future performance of the securities.

Two general approaches have been employed in this factor identification process. First, risk factors can be macroeconomic in nature; that is, they can attempt to capture variations in the underlying reasons an asset’s cash flows and investment returns might change over time (e.g., changes in inflation or real GDP growth (Chen, Roll, and Ross, 1986) and (Burmeister, Roll, and Ross, 1994). On the other hand, risk factors can also be identified at a microeconomic level by focusing on relevant characteristics of the securities themselves, such as the size of the firm in question or some of its financial ratios (Fama and French, 1993).

The advantage of this approach, is that the investor knows precisely how many and what things need to be estimated to fit the regression equation. On the other hand, the major disadvantage of a multifactor model is that it is developed with little theoretical guidance as to the true nature of the risk return relationship. In this sense, developing a useful factor model is as much an art form as it is a theoretical exercise.

**2.3.3.3 The Single Index Market Model**

When it comes to putting theory into practice, one advantage of the CAPM framework is that the identity of the single risk factor i.e., the excess return to the market portfolio is well specified. Thus, the empirical challenge in implementing the CAPM successfully is to accurately estimate the market portfolio, a process that first requires identifying the relevant investment universe. However this is not a trivial problem as an improperly chosen proxy for
the market portfolio can lead to erroneous judgments. However, once the returns to an acceptable surrogate for the market portfolio are identified, the process for estimating the parameters of the CAPM is straightforward and can be accomplished by a security or portfolio’s characteristic line that can be estimated via regression techniques using a special case of a multiple index model that expresses the return of a security as: (Reilly and Brown, 2002).

Beta is obtained by regressing the returns on the security with the returns on a market index. The characteristic line, the regression line of best fit through a scatter plot of rates of return for the individual risky asset and for the market portfolio of risky assets over some designated past period. The study used this model to estimate the risk parameters.

2.3.3.4 Value at Risk

An increasingly popular and understandable way of measuring risk is by using the Value at Risk method or VaR. It defines risk as the worst possible loss under normal market conditions for a given time horizon (Grinblatt and Titman, 2001). According to Biglova et al. (2004) this risk measurement technique is simple to handle since it provides a risk measure by a single variable. This variable provides the investor with the possibility of losses given a probability \((1-p)\) in a given time horizon and offers a comprehensible understanding of the likelihood of losing money on the investment.

VaR can also measure risk to lose money within a time period and not just at the terminal date. According to Kritzman and Rich (2002) investors are generally exposed to far greater risks during the investment than on the actual end date. Investors often measure the outcome, positive or negative, on the expiring date of the investment. Continuous VaR however allows
them to measure risk during the time period instead since the investment might not last the
duration of the expected time. Focus should therefore shift from the end period measurement
and focus on the risk during the whole holding period, so that losses during time will not affect
the terminal investment.

2.4 The Conceptual Framework

The researcher conceptualized in the study the impact of return interval on the estimation of
beta in listed companies trading in the NSE. In the framework, systematic risk was the
independent variable and was indicated by the covariance of the market and individual
securities. The dependent variables were the returns and return intervals which were daily,
weekly, monthly and annually. The returns were measured by the inverse of the difference
between the share price at time end of the interval and share price at the beginning the interval.

Finally the risk propensity and management by the investor was proposed to moderate the
relationship between the independent and dependent variables. Risk propensity is the tradeoff
between risk and expected return as demanded by a particular investor and it can either be high,
low or neutral depending on an investors tolerance levels. Risk management deals with
strategies to cope with risks through the quantification of the potential for losses in an
investment then take suitable actions to minimize these depending on the investment objectives.
The mandatory scrutiny and monitoring of listed equity stocks trading at the NSE by the market
regulator, CMA in the short run affects the systematic risk of the equity stocks at the NSE and
in long run influenced their return to investors.
Figure 2.2: The Conceptual Framework

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Intervening Variable</th>
<th>Dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SYSTEMATIC RISK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Stock and market risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Equity stock risk intervals (daily, Weekly, Monthly, Annual)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EQUITY STOCK RETURNS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Stock &amp; market returns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Equity stock return intervals (daily, Weekly, Monthly, Annual)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>INVESTMENT DECISIONS</strong></td>
<td></td>
<td></td>
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<tr>
<td>Risk propensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Risk taker</td>
<td></td>
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<tr>
<td>• Risk neutral</td>
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<tr>
<td>• Risk averse</td>
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<tr>
<td>Risk management</td>
<td></td>
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<tr>
<td>• Hedging</td>
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<tr>
<td>• Diversification</td>
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</tbody>
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Source: Author, (2013)
CHAPTER THREE

3.0 Research Methodology

3.1. Introduction

The chapter describes the procedure used to conduct the empirical research. This includes how the data was collected, assumptions made, determination of the sample used and how the information will be interpreted i.e. research design, the target population, sampling size and strategy, data collection instruments and procedures, and methods of data analysis. The chapter ends with a discussion on the reliability and validity of the chosen methods.

3.2. Research Design

The study adopted a quantitative historical research design that sought to assess the impact of return interval on the estimation of systematic risk for listed companies trading in the NSE. The design enabled the researcher to define dependent and independent variable studied. The procedure used to examine variable and steps used take control intervening variables that might threaten the findings. The quantitative historical research design was considered suitable for this study due to the nature of the investigation since the researcher used historical unbiased quantitative data retrieved from independent sources, and it was analyzed to respond to the proposed research question and was true for all the observations. The secondary data for the study is by means of using daily activity stock information from the NSE.
3.3 Target Population

The target population comprised of all the listed companies that traded in the NSE. As at December 2011, there were a total of 58 listed companies in ten sectors namely; agricultural, automobiles and accessories, banking, commercial and service, construction and allied, energy and petroleum, insurance, investment, manufacturing and allied and telecommunication and technology.

Table 3.1: Target Population

<table>
<thead>
<tr>
<th>Category of population</th>
<th>Population frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSE listed companies</td>
<td>58</td>
</tr>
</tbody>
</table>

Source: Author, (2013)

3.4 Sampling Design.

The study used a quantitative analysis based on; daily, weekly, monthly and yearly returns from January 1997 to December 2011 for the NSE equity stocks. This period was selected as it captured both times of improved growth and decline of growth in the Kenyan economy. Stratified sampling method was used to come up with the above population strata (Wimmer and Dominick, 1991). From the above target population of 58 listed companies, the researcher picked a sample of 21 listed companies out of the 25 listed companies that in total constituted the NSE 20 Share Index within the period under study. Normally there are 20 shares in the Index and a review of the status of these companies is done periodically after which some new
companies are included and others dropped. During the 15 years period under study, four new companies were included into the index in 2008; Safaricom Ltd, Kengen, Equity bank and Cooperative bank but were excluded in this study due to a limitation in their number of observations, thus the use of the 21 listed companies. All the twenty one sampled listed companies traded consistently throughout the period under study apart from Athi River mining which was included in August 1997, Mumias Sugar in November 2001 and CMC Ltd whose trading was suspended in mid September 2011. However, the results were not significantly affected by this inconsistency since the sampled trade shares represent over 80 percent of the market capitalization.

The NSE 20 Share Index (NSE 20) is the long standing benchmark index used for equities trading in Kenya’s Nairobi Securities Exchange and it represents the geometric mean of share prices of the Nairobi Securities Exchange’s 20 top stocks. Kathufi and Pals (1993) table to determine the sample size as shown in appendices.

Sample ratio = \[\frac{21\text{(Sample)}}{58\text{(Population)}} = 0.36.20\]

The sample was 36.20% of target population and it was considered adequate. This sample size was arrived at after considering the best performing companies as captured by NSE 20 Share index and also given that this market index is reviewed periodically to ensure that it reflects an accurate picture of market performance. This review was taken into consideration by adjusting the NSE 20-Share Index constituent companies accordingly during the period of study.
Table 3.2: Sample Frame

<table>
<thead>
<tr>
<th>Respondent Categories</th>
<th>Population frequency</th>
<th>Sample ratio</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>58</td>
<td>36.20</td>
<td>21</td>
</tr>
</tbody>
</table>

Source: Author, (2013)

3.5 Data Collection

The study was based on the quantitative historical research method and objective statistical data meaning that mostly secondary sources were used. Secondary research involved both published and unpublished materials in both public and private libraries and the NSE. All cited works were rightly accredited. The data on the NSE equity stock prices was obtained from the NSE data centre and complied by means of a secondary data schedule form. The researcher used the raw secondary data consisting of the NSE listed companies daily prices for the 15 years under review; this was in order to avoid the subjectivity that otherwise could have been present if predicted future earnings had been used. As much as the data is collected and compiled by the NSE for various purposes, it was analyzed to respond to the proposed research questions. All the stocks’ returns used for the purpose of this study were not adjusted for dividends. However, the results were not greatly affected by such non adjustments since earlier researchers; including Black et al (1972) applied similar measures.

Reliability and validity of any research is very important. Reliability tells us whether a result is replicable or not and validity deals with whether the conclusions drawn from the data are valid (Bryman and Bell 2003). Since the data required from the NSE was already available, the researcher was limited to use data which was already compiled. This was the only source of
reliable information for the required historical quantitative raw data, preferably it consisted of objectively gathered data collected and all companies were presented in an equal and consistent manner, hence there was no need to doubt the reliability of this information source.

Due to the amount of historical figures that will be collected from our sample of the 21 listed companies for a period of 15 years, the researcher realizes that there was a possibility of error due to human mistakes. Countless numbers and calculations were used and there was of course the risk of errors. To limit this, each calculation and historical data was checked thoroughly. By reading and repeating each figure, the researcher believes that these errors were possible minimized and therefore did not affect the results.

3.6 Data Analysis

The study examined the collected data to make inferences through a series of operations involving editing to eliminate repetitions and inconsistencies. The research used daily, weekly, monthly and annual return intervals. The raw data was tabulated by means of a secondary data schedule form, where by average returns were calculated and tabulated using Microsoft excel for all the sampled listed companies and the average returns for these 21 listed companies were used as proxy for the market return. A regression model was used in data analysis and the descriptive statistics were generated with the aid of Microsoft excel. The study used the variance or standard deviation of expected returns as the measure of risk. The variance, or standard deviation, is a measure of the variation of possible rates of return, from the expected rate of return. The systematic risk input for the individual NSE listed companies were derived from a regression model, referred to as the asset’s characteristic line with the market portfolio.
The individual stock return and the market return were calculated first in accordance with the following formula provided by Brealey et al (2005).

\[ \text{Return (R)} = \frac{(P_t - P_{t-1})}{P_{t-1}} \]

Return on the market was the average daily, weekly, monthly and yearly return for all the 21 listed companies in this study. The next step was to estimate a beta coefficient for each stock using the weekly, monthly and annual returns during the period January 1997 to December 2011. A regression model was used to measure beta, by having return on each stock as dependent variable and return on market as independent variable. This relationship was built based on the assumption that beta (\(\beta\)) measures the sensitivity of a stock’s returns to changes in returns on the market portfolio. To evaluate the data and regression results, a statistical test referred to as significance testing was conducted to find out if the independent variable has any effect upon the dependent variable. The t-tests was used and in defining the data significant to conclude with 95% confidence, a 5% level of significance was used and 18 degrees of freedom. T-statistic was considered significant if the p-value is less than 0.05. To find out the proportion of variation in the dependent variable explained by the regression model, R-squared, the multiple correlation coefficients, the correlation between the observed and predicted values of the dependent variable was calculated. The values of \(R^2\) for models produced by the regression procedure range from 0 to 1 or 0% to 100%.

Upon the computation of betas, the betas and returns were grouped into four time intervals; daily, weekly, monthly and annual. The means procedure was used to calculate subgroup means and related univariate statistics for dependent variables return and beta, within categories of independent variables namely period classified as daily, weekly, monthly and yearly.
Specifically we measure the average return and beta across four different periods and performed a one way analysis of variance to see if the means differ.

To focus on specific results, the categories by summary statistic were used and the output was then presented through the use of tables. All the data was aimed at providing answers to research questions. This type of data analysis was based on the use of numeric data in the form of numbers, levels and categories. Tables and graphs were used to organize and give a summary of the data and display in a meaningful and understandable manner so as to aid in describing and interpreting the outcome of the research.
CHAPTER FOUR

4.0 Data Analysis, Presentation of Results and Findings

4.1 Introduction

This chapter entails the analysis, and presentation of the findings of the study. The purpose of this chapter is to represent the result of the procedures described in the methods and present evidence in form of tables, text and figures. The study used 15 years raw quantitative historical data consisting of the NSE equity stock daily price lists as obtained from the NSE data centre and was complied by means of a secondary data schedule form. The information was analyzed quantitatively and qualitatively through the use of tables and graphs for easy, simple and clear interpretation of data.

4.2 Data Analysis and Presentation of Findings

The objective of this study is to use return interval in average daily, weekly, monthly and yearly stock price and returns to explain variations in market risk (systematic risk) inherent in companies listed at NSE. The study used a sample of 21 companies out of 25 listed companies that in total constituted NSE 20 share the index between January 1997 to 31\textsuperscript{st} December 2011. This is a period of 15 years. Normally there are 20 shares in the Index and a review of the status of these companies is done periodically after which some new companies are included and others dropped. The four new companies; Safaricom Ltd, Kengen, Equity bank and Cooperative bank that were included into the index in 2008 were excluded in this study due to a limitation in their number of observations during the period of study. All the twenty one (21) sampled listed companies traded consistently throughout the period under study apart from Athi
River mining which was included in August 1997, Mumias Sugar in November 2001 and from CMC Ltd who’s trading was suspended in mid September 2011. However, the results will not be significantly affected by this inconsistency since the sampled trade shares represent over 80 percent of the market capitalization.

4.2.1 Analysis of Risk and Return

Risk refers to the potential variability of returns from an asset or portfolio of assets. Returns are cash flows from an investment, in this case investment from companies listed at NSE. Risk free or riskless assets have returns known with certainty, such as returns from bonds issued by the government of Kenya like treasury bills.

Beta measures non diversifiable risk; risk relative to a stock market index. In this study an average of the 21 constituent listed companies that formed the NSE 20 share market index from January 1997 to December 2011. Therefore, the beta reflects market risk and is estimated relative to a stock index. The low betas reflect the low market risk inherent in these stocks; but such firms are expected to have substantial firm-specific risk. It might be that there are differences amongst these firms and between these firms and the private firm that are not averaged out in the numbers. The difference in beta across firms in the same industry could be that the degree of operating leverage might be different, as might the business mix in each firm.

Return on the market is the average daily, weekly, monthly and yearly return for all the 21 shares in this study. For this purpose return is change in market price of a share:

\[
\text{Return (R) = } \frac{(P_t - P_{t-1})}{P_{t-1}}
\]
\(P_t = \text{end period market price}; \text{ and } P_{t-1} = \text{beginning of period market price.}\)

Systematic or market risk (\(\beta\)) is estimated using market model:

\[R_j = \alpha + \beta R_m + \epsilon_i\]

\(R_j = \text{return on risky asset } j\)

\(R_m = \text{Return on market}\)

\(\beta = \text{Beta which is a measure of systematic risk}\)

The beta value is calculated using the regression equation. The regression equation tell us that

\[\beta_a = \frac{\text{Cov}(r_a, r_b)}{\text{Var}(r_b)},\]

The above equation tell us how to estimate beta of stock \(a\). Where \(r_a\) measures the rate of return of the stock, \(r_b\) measures the rate of return of the portfolio benchmark i.e., market index, and \(\text{Cov}(r_a, r_b)\) is the covariance between the rates of return. The portfolio of interest in the CAPM formulation is the market portfolio that contains all risky assets, and so the \(r_b\) terms in the formula are replaced by \(r_m\), the rate of return of the market.

A regression was used to measure beta, by having return on each share such as KCB as dependent variable and return on market as independent variable. This relationship was built based on the assumption that beta (\(\beta\)) measures the sensitivity of a stock’s returns to changes in returns on the market portfolio.

This study set out to determine whether the beta of companies listed at NSE is period dependant; whether the use of daily, weekly, monthly or yearly data result into betas that are
significantly different. This required that daily, weekly, monthly or yearly beta’s be compared to establish the level of their difference. The calculated betas were summarized in Table 4.2.1.1 to 4.2.1.4. In the table, \( N \) is the number of observations and \( N^* \) is the missing number of observations; \( \text{StDEv} \) is standard deviation which is a measure of total risk of a share.

### Table 4.2.1.1: Daily Individual Stock Betas and Other Variables

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<th>Security</th>
<th>N</th>
<th>( N^* )</th>
<th>Return</th>
<th>StDev</th>
<th>Beta</th>
<th>( R^2 ) (%)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
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Table 4.2.1.2: Weekly Individual Stock Betas and Other Variables

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<th>Security</th>
<th>N</th>
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<th>Return</th>
<th>StDev</th>
<th>Beta</th>
<th>R² (%)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
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Table 4.2.1.3: Monthly Individual Stock Betas and Other Variables

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<th>Return</th>
<th>StDev</th>
<th>Beta</th>
<th>R²(%)</th>
<th>t-value</th>
<th>P-value</th>
</tr>
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Table 4.2.1.4: Yearly Individual Stock Betas and Other Variables

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<th>Security</th>
<th>N</th>
<th>N*</th>
<th>Return</th>
<th>StDev</th>
<th>Beta</th>
<th>R-Sq(%)</th>
<th>t-value</th>
<th>P-value</th>
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<tr>
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<td>1.49</td>
<td>82.60</td>
<td>7.86</td>
<td>0.00</td>
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<tr>
<td>KENAIR</td>
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<td>0.92</td>
<td>20.80</td>
<td>1.85</td>
<td>0.09</td>
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<td>48.90</td>
<td>0.72</td>
<td>43.30</td>
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<td>0.01</td>
</tr>
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<td>63.50</td>
<td>4.76</td>
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<td>1.01</td>
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<td>0.06</td>
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<td>0.89</td>
<td>53.00</td>
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<tr>
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<td>73.70</td>
<td>6.04</td>
<td>0.00</td>
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<td>0.80</td>
<td>68.80</td>
<td>5.35</td>
<td>0.00</td>
</tr>
<tr>
<td>SASINI</td>
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<td>15.90</td>
<td>56.00</td>
<td>0.73</td>
<td>33.20</td>
<td>2.54</td>
<td>0.03</td>
</tr>
<tr>
<td>SCBANK</td>
<td>15</td>
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<td>18.57</td>
<td>33.71</td>
<td>0.55</td>
<td>51.60</td>
<td>3.73</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: Statistical survey (2013)

The first step was to establish whether the beta is different from zero. A beta of zero tells us that the return on stock whose beta is zero is not explained by changes in the market index. However, a beta can be zero if the correlation between that stock's returns and the market's returns is zero. A stock with a beta of zero is certainly not a risk-free investment. A stock beta is negative when both the benchmark index and the stock under consideration have positive returns. This occurs when lower positive returns of the index coincide with higher positive returns of the stock, or vice versa. The slope of the regression line in such a case will be negative. From the tables above we see that beta has no upper or lower bound, and betas as large as 3.15 for Kenol Kobil and 4.35 for EABL under the daily interval occurred with highly volatile stocks; and that such stock tend to show high total risk as measured by standard deviation. Bamburi had the lowest beta of 0.05 under the daily interval meaning that its daily
returns are highly insensitive changes in the market. None of the sampled stocks had a zero beta hence all the sampled stock returns are explained by the changes in the market but with different sensitivity levels.

T-value tests were done to establish the significance of beta. A t-value tests whether the null hypothesis of the coefficient is equal to zero and the corresponding p-value is given. The study provided a cut off absolute value of two (2) for the t-value and 0.05 for p-value.

The results in the tables above shows that the t-values values decrease as you move from daily to annual intervals; KPL the company with the highest t-value at the daily interval at 55.12 experienced declines to 21.18 for weekly, 13.49 for monthly and 4.76 for annual interval except for Bamburi which experienced an increase in t-value from lows of 1.38, the very lowest and out of range in the daily interval to 10.13 for weekly, 11.40 for monthly and 5.33 for annual interval. The t-values were all greater than the cutoff point 2 except for few exceptional cases like Bamburi at 1.38 under daily interval and Kakuzi at 1.23 under the annual intervals therefore statistically significant. The p-values were constantly zero for all the stocks in three intervals, daily, weekly and monthly except for Bamburi with a p-value of 0.166 under the daily interval. Under the yearly interval 10 stocks (48%) had zero p-value while eleven stocks (52%) had non zero value but only three out of the eleven; Kenya airways 0.088, Mumias 0.055 and Kakuzi 0.242 had p-value greater than the cutoff of 0.05 confirming the significance of the beta in 90% of sampled stocks though at a decreasing rate across the intervals from daily to yearly.

The multiple correlation coefficients R, is the correlation between the observed and predicted values of the dependent variable. The values of R range from 0 to 1 or 0% to 100%. R is the
proportion of variation in the dependent variable explained by the regression model. Larger values of $R^2$ (%) indicate stronger relationships between changes in share prices and changes in the market. The results in the tables above shows that $R^2$ values were all non zero and increased across the intervals from daily to yearly intervals with KCB recording the highest $R^2$ at 82.60 under the yearly interval and Bamburi the lowest and out of range $R^2$ at 0.100. under the daily interval but observed a fluctuation to 10.13 under weekly, 42.10 for monthly and 68.60 under the annual interval thus indicating that the share price is significantly influenced by the changes in the market under the three intervals. All the beta coefficients were found to be statistically significant since they had a value that was different from zero and therefore they have information content.

### 4.2.2 Comparing Periodic Return and Periodic Beta

The objective of this study is to assess the significant of return interval on the estimation of beta. Betas of 21 most actively traded securities listed in the NSE are estimated on the basis of daily, weekly, monthly and yearly using the their returns as market proxy. The results of using daily, weekly, monthly and annual returns of each stock to estimate the stocks beta is summarized in table 4.2.2.1 (a) and 4.2.2.1 (b) below.

It is clear that using shorter return intervals such as weekly return or daily return increases the number of observations in the regression, for any given time period, but a problem arise when there is non-trading. Stocks such as shares of Limuru Tea Ltd do not trade on a continuous basis, and this affects the beta calculated. Such non-trading on an asset during a return period can reduce the correlation between stock return and the return from the market. One way to reduce the non-trading problem is to use longer return intervals such as monthly, or quarterly or
half yearly or annual return; however the researcher will end up with few observations. The researcher estimated betas using short returns interval after adjusting the betas for non-trading effect.

Table 4.2.2.1 (a): Daily, Weekly, Monthly, Yearly Betas.

<table>
<thead>
<tr>
<th>Stock</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATHI</td>
<td>0.85</td>
<td>1.16</td>
<td>1.16</td>
<td>1.61</td>
</tr>
<tr>
<td>BAMB</td>
<td>0.05</td>
<td>0.56</td>
<td>0.86</td>
<td>1.43</td>
</tr>
<tr>
<td>BAT</td>
<td>0.20</td>
<td>0.57</td>
<td>0.63</td>
<td>0.74</td>
</tr>
<tr>
<td>BBK</td>
<td>0.36</td>
<td>0.82</td>
<td>0.85</td>
<td>0.65</td>
</tr>
<tr>
<td>CENTUM</td>
<td>0.97</td>
<td>1.18</td>
<td>1.13</td>
<td>0.97</td>
</tr>
<tr>
<td>CMC</td>
<td>0.87</td>
<td>1.10</td>
<td>1.03</td>
<td>1.42</td>
</tr>
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<td>0.91</td>
<td>0.90</td>
<td>1.16</td>
</tr>
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<td>0.66</td>
<td>0.61</td>
<td>1.02</td>
</tr>
<tr>
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<td>0.31</td>
<td>1.14</td>
<td>1.27</td>
<td>1.35</td>
</tr>
<tr>
<td>EXPRESS</td>
<td>0.32</td>
<td>0.63</td>
<td>0.65</td>
<td>0.66</td>
</tr>
<tr>
<td>KAKUZI</td>
<td>0.58</td>
<td>0.67</td>
<td>0.95</td>
<td>0.38</td>
</tr>
<tr>
<td>KCB</td>
<td>0.77</td>
<td>1.36</td>
<td>1.41</td>
<td>1.49</td>
</tr>
<tr>
<td>KENAIR</td>
<td>1.21</td>
<td>1.03</td>
<td>0.93</td>
<td>0.92</td>
</tr>
<tr>
<td>KKOBI</td>
<td>3.15</td>
<td>1.75</td>
<td>0.97</td>
<td>0.72</td>
</tr>
<tr>
<td>KPL</td>
<td>2.52</td>
<td>1.52</td>
<td>1.86</td>
<td>1.68</td>
</tr>
<tr>
<td>MUMIAS</td>
<td>0.78</td>
<td>1.48</td>
<td>1.45</td>
<td>1.01</td>
</tr>
<tr>
<td>NMG</td>
<td>0.76</td>
<td>0.63</td>
<td>0.53</td>
<td>0.89</td>
</tr>
<tr>
<td>NIC</td>
<td>0.93</td>
<td>1.20</td>
<td>1.09</td>
<td>0.83</td>
</tr>
<tr>
<td>REAV</td>
<td>0.49</td>
<td>0.99</td>
<td>1.03</td>
<td>0.80</td>
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<td>0.64</td>
<td>0.65</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Source: Statistical survey, (2013)

The influence of return interval on beta estimates could point out the significance of the time scale concern. This will force investment analyst to identify appropriate time interval in estimating beta that will be used is estimating asset returns. Research elsewhere report that beta of the stock increased with increased time intervals (Damodaran, 2001; Gencay, Selcuk., and Whitcher 2002). Daily return interval should be used to estimate the beta because, daily return intervals increases its precision (Daves, Ehrhardt, and Kunkel, 2000).
From table 4.2.2.1 (a), on face value the results show a substantial difference in beta values when different return intervals are employed. In some instances, the daily betas seemed to be out of line with the other 3 intervals. It is possible that some of the daily price were not captured correctly at NSE. For example in the case of EABL the daily beta at 4.35 seems to be out of line due to an outlier price. An observation of the 21 sampled companies revealed that; 7 companies (33%); Athi river mining, Bamburi, BAT, DTB, East African Cables, Express Kenya Ltd and KCB reported a complete increase in beta from daily to annual interval indicating an increased sensitivity of their returns to changes in the market with increased time intervals, 5 companies (24%); BBK, Kakuzi, Rea Vipingo, Sasini and SCBank reported an increase in beta from daily to monthly and a decrease in beta for the annual estimation depicting a decrease in return sensitivity with annual returns. On the other hand, 4 companies (19%); Centum, NIC Bank, Mumias sugar and Nation media Group reported an increase in beta only from daily to weekly followed by a complete decrease for the 3 intervals. Only 3 companies (14%); Kenya airways, Kenol Kobil and EABL reported a complete decrease in beta with increase return interval from daily to yearly. The remaining 2 companies (10%) notable KPL and CMC reported fluctuating betas as you move from daily to annual intervals.

Since majority (57%) of the stocks in the study reports an increase in beta when return interval increase. These results confirms previous research (Gencay et.al, 2002), which reported an increase in beta when return interval increases from daily to yearly and further show that there exist a positive relationship between multi scale return and systematic risk coefficients and that beta changes according to the time interval. Looking at the individual results, they indicate that this relationship becomes stronger at monthly and annual intervals and the effect of the market return on an individual asset’s return will be greater at these two intervals. Notable are the 3
companies from the agricultural sector in the sample which all fall in this category hence depicting that the agricultural sector company’s returns are least sensitive to the market with the use of annual returns and highly sensitive at the monthly interval where they reach their pick. In the same category are 4 out of the 6 banks in the sample which indicate a strong positive relation between their returns and the market at annual intervals.

Table 4.2.2.1 (b): Daily, Weekly, Monthly, Yearly Returns.

<table>
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<th>Weekly</th>
<th>Monthly</th>
<th>Annual</th>
</tr>
</thead>
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</tr>
<tr>
<td>CMC</td>
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<td>19.30</td>
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<td>0.36</td>
<td>1.49</td>
<td>34.20</td>
</tr>
<tr>
<td>EXPRESS</td>
<td>-0.07</td>
<td>-0.25</td>
<td>-1.23</td>
<td>-10.10</td>
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<tr>
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<td>18.90</td>
</tr>
<tr>
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<td>1.20</td>
<td>21.10</td>
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</table>

Source: Statistical survey, (2013)

From the table above, it is clear that returns for all the shares were all positive and increased at an increasing rate with increase in time interval from daily to annual except for Express Kenya.
Ltd with negative returns whose returns decreased with an increase in time intervals and recorded the lowest returns at -10.10 under annual interval. Kakuzi was also 2nd lowest returns in all time intervals at 0.04 under the daily interval, 0.09 under weekly, 0.43 under monthly and a mere 6.80 under the annual interval while KPL recorded the highest returns at 38.90 under the annual interval up from 0.15, 0.43 and 2.07 for daily, weekly and monthly respectively.

The means procedure was used to calculate subgroup means and related univariate statistics for dependent variables, return and beta, within categories of independent variables namely period classified as daily (1), weekly (2), monthly (3) and yearly (4) totaling 84 cases. The results include a one-way analysis of variance, eta, and tests for linearity. Specifically we measure the average return and beta by across four different periods and perform a one-way analysis of variance to see if the means differ.

### Table 4.2.2.2: Summary of Cases

<table>
<thead>
<tr>
<th>Period</th>
<th>N</th>
<th>Included</th>
<th>Excluded</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta *</td>
<td>84</td>
<td>100.0%</td>
<td>0</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Source:** Statistical survey, (2013)

### Table 4.2.2.3: Comparing Beta for different Periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean Beta</th>
<th>Std. Dev</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
<th>Kurtosis</th>
<th>Skewness</th>
<th>Std. Error of Kurtosis</th>
<th>Std. Error of Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Daily</td>
<td>0.9957</td>
<td>0.10628</td>
<td>0.755</td>
<td>0.047</td>
<td>4.350</td>
<td>4.303</td>
<td>-0.595</td>
<td>0.558</td>
<td>0.047</td>
<td>0.047</td>
</tr>
<tr>
<td>2– Weekly</td>
<td>1.0041</td>
<td>0.3450</td>
<td>1.030</td>
<td>0.558</td>
<td>1.750</td>
<td>1.192</td>
<td>-0.852</td>
<td>0.380</td>
<td>0.047</td>
<td>0.047</td>
</tr>
<tr>
<td>3- Monthly</td>
<td>1.0029</td>
<td>0.3211</td>
<td>0.970</td>
<td>0.526</td>
<td>1.860</td>
<td>1.334</td>
<td>-1.192</td>
<td>0.972</td>
<td>0.047</td>
<td>0.047</td>
</tr>
<tr>
<td>4- Yearly</td>
<td>1.0005</td>
<td>0.3694</td>
<td>0.922</td>
<td>0.380</td>
<td>1.680</td>
<td>1.300</td>
<td>-0.852</td>
<td>0.408</td>
<td>0.047</td>
<td>0.047</td>
</tr>
<tr>
<td>Total</td>
<td>1.0008</td>
<td>0.5988</td>
<td>0.915</td>
<td>0.047</td>
<td>4.350</td>
<td>4.303</td>
<td>12.686</td>
<td>2.828</td>
<td>0.520</td>
<td>0.263</td>
</tr>
</tbody>
</table>

**Source:** Statistical survey, (2013)
In the table above, the report table lists the selected statistics for each level of the independent variable, beta. The weekly beta average (1.0041) is the highest, while the daily beta average (0.9957) is the lowest. The statistics describe the distribution of the beta for each group (period). However the average beta is 1 for each period, save for distribution. For each period, the mean and median are approximately equal, suggesting a symmetrical distribution of beta. For weekly, monthly, and yearly beta, the skewness statistics less than 1 suggest symmetrical distributions. However for daily beta the skewness statistics greater than 1 (2.225) suggest asymmetrical distributions.

Comparing the statistics across the groups reveals differences between the levels of beta vary marginally. Except for daily beta with a standard deviation of 1.0628, the spread of the scores is approximately constant across periods.

### Table 4.2.2.4: ANOVA - Comparing mean Beta for different groups

| Source: Statistical survey, (2013) |

| Source: Statistical survey, (2013) |

<table>
<thead>
<tr>
<th>Beta * Period Groups</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta * Period Groups</td>
<td>Between Groups (Combined)</td>
<td>0.001</td>
<td>3</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Beta * Period Groups</td>
<td>Linearity</td>
<td>0.000</td>
<td>1</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Beta * Period Groups</td>
<td>Deviation from Linearity</td>
<td>0.001</td>
<td>2</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Beta * Period Groups</td>
<td>Within Groups</td>
<td>29.762</td>
<td>80</td>
<td>0.372</td>
<td></td>
</tr>
<tr>
<td>Beta * Period Groups</td>
<td>Total</td>
<td>29.763</td>
<td>83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An ANOVA compares the means for the different groups. The total variation is partitioned into two components. Between Groups represents variation of the group means around the overall mean. Within Groups represents variation of the individual scores around their group means. Small significance values (<.05) indicate group differences. In this case, the significance level for beta (1.00) exceeds .05, indicating that the beta for the four periods do not differ.
We further explore the relationship between the periods. Linearity reflects variation due to a linear relationship between the periods. A small significance value (<.05) indicates that a linear relationship exists. In this example, the significance value of 0.982 exceeds .05, therefore no linear relationship exists. Deviation from Linearity reflects variation due to nonlinear relationships between the variables. Small significance values (<.05) indicate that nonlinear relationships exist. In this example, the significance value of 0.999 is greater than 0.05. A nonlinear relationship exists.

**Table 4.2.2.5: Measures of Association**

<table>
<thead>
<tr>
<th>Beta * Period</th>
<th>R</th>
<th>R²</th>
<th>Eta</th>
<th>Eta²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.002</td>
<td>0.000</td>
<td>0.005</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Source: Statistical survey, (2013)*

In the above table are means report for measures of association between the beta for the four periods. $R$ and $R^2$ are appropriate if a linear relationship exists which not the case in this study. $R^2$ reflects the proportion of variation in the dependent (beta) variable accounted for by the linear model. In this case, a linear relationship with periods accounts for 0% of the variation in beta. $Eta$ and $Eta^2$ do not assume a linear relationship exists between the variables. $Eta^2$ represents the proportion of variation accounted for by the differences among the groups (period). In this example, differences between the regions account for 0% of the variation in beta.
4.2.3 Comparing Standard Deviation to Beta

Total variance and standard deviations are measures of total risk. So long as the correlation coefficient is below 1.0, the portfolio will benefit from diversification because returns on component securities will not move in perfect lockstep. The portfolio standard deviation will be less than a weighted average of the standard deviations of the component securities.

Systematic risk, measured by beta, refers to fluctuations in asset prices caused by macroeconomic factors that are common to all risky assets; hence systematic risk is often referred to as market risk. Examples of systematic risk factors include the business cycle, inflation, monetary policy, and technological changes.

Firm-specific risk, measured as residual variance refers, to fluctuations in asset prices caused by factors that are independent of the market, such as industry characteristics or firm characteristics. Examples of firm-specific risk factors include litigation, patents, management, and financial leverage. The equation disaggregating risk in various components is:

Total variance = Systematic variance + Residual variance = $\beta^2 \text{Var}(\text{R}_M) + \text{Var}(e)$

The basic difference between beta and standard deviation is that beta measures volatility based on a security’s correlation with the market as a whole, whereas standard deviation determines volatility based on its historical pattern. If the standard deviation is too high then the investment is a gamble and should be avoided. It should be noted that standard deviation is the risk of a particular investment.
Figure 4.2.3.1: Daily - Comparing Standard Deviation to Beta

Source: Author, (2013)

Figure 4.2.3.2: Weekly- Comparing Standard Deviation to Beta

Source: Author, (2013)
Figure 4.2.3.3: Monthly – Comparing Standard Deviation to Beta

Source: Author, (2013)

Figure 4.2.3.4: Annual – Comparing Standard Deviation to Beta

Source: Author, (2013)
From the results Figures 4.2.3.1 to 4.2.3.4, it can be seen that while beta approaches 1, i.e. stabilizes at low frequencies; monthly and annual time scales; the standard deviation, which is a measure of total risk, remain erratic. This is expected given that standard deviation measures total risk while beta measures risk that cannot be diversified away. The daily beta though significant appears flat due to marginal changes in daily prices and the yearly beta appears close to monthly beta, the yearly observations are too few too derive a conclusion.

4.2.4: The estimates of average return versus average stock beta

In order to study, the robustness relationship between the return of the stock and its beta at different time scales, table 4.2.4.1 was established. This reports the estimates of average stock return (dependent variable) versus average stock beta (independent variable) at different return intervals.

Table 4.2.4.1: Estimates of average return versus average stock beta

<table>
<thead>
<tr>
<th>Period</th>
<th>Constant</th>
<th>Slope</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily - 1</td>
<td>0.041**</td>
<td>0.068***</td>
<td>0.297</td>
</tr>
<tr>
<td>Weekly – 2</td>
<td>0.057**</td>
<td>0.254***</td>
<td>0.252</td>
</tr>
<tr>
<td>Monthly – 3</td>
<td>0.447**</td>
<td>0.784***</td>
<td>0.122</td>
</tr>
<tr>
<td>Yearly – 4</td>
<td>0.644**</td>
<td>21.10***</td>
<td>0.456</td>
</tr>
</tbody>
</table>

Note: (**) indicates that the coefficient is significant at the 5% level of significance, and (***) at 1%.

Source: Statistical survey, (2013)

The table reveals that the slope is higher at scale period 3 and 4. This result enforce that the relationship between returns and its beta is more important at monthly and annual periods, and
this shows that the NSE is more efficient at longer periods. Therefore, the CAPM is a multi
scale phenomenon, and longer periods are more relevant in explaining the relationship between
stock return and its beta.

The relationship between risk and return is explained further using figures 4.2.4.1 – 4.2.4.4
which plots average stock returns versus corresponding average stock beta at different time
scales.

Figure 4.2.4.1: Daily Returns Vs Daily Beta

![Daily Returns Vs Daily Beta Graph]

Figure 4.2.4.2: Weekly Returns Vs Weekly Beta

![Weekly Return Vs Beta Weekly](image1)


Figure 4.2.4.3: Monthly Returns Vs Monthly Beta

![Monthly Return Vs Beta Monthly](image2)

The inspection of the figures above shows a positive relation between the average betas of stocks and average returns at every scale. These finding enforce our earlier conclusions that there exist a positive relationship between multi scale return and systematic risk coefficients, and that beta changes according to the time interval. Furthermore, as the scale increase from low (period 1 daily), daily to high (period 4 - annual) the relation between the beta and the return becomes steeper. This evidence supports the proposition that the major part of the market’s influence on individual asset prices is at lower frequencies as already evidenced by our higher $R^2(\%)$ in table 4.2.1.4.

From the analysis above the convincing evidence is that at the NSE, stocks with higher risks, measured as standard deviation and beta, are associated with higher returns and vice versa. Morningstar a U.S. fund-ranking company state that standard deviation is probably used more than any other measure to gauge a fund’s risk (Franklin Templeton Investments, 2012). Beta as
a product of Capital Asset Pricing Model suffered a major setback due to a series of papers published by Fama and French (1995, and 1997) who claimed that beta itself is not sufficient for explaining expected return. However it could be the way that we measure beta that undermine its usefulness. Betas are estimated by regressing returns on an asset against a market index stock index, with the slope of the regression being the beta of the asset. The flaws in regression betas, especially for companies in emerging markets followed by approach that allows an estimate of beta that reflect the current business mix and financial leverage of a firm is in (Damodaran, 2010)
CHAPTER FIVE

5.0 Summary of Findings, Conclusions and Recommendations

5.1 Introduction

The objective of the study was to assess the significance of return intervals; daily, weekly, monthly and annual intervals in estimating systematic risk in companies listed at the Nairobi Securities Exchange. This chapter gives a summary of the entire research highlighting the major findings, conclusions, recommendations and suggestions for further studies. The recommendations and suggestions are based on the findings in the previous chapters and the objective of the study.

5.2 Summary of findings

The sample size was twenty one companies which constituted the NSE-20 share index during the 15 years period under study. A regression was used to measure beta, by having return on each share as dependent variable and return on market as independent variable. All of the results of this study highlight the importance of considering time and frequency varying features in risk assessment; whether the use of daily, weekly, monthly or yearly data results into betas that are significantly different.

On analysis of risk and return, the study first measured the correlation between the stock’s returns and the market returns. This was done by establishing whether the sampled stock betas were different from zero since a beta of zero indicates that the return on stock whose beta is zero is not explained by changes in the market index. From tables 4.2.1.1 to 4.2.1.4 the results
show that beta has no upper or lower bound since they ranged from as large as 3.15 for Kenol Kobil and 4.35 for EABL under the daily interval. Bamburi had the lowest beta at 0.05 under the daily interval meaning that its daily returns are highly insensitive changes in the market. None of the sampled stocked had a zero beta hence all the sampled stock returns are explained by the changes in the market but with different sensitivity levels.

To confirm the assumption that beta (β) measures the sensitivity of a stock’s returns to changes in returns on the market portfolio, the study used the t-value, p-value and R² and provided a cut off absolute value of two (2) for the t-value, 0.05 for p-value a range of 0 to 1 for R². The results in tables 4.2.1.1 to 4.2.1.4 indicated that the t-values values decrease as you move from daily to annual intervals reporting highs of 55.12 for KPL under the daily interval but declining to 21.18 for weekly, 13.49 for monthly and 4.76 for annual interval except for Bamburi which experienced an increase in t-value from lows of 1.38, the very lowest and out of range in the daily interval to 10.13 for weekly, 11.40 for monthly and 5.33 for annual interval. The t-values were also all greater than the cutoff point 2 except for few exceptional cases like Bamburi at 1.38 under daily interval and Kakuzi at 1.23 under the annual intervals therefore statistically significant. The p-values were observed to be constantly zero for all the stocks in three intervals, daily, weekly and monthly except for Bamburi with a p-value of 0.166 under the daily interval. Under the yearly interval 10 stocks (48%) had zero p-value while eleven stocks (52%) had non zero value but only three out of the eleven; Kenya airways 0.088, Mumias 0.055 and Kakuzi 0.242 had p-value greater than the cutoff of 0.05 confirming the significance of the beta in 90% of sampled stocks though at a decreasing rate across the intervals from daily to yearly. Using R², the results indicated that R² values were all non zero and increased across the intervals from daily to yearly intervals with KCB recording the highest R² at 82.60 under the
yearly interval and Bamburi the lowest and out of range R\(^2\) at 0.100 under the daily interval but observed a fluctuation to 10.13 under weekly, 42.10 for monthly and 68.60 under the annual interval. All the beta coefficients were found to be statistically significant since they had a value that was different from zero and therefore they have information content.

To compare periodic return and periodic beta, the study summarized the four periodic beta’s and returns in tables 4.2.2.1 (a) and 4.2.2.1 (b). From table 4.2.2.1 (a), the results show a substantial difference in beta values when different return intervals are employed. However a close observation of the results revealed that 33% reported a complete increase in beta from daily to annual interval indicating an increased sensitivity of their returns to changes in the market with increased time intervals and 24% reported an increase in beta from daily to monthly and a decrease in beta for the annual estimation depicting a decrease in return sensitivity with annual returns. On the other hand, 19% reported an increase in beta only from daily to weekly followed by a complete decrease for the 3 intervals and only 14% reported a complete decrease in beta with increase return interval from daily to yearly. The 10% reported fluctuating betas across intervals from daily to annual intervals. Since majority (57%) of the stocks in the study report an increase in beta across time interval, the results indicates an increase in beta when return interval increase from daily to yearly and there exist a positive relationship between multi scale return and systematic risk coefficients and that beta changes according to the time interval. Looking at the individual results, they indicate that this relationship becomes stronger at monthly and annual intervals and the effect of the market return on an individual asset’s return will be greater at these two intervals.

From the table 4.2.2.1 (b), the results indicates that returns for all the shares were all positive and increased at an increasing rate across the time intervals except for Express Kenya Ltd with
negative returns whose returns decreased with an increase in time intervals and recorded the lowest returns at -10.10 under the annual interval. Kakuzi also recorded the 2nd lowest returns in all time intervals at 0.04 under the daily interval, 0.09 under weekly, 0.43 under monthly and a mere 6.80 under the annual interval while KPL recorded the highest returns at 38.90 under the annual interval up from 0.15, 0.43 and 2.07 for daily, weekly and monthly respectively.

The study also used the mean procedure for measuring subgroup means and related univariate statistics for dependent variables, return and beta, within categories of independent variables namely period classified as daily (1), weekly (2), monthly (3) and yearly (4) totaling 84 cases. The results include a one-way analysis of variance, eta, and tests for linearity. The results were summarized in tables 4.2.2.2 to 4.2.2.3 and indicated that the betas across periods were 0.9957, 1.0041, 1.0029 and 1.0005 for daily, weekly, monthly and yearly period respectively. The weekly beta average (1.0041) is the highest, while the daily beta average (0.9957) is the lowest. The average beta was therefore 1 for each period, save for distribution, the mean ranges of 0.047, 0.558, 0.526 and 0.380 and median ranges of 0.755, 1.030, 0.970 and 0.922 were approximately suggesting a symmetrical distribution of beta. For weekly, monthly, and yearly beta, the skewness statistics less than 1 suggest symmetrical distributions. However for daily beta the skewness statistics greater than 1 (2.225) suggest asymmetrical distributions. In table 4.2.2.4, an ANOVA compares the means for the different groups. The total variation is partitioned into two components. Between Groups represents variation of the group means around the overall mean. Within Groups represents variation of the individual scores around their group means. Small significance values (<.05) indicate group differences. In this case, the significance level for beta (1.00) exceeds .05, indicating that the beta for the four periods do not differ.
A summary of the above results is confirmed in figures 4.2.3.1 to 4.2.3.4, which shows that as beta approaches 1 and therefore stabilizing at low frequencies; monthly and annual time scales, the standard deviation, which is a measure of total risk, remain erratic. This is expected given that standard deviation measures total risk while beta measures risk that cannot be diversified away. The same is further confirmed in tables 4.2.4.1 and figures 4.2.4.1 to 4.2.4.4 which reveals that the slope increases across periods from 0.041 and 0.057 under the daily and monthly interval respectively, to highs of 0.447 and 0.644 at scale period 3 and 4 therefore enforcing that the relationship between returns and its beta is more important longer time scales; monthly and annual period.

5.3 Conclusion

The valuation of risky assets is one of the major research tasks in financial economics, particularly modeling risk and return. This study evaluates the significance of return interval on the estimation of market risk as measured by beta. First, the study sort to establish the holding returns of listed companies at the NSE at different time intervals. The results in the analysis indicated that except for Express Kenya Ltd that had negative returns and decreasing with an increase in time intervals, returns for all the other shares were all positive and increased with increase in time interval from daily to annual indicating that longer period average prices (monthly and yearly) are more appropriate at the NSE in establishing the returns of shares compared to the rest.

Secondly the study aimed at estimating the systematic risk (beta) of listed companies trading at the NSE with four return intervals; daily, weekly, monthly and yearly. Substantial differences in beta values when different return intervals are employed but more so an increase in beta when
return interval increases from daily to yearly was revealed. These results confirm that there exist a positive relationship between multi scale return and systematic risk coefficients, and that beta changes according to the time interval; as the scale increase from low (period 1 and 2 daily and weekly), to high (period 4 and 3 – monthly and annual) the relationship became stronger at monthly and annual intervals and the effect of the market return on an individual asset’s return as measured by beta was greater at the annual interval. From the two findings therefore, the convincing evidence is that at the NSE, the listed companies with the highest beta also have the highest return and the companies which with the lowest beta also have the lowest return hence it can be concluded that higher risks are associated with higher returns and the lower the risk, the lower the returns.

Lastly the study assessed the significance of return interval on the estimation of market risk as measured by beta for listed companies at the NSE. From the findings, it was evident that time intervals and frequency levels are significantly important in the estimation of systematic risk as evidenced by the substantial differences in returns and beta values when different return or time intervals are employed. In both cases the results showed an increase in values when return interval increases from daily to yearly. These results enforced our earlier findings that the relationship between returns and its beta is more important in longer periods making the NSE more efficient at longer periods which are more relevant in explaining the relationship between stock return and its beta. This can also be explained by the fact that market changes are occasioned by major macro economic factors whose effects on individual stock returns are not instant but felt after a long period of time contrary to individual stock micro economic factors whose effects are instantaneous on the stock return.
5.4 Recommendations

Finally although most textbook models assumed volatilities and covariance’s to be constant, it has long been acknowledged among both finance academics and practitioners as well as confirmed by this study that market risk varies over time. Besides taking into account such time varying feature, the risk profile of an investor, in terms of investment horizon, makes it also crucial to assess risk at the various time intervals. Based on the findings of this study, the following recommendations can be made in order to improve one’s investment decisions.

1. Since short term investors are more interested in the risk associated with high frequencies interval (shorter intervals), the study finds and recommends to short term investors to consider using daily and weekly returns, short estimation periods to estimate beta for short term expected returns. Shorter estimation period reflect recent changes in restructuring, acquisitions, disinvestment and policy issues.

2. On the other hand, as long term investor focuses on lower frequencies while making long term investment decisions, they are advised to go for beta estimated on longer time intervals; monthly and annual intervals longer estimation periods since their systematic risk appears to be more stable and therefore usable.

3. Due to rapid changing economic conditions at the NSE, investors are advised to take adequate risk management strategies apart from considering one’s risk tolerance levels so as to cope with risk in a portfolio by quantifying the potential for losses and take suitable actions to minimize these depending on the investment objectives.
5.5 Limitations of the Study

Although most of the study was conducted smoothly, there were challenges that were met in the course of the study. Because using the 90-day Treasury bill rate as proxy for the risk free rate of return proved to be a challenge in analyzing a weekly stock returns, the researcher therefore changed to the market model which uses alpha instead of the risk free rate of return. This was assumed could generate the same result which might not have been the case.

As far as the study is based on historical data, it is always going to be difficult to make a conclusion from the findings which are usable in the future. The fact that data has been fully used and archived means that policy makers and academicians will always use projections in making any decisions for the future.

It is also worth noting that not all the companies listed in the Nairobi Securities exchange were picked for the sample, only the 21 companies that formed the NSE 20 share index and traded evenly during the period under study were considered. This was a challenge because the study could not give a very fine picture of the status for the entire Nairobi Securities Exchange. However, the results were not significantly affected by this inconsistency since the sampled trade shares represent over 80 percent of the market capitalization.

The effect of the market proxy is another significant decision when computing an asset’s characteristic line and as such a decision needs to be made in which indicator series to use as a proxy for the market portfolio of all risky assets. Whereas Sharpe and Cooper (1972) noted that the market portfolio of all risky assets should include all the countries market stocks and bonds, and any other marketable risky asset in the market, most researchers have used the long established NSE 20 share index which encompasses only the 20 best performing blue chip
listings as a proxy for the market portfolio, the study used the average returns of the 21 stocks due to the fact that they already form the sample of the study.

It was therefore assumed that the market return for the 21 companies was a good measure of the market index. This might not have been the case as the market index should be measured using all the stocks in the capital market.

5.6 Suggestions for Further Research

This study is not conclusive but it’s open for further research on this particular area of systematic risk estimation. In general, it is assumed that a security with high beta is more risky than a security with low beta. There is need for further study on how investors’ behavior influences their investment decisions to invest in certain securities and how this affects the market price of the security. This is important because by affecting the market price of security, it also affects the returns of that security. All though extensive research has been done at the NSE on the estimation of systematic risk, further research which takes into account the change in beta when different estimation periods, proxy for the market, investment time horizon and efficiency of market need to be considered. This will reveal more information as regards investment decision making and the unique variables to be considered in any decision making.
References:


Appendix 1: Letter of Introduction

TO

The NSE Data Centre

Subject: Request for NSE Daily activity Data

My name is Constance Furaha, I am currently pursuing MBA course at Kenyatta University. I am conducting a study on the impact of return interval on the estimation of systematic risk on equity stocks trading in the NSE in partially fulfillment of my course. I am in need of the NSE daily activity data for the period January 1997 – December 2011. The data collected will help in analyzing information needed to assess the impact of different return interval on the estimation of beta on NSE equity stocks. All data given will be handled with outmost care and only utilized for academic study by giving a general report and not in any way give professional advice to the public on the NSE or marline the NSE.

Thank you

Constance Furaha Mwahunga

MBA Student – Kenyatta University
Appendix 11: NSE Listed Companies

Agricultural
1. Eaagads Ltd
2. Kapchorua Tea Co. Ltd
3. Kakuzi
4. Limuru Tea Co. Ltd
5. Rea Vipingo Plantations Ltd
6. Sasini Ltd
7. Williamson Tea Kenya Ltd

Commercial And Services
8. Express Ltd
9. Kenya Airways Ltd
10. Nation Media Group
11. Standard Group Ltd
12. TPS Eastern Africa (Serena) Ltd
13. Scangroup Ltd
14. Uchumi Supermarket Ltd
15. Hutchings Biemer Ltd
16. Longhorn Kenya Ltd

Telecommunication and Technology
17. AccessKenya Group Ltd
18. Safaricom Ltd

Automobiles and Accessories
19. Car and General (K) Ltd
20. CMC Holdings Ltd
21. Sameer Africa Ltd
22. Marshalls (E.A.) Ltd

Banking
23. Barclays Bank Ltd
24. CFC Stanbic Holdings Ltd
25. Diamond Trust Bank Kenya Ltd
26. Housing Finance Co Ltd
27. Kenya Commercial Bank Ltd
29. NIC Bank Ltd
30. Standard Chartered Bank Ltd
31. Equity Bank Ltd
32. The Co-operative Bank of Kenya Ltd

**Insurance**

33. Jubilee Holdings Ltd
34. Kenya Re-Insurance Corporation Ltd
35. CFC Insurance Holdings
36. British-American Investments Company (Kenya) Ltd

**Investment**

37. City Trust Ltd
38. Olympia Capital Holdings Ltd
39. Centum Investment Co Ltd
40. Trans-Century Ltd

**Manufacturing and Allied**

41. A.Baumann CO Ltd
42. B.O.C Kenya Ltd
43. British American Tobacco Kenya Ltd
44. Carbacid Investments Ltd
45. East African Breweries Ltd
46. Mumias Sugar Co. Ltd
47. Unga Group Ltd
48. Eveready East Africa Ltd
49. Kenya Orchards Ltd

**Construction and Allied**

50. Athi River Mining
51. Bamburi Cement Ltd
52. Crown Berger Ltd
53. E.A.Cables Ltd
54. E.A.Portland Cement Ltd

**Energy and Petroleum**

55. KenolKobil Ltd
56. Total Kenya Ltd
57. KenGen Ltd
58. Kenya Power & Lighting Co Ltd
Appendix III: NSE Sampled listed companies

Agricultural
1. Rea Vipingo Ltd.
2. Sasini Tea & Coffee Ltd.
3. Kakuzi Ltd.

Automobiles & Accessories
4. CMC Holding Ltd.

Banking
5. Barclays Bank of Kenya
6. Diamond Trust Bank
7. Kenya Commercial Bank
8. Standard Chartered Bank
9. NIC Bank
10. Centum Investment Co.

Commercial and Services
11. Kenya Airways Ltd.
12. Nation Media Group Ltd.
13. Express Kenya Ltd.

Construction and Allied
14. Athi River Mining Ltd.
15. Bamburi Cement Ltd.
16. East Africa cables

Manufacturing and Allied
17. British American Tobacco Kenya Ltd.
18. East Africa Breweries Ltd.
19. Mumias Sugar Company Ltd.

Energy and Petroleum
20. Kenya Power & Lighting Co. Ltd
21. Kenol Kobil Ltd
Appendix IV: Regression output

Results for: DAILY RETURNS.xls

Descriptive Statistics: ATHI, BAM\text{B}, BAT, BBK, CENTUM, CMC, DIAMTR, EABL, EACABLE

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Results for: WEEKLY RETURNS.xls

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Results for: BETA ANALYSIS FILE 1.xls

Descriptive Statistics: Return, StDev, ... by Period

1= Daily Statistics; 2 = Weekly Statistics; 3 = Monthly Statistics; 4 Yearly Statistics

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Results for: RANK CORRELATION.xls

Correlations: BetaD, BetaW, BetaM, BetaY

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Cell Contents: Pearson correlation
P-Value

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Correlations: ReturnD, StDevD, BetaD

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Cell Contents: Pearson correlation

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