APPLICATION OF CAPITAL ASSET PRICING MODEL IN ASSET PRICING ON THE NAIROBI STOCK EXCHANGE, KENYA.

BY

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DECLARATION

This research thesis is my original work and has not been presented in any other university for academic or any other purpose.

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DEDICATION

This work is dedicated to my husband Sam, my son Muchemi, my mom, my brothers, and Kimani.

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ABBREVIATIONS

ADF	Augmented Dickey-Fuller Test
AIMS	Alternative Investment Market Segment
APT	Arbitrage Pricing Model
ARIMA	Autoregressive Integrated Moving Average
BAMBURI	Bamburi Cement Ltd
BARCLAYS	Barclays Bank of Kenya Ltd
BAT	British American Tobacco Ltd
BBOND	Unilever Tea Kenya ltd / Brooke Bond
BOC	B.O.C. Kenya Ltd
CAPM	Capital Asset Pricing Model
CCAPM	Conditional Capital Asset Pricing Model
CARB	Carbacid Investment Ltd
CFC	CFC Bank Ltd
CMC	CMC Holdings Ltd
DTK	Diamond Trust Bank Kenya Ltd
DUN LOP	Olympia Capital Holdings Ltd /Dunlop
DW	Durbin Watson Test
EABL	East African Breweries Ltd
EAPORT	East African Portland Cement Ltd
FEA	Firestone East African Ltd
FISMS	Fixed Income Securities Market Segment
FOMS	Futures and Options Market Segment

ICDC	ICDC Investment Co. Ltd
JUB	Jubilee Insurance Co. Ltd
KAKUZI	Kakuzi Ltd
KCB	Kenya commercial Bank Ltd
KENOL	Kenya Oil Co. Ltd
KPLC	Kenya Power & Lighting Co. Ltd
KQ	Kenya Airways Ltd
MIMS	Main Investment Market Segment
NBK	National bank of Kenya ltd
NIC	NIC Bank Ltd
NMG	Nation Media Group Ltd
NSE	Nairobi Stock Exchange
OLS	Ordinary Least Square
ROI	Return on Investment
RVP	Rea Vipingo Plantations Ltd
SASINI	Sasini Tea & Coffee Ltd
SCBK	Standard Chartered Bank Ltd
SNG	Standard Newspaper Group Ltd
TOTAL	Total Kenya Ltd
UCHUMI	Uchumi Supermarket Ltd
UNGA	Unga Group Ltd

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DEFINITIONS OF OPERATIONAL TERMS

Beta - a measure of risk on the stock's sensitivity to the market. It is a coefficient in the CAPM model. Dead beta in this case should be taken as one that is theoretically true but empirically inapplicable.

Derivatives - Financial instruments or arrangements that derive their value from some underlying stock, bond, commodity or other asset. Futures, swaps, some forwards, options and warrants, and certain mortgage-backed securities are the most common derivative forms.

Emerging market - a stock exchange characterized by low trading volumes, low turnover ratio, and few listed companies.

Frontier market - refers to a relatively small and illiquid market even by emerging market standards

Systematic / Undiversifiable/ idiosyncratic Risk - the variability of return on stocks or portfolios associated with changes in return on the market as a whole.

Unsystematic / Diversifiable Risk - the variability of return on stocks or portfolios not explained by general market movements. It is avoidable through diversification.

Shares/ Stock/ Securities - used interchangeably to represent the ultimate ownership position in a company.

Risky Asset - one for which future returns are uncertain.

Risk free Asset - an asset with returns that exhibit zero variance or risk.

ABSTRACT

The study is a survey on the asset pricing characteristics in the Nairobi Stock Exchange (NSE), with emphasis on the application and evidence of the Capital Asset Pricing Model (CAPM). This is in order to determine the stock returns and hence the estimation of *beta* coefficients (risk) for the securities listed in the market.

The study's objective was to find out whether the CAPM works in the NSE, as a typical African emerging market. The CAPM offers the ability to predict securities' returns more accurately than common market analysis techniques such as technical and fundamental analysis.

Using a sample of equity stocks traded on the NSE, the study examined empirically the relationship between returns and beta as CAPM stipulates, over the period from January 1997 to December 2003. The evidence supports the hypothesis that, if the market prices the risk variable, then there exists a systematic relationship between the risk variable and average returns. The relationship found is weak with 31.4% of market return explaining a stocks' return. This indicates that CAPM does work in the market but has a low explanatory power as regards risk on stocks traded in the market. As for its applicability, only a few market participants use it in portfolio selection.

This outcome however, is essential in investment management that involves matching stock profiles to determine the most optimal set of assets to include in a portfolio. The findings are also useful in performance and project evaluation where equity is an essential part of a company's corporate financing policy.

CHAPTER ONE

INTRODUCTION

1.1 Background to the problem

1.1.1 Asset Pricing in the Stock Exchange Market

A stock market is one that deals with the exchange of securities. Securities represent a spectrum of risky assets ranging from virtually risk-free debt instruments to highly speculative bonds, common stocks, and warrants (Sprecher 1975). According to Campbell (2000), asset pricing theory is a framework designed to identify and measure risk as well as assign rewards for risk bearing. An efficient pricing mechanism of stock market is a driving force for channeling savings into profitable investments, facilitating optimal allocation of capital. This is because it ensures suitable return on investment that exposes viable investment opportunities to potential investors. A stock exchange facilitates two principal activities in the financial system (Mbaru 2003). First, it enables companies to gain access to long-term investible funds by issuing shares and debt securities to the public. Secondly, it provides liquidity to investors by allowing the transfer of ownership through sale of shares and hence the realization of cash by the holders. In this sense, it facilitates the mobilization of long-term financial resources, channeling them to long-term investments that yield economic benefits to the nation. The indices of stock market operations such as market capitalization, liquidity, asset prices and turnover, help to assess whether the economy is proceeding on sound lines or not (Javed 2000). It is in this regard, that the stock exchange acts as a barometer of the economy, more so, because the movements of securities prices, as determined by the market forces, can be an indicator of the general trend in the economy. Therefore, healthy stock market is indispensable for economic growth.

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The stock market plays specific roles such as raising capital for businesses through issue of shares, and for the government through issue of bonds, mobilizing savings for investment as well as creating investment opportunities for small investors. It also facilitates in the redistribution of wealth from the company's profitability to its shareholders, and improvement of corporate governance for such companies through having a wide and varied scope of owners.

The Capital Asset Pricing Model (CAPM) shows a linear relationship between the rate of return and risk for any given asset, given the market wide risk premium. It provides an analytic basis for explaining asset prices and the intuition that asset risk premium depend, not on total risk of the asset, but rather on the relationship of the asset to the overall market. The rate of return an investor receives from buying a common stock and holding it for a given period is equal to the cash dividends received plus the capital gain or minus the capital loss during the holding period divided by the purchase price of the stock. However, the actual realized returns may differ from the expected returns because fluctuating stock prices result in fluctuating returns, making stocks risky. Financial theory defines risk as the possibility that actual returns will deviate from expected returns, and the degree of potential fluctuation determines the degree of risk (Sabal 2002). CAPM deals with the risks and returns on financial securities giving the expected return for any asset or portfolio as a function of a measure of risk called beta.

Asset pricing theory helps to explain why the expected return on a short-term government bond is a lot less than the expected return on a stock. Similarly, it helps to show how two different stocks have different expected returns and why expected returns change through time. The asset-pricing framework usually begins with a number of premises such

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as: investors like higher rather than lower expected returns, investors dislike risk and investors hold well-diversified portfolios (Souflan 2001). These insights guide in assessing the "fair" rate of return for a particular asset. Such information is critical for the investment decision facing both those corporations evaluating projects and investors forming portfolios. In the corporate setting, the theory characterizes the risk of a particular project or an acquisition and assigns a discount rate that reflects the risk. In choosing projects that have a higher promised rate of return than what the risk theory would assume, corporations create value. In the portfolio investment setting, the theory helps identify overvalued and undervalued assets. The theory is also integral to establishing a framework to help an investor understand the risks faced with a particular portfolio.

1.1.2 The Nairobi Stock Exchange

The Nairobi Stock Exchange (NSE), constituted as a voluntary association of stockbrokers in 1954, has had remarkable development to become what it is today. Its market capitalization has seen tremendous improvement to stand above Kshs. 317 billion (US$ 4.18 million) at the close of 2003 (NSE 2003). Turnover for the same period stood at Kshs. 9.5 billion. It has also continued to play an important role in economic development, especially concerning its role in financial intermediation. Securities traded in the NSE are both bonds and shares that constitute the market's two broad segments. The shares market is referred to as the Equity Market, which is further divided into two segments, the Main Investment Market segment and the Alternative Investment Market Segment. The Main Investment Market segment has four sectors, namely, the Agricultural Sector, Commercial and Services, Financial Sector, Industrial and Allied,. Characterized by its liquidity, market capitalization,

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and turnover, it may be classified as both an emerging market and a frontier market (Muhanji 2000).

NSE is a model emerging market in view of its high returns, vibrancy and a well-developed market structure (Ogum et al. 2000). Most asset pricing studies have focused on developed markets. Moreover, research on emerging markets has focused on Asian and Latin American countries leaving the African markets under-researched. It is in this light that NSE is of particular interest, with a size of at least forty-eight listed companies, and an established fixed income securities segment. It is among the most vibrant African bourse and the most developed capital market in East Africa. In light of this and with its historical development the stock exchange raises interests and sets a precedent for comparison with other emerging markets both in Africa and the world at large.

1.2 Statement of the Problem

An important aspect of efficient markets is equality in pricing of securities by the market. The prospects and value of any security should be that perceived by the market, given the ultimate objective of investors, as being the need to derive a portfolio of the financial securities that meet preferences for risk and expected return. Such expected return is based on the stock prices where a capital gain is realized after factoring in the consequential costs and with an appreciation of the stocks' prices. Stock prices however, fluctuate due to several reasons, one being the changes in the perceived risk. If such risk can be established beforehand, then it would be easier to identify an efficient portfolio to satisfy investors. This is the principle objective of the CAPM model, and the motivating factor in testing its validity in the NSE market.

Although the model has undergone remarkable research over the years both in developed and emerging markets, there seem to be few studies on its application in the Kenyan stock market. An example of those studies that dwelled on the model, and the risk and Return relationship include that of Gitari, (1990), Muli, (1991), and Munywoki, (1998). The studies done on the NSE in relation to the market risk and return followed the Mean-Variance approach in estimating the unsystematic risk and return.

Moreover, companies originally listed on the exchange have changed in that some have been de-listed, others suspended, and new ones listed. The economy has also changed especially with incept of the coalition government in 2003, posing different political eras and the amount of risk exposure since the study by Munywoki (1998). Establishing the model's workability, application and validity for the market is of much significance in rating stocks and especially so if a modified model can be established to suit the market as an emerging one.

1.3 Objectives of the Study

The study's general objective involved the assessment of the application of the CAPM model in asset pricing on NSE, which was to be achieved through three specific objectives. These were to:

i. identify the asset pricing mechanisms of risk exhibited in the Nairobi Stock Exchange

ii. assess the application of CAPM in asset pricing in the market, as a typical African emerging market.

iii. draw policy recommendations for the application of the model in the stock selection process.

1.4 Research Questions

As a tentative answer to the research problem on the applicability of CAPM model in NSE, the study sought to answer the following questions:

i. Is risk priced in the Nairobi Stock Exchange, and if so?

ii. What asset pricing mechanisms does the market exhibit?

iii. Is CAPM useful in asset pricing of stocks for the market?

iv. Is there evidence to support the hypothesis that the market is linear?

1.5 Significance of the Study

The outcome of this study is essential in portfolio management in matching stock profiles to determine an optimal set of assets to include in a portfolio. The findings are also useful in performance and project evaluation, where equity is an essential part of a company's corporate financing policy. To the investors and public at large, the study will help ease the decision process as well as equip them with critical information in stock rating and hence optimal decision-making. Lastly, the findings will add knowledge in the finance discipline on the application of the model in an emerging market.

1.6 Scope and Organization of the Study

The study aimed at establishing the risk – return relationship by computing the betas for securities listed in the market based on CAPM model. It emphasized on the application and evidence of the Capital Asset Pricing Model in the determination of stock returns and hence the estimation of risk (*beta* coefficients) for the securities listed in the market. Its focus thus was on the asset pricing mechanism exhibited in the market as depicted by CAPM with tests being conducted to explain the efficacy of the model. With forty-eight listed companies in the NSE market, but being an emerging market that is characterized by thin trading in

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some stocks, only thirty most active stocks were included in the study. The thirty stocks sampled had to meet a condition of having traded at least once per month through the period of study, from January 1997 to December 2003. This was to facilitate the accuracy in estimating the model's coefficients and validating its application. The whole period under consideration thus gave eighty-four months data series. The 1997-2003 period helped enhance the capture of the most current data and their effects in the market for purposes of validity and reliability. The period also captured two political regimes in different economic conditions.

The organization of this dissertation then proceeds as follows. In the next chapter, an in-depth literature review of the articles that most closely relate to the subject of this dissertation will be provided. In the third chapter, theoretical framework is presented on the model of application together with the developed testable hypotheses. The fourth chapter outlines the methodology and data presentation, as well as the steps followed in data analysis. The fifth chapter contains the empirical results and discusses the interpretation of the results, while the sixth chapter concludes and outlines the research recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Capital Asset Pricing Model is not a new concept in the field of finance. The model has undergone numerous theoretical and empirical tests since the early classical works of Sharpe and Lintner (1965), depicting an interesting historical evolution with mixed results and lots of criticism. CAPM has progressed along frenzied debate over its applicability and strength in asset pricing and researchers' relentless undertaking on the model has developed new discoveries along.

This chapter looked into the model's evolution process, moving from the earlier classical studies by Sharpe and Lintner (1965) in theoretical literature to the more controversial and mixed empirical evidence from studies on developed and emerging markets, but with emphasis on the latter. Various alternative asset pricing models were also discussed, with focus on its main modification models of CAPM with non- marketable assets or the zero-beta portfolio CAPM, multi-period CAPM, Conditional CAPM, and the Consumption-Based CAPM model. Its main critical model, the Arbitrage Pricing Model (APT), was looked into as well as other related studies done specifically on the Kenyan market in relation to asset pricing and the market's risk – return relationship. An outline of the model's relevant formulae used in the study, and its specification was as portrayed at the end of the chapter giving its mathematical development and the rationale behind it. The chapter then proceeded as follows.

2.2 Theoretical Literature

An underpinning of CAPM is the observation that risky stocks can be combined such that the portfolio is less risky than any of its components. It shows that if investors are rational mean-variance optimizers and have the same view of risk and return, market equilibrium requires that the market portfolio be mean -variance efficient, (Jorion 1996). Mean-variance optimization means that the investor attempts to maximize the expected return of the portfolio and minimize the variance/risk of that return. According to CAPM, investors should not expect compensation for risk that can be eliminated by holding a portfolio, which should only contain the systematic/undiversifiable risk.

However, investors do not hold a combination of the risk-free asset and the market portfolio and the risky portfolios of investors are different from what could be termed a market portfolio. CAPM yields unsatisfactory results for stocks of small or fast growing companies (Cochrane 1999). In addition, empirical evidence shows that the distribution may have fat tails, implying that probabilities of extreme asset returns may be larger than those implied by the normal distribution. The model, like any other, also has its strengths and weaknesses as pointed out by Sabal (2002). In its strengths, the model presents a positive relationship between risk and return, takes the benefits of diversification into account, and in relatively efficient markets, the relationship between beta and return is linear, as predicted by CAPM. The linear relationship between beta and return also simplifies its application in portfolio management.

Asset pricing has not only had a long history of theoretical but also empirical investigations. As an extension of the one period mean-variance portfolio model of Markowitz (1959), the foundational work in Capital Asset Pricing Model originated with

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Sharpe (1964) and Lintner (1965). In the late 1960's, Markowitz developed the basic portfolio model deriving the expected rate of return for a portfolio of assets and an expected risk measure. The Markowitz model is a single factor model, where an investors' objective is to maximize the portfolio's expected return, subject to an acceptable level of risk. Similarly, the investors' objective is to minimize risk subject to an acceptable level of expected return. The assumption of single period, coupled with the assumption of investors with the assumption of investors' attitude towards risk, allows risk to be measured by variance (or standard deviation) of portfolio return.

Markowitz (1959) study showed that the variance of the rate of return was a meaningful measure of portfolio risk, and an asset or a portfolio is efficient if no other asset or portfolio offers higher expected return with the same or lower risk /variance (Reilly 1992). Sharpe (1964) combined a risk free asset with a risky portfolio deriving a generalized theory of capital asset pricing from the Markowitz portfolio theory. Lintner and Mossin (1965) then derived similar theories that consequently led to the capital asset pricing model being referred to as the Sharpe- Lintner model.

The Sharpe (1964) and Lintner (1965) CAPM framework is thus a crucial starting point in assessing asset pricing mechanisms in emerging markets. With liberalization in place, capital markets integration is inevitable and occurs through foreign investment in emerging markets, indispensable due to their high returns. A major hindrance towards such integration is the lack of information about price behaviour in these markets, and a study on asset pricing mechanisms of NSE as an emerging market could be a revelation.

CAPM is a theory that shows assets as priced in relation to their risk, assuming that market portfolio is efficient. At a given level of risk, CAPM obtains higher expected returns.

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The model is useful for two reasons. First, it provides a benchmark rate of return for evaluating existing securities (looking for overpriced/ underpriced assets). Second, it allows the making of an educated guess as to the initial price of a newly issued security. The key to understanding the complexities of asset pricing in an emerging market, and in application to CAPM, lies with a set of some rather strict assumptions as pointed out by Sabal (2002). First, CAPM assumes that there are many small investors such that no individual investor possesses enough wealth to influence the market. Second, that there is a risk-free asset and money can be lent and borrowed at its interest rate. This limits investments to stocks, bonds, and a risk free asset. Third, capital markets are perfect in that no transaction costs exists, securities are infinitely divisible, short sales exist, investors are price takers and the efficient portfolio is precisely the market portfolio.

Fourth, it is the model's assumption that all investors are rational and mean/variance optimizers. Being risk-averse, the investors choose their investments based on expected return and risk with a bias towards those investments with a higher return and lower risk. This attribute is supported by the fifth assumption that depicts investors' rationality with homogeneous expectations about the distribution of returns. That is, all investors have the same information at any given point in time and, hence, have the same estimates on mean, variance, and covariance in regard to the various securities available. Lastly, the model expects that all investors are myopic with very short time horizons.

2.3 Alternative Asset Pricing Models

The standard Sharpe-Lintner CAPM model incorporated the assumption of a risk-free asset rate of return. After CAPM, other models developed, most being a modification of the

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standard CAPM. Such models include; CAPM with non- marketable assets, multi-period CAPM, Conditional CAPM, or the Consumption-Based CAPM.

In the absence of a riskless asset, Black (1972) suggested a zero-beta portfolio, *Rz,* (given that *Cov (Rz, Rm) =0*), as a proxy for the riskless asset. Where *Rz* is the zero-beta portfolio and *Rm* is the market return. This brought about a multifactor CAPM model (Sabal 2002) represented as:

$$E(R_{it}) = E(R_z) + \beta_{i\,t}[E(R_{mt}) - E(Rz)]$$

Where R_{it} - stock *i*'s expected return

R_{zt} - the return on the risk-free rate

$\beta_{i\,t}$ -the stock's sensitivity to the market

R_{mt} - the market's return

In this case, CAPM is as an equilibrium return-risk model with a market portfolio R_m and a minimum variance portfolio that is uncorrelated with the market portfolio.

A Conditional CAPM (CCAPM) later emerged to describe returns solely on β measure, based on the assumption that all market participants are mean-variance optimizers if faced with a normal distribution of returns. The argument for the model settled on the returns' distribution being time variant in nature and hence CAPM should be conditional on the information at the time *t* given as I_{t-1}. CCAPM then becomes;

$$E(R_{it}/I_{t-1}) = E(R_{ft}/I_{t-1}) + \beta_{i\,t}[E(R_{mt}/I_{t-1}) - E(Rft/I_{t-1})]$$

A close critic alternative to the CAPM however, and one that offers a different approach to asset pricing is the Arbitrage Pricing Theory (APT). Developed by Ross (1976), it arguably concludes that CAPM has several shortcomings and a better more inclusive model does exist. APT is more general than CAPM, allowing for multiple risk factors and

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does not require the identification of the market portfolio. It linearly relates asset returns to a set of factors and is not restricted to any particular return distribution (Sabal 2002). Copeland and Weston (1985), suggests that APT does not require assumptions about utility or the distribution of security returns. It relies on the assumptions that; Returns are generated according to a linear factor model, the number of assets is close to infinite (no need of a market portfolio), investors have homogenous expectations (same as CAPM), and capital markets are perfect, with perfect competition and no transactions costs.

The APT Equation then is a linear factor model (Copeland and Weston, 1985) represented as:

$$R_i = a_i + b_{i1} F_1 + b_{i2} F_2 + \text{---} + b_{ik} F_k + \varepsilon_i$$

The return on asset i (R_i), depends linearly on k factors (~ $F1$, ~ $F2$, ~ Fk) and its unsystematic (idiosyncratic) risk εi. Such factors include macroeconomic variables like GDP growth, unemployment rate, taxes, fiscal policy, inflation, and exchange rate. The extent to which the return on the asset depends on the factors is given by the factor loadings b_{i1}, b_{i2}, ---, b_{ik} . APT is also based on the assumptions that the idiosyncratic risk is zero on average, is uncorrelated across different assets and with the factors, that the different factors are uncorrelated, and that the factor distribution is zero on average or normal.

The basic point, however, is that the two theories capture two different sets of risks and address different aspects of the premium-awarding scheme for taking such risks. The CAPM, by its emphasis on efficient diversification in the context of a finite number of assets, neglects unsystematic risks in the sense of the APT whereas the APT, with its explicit focus on markets with a large number of assets, and by its emphasis on naive diversification and on the law of large numbers, neglects essential risks.

2.4 Empirical Literature

Early extensive studies of the Sharpe-Lintner model include Black and Scholes (1972), Fama and MacBeth (1973), Banz (1981), Gibbons (1982). Lintner (1965) test on CAPM found the intercept having a value much larger than R_f, the Beta coefficient being statistically significant but with a lower value, and the residual risk having effect on security returns. The methodology employed involved a first estimation of betas using time series regression. The estimated betas were then regressed as explanatory variables in testing validity of CAPM. Black and Scholes (1972) showed that the intercept term is different from zero and is time variant, concluding that when beta is greater than one, the intercept is negative and vice versa, a violation to CAPM.

Fama and MacBeth (1973) combined time series and cross sectional steps to investigate whether the risk premia of the factors in the second regression are non-zero. Fama and MacBeth (1973) studied the relationship between equity returns, taken as the relative change in equity prices, and risk using CAPM to estimate betas in explaining the variation in expected returns. The regressions actually used the statistical modeling method of cross-sectional regressions, consisting of two steps. First, they used ordinary least squares (OLS) to fit linear regression models for monthly returns, and secondly, tested the hypothesis that the time series average of the monthly regression coefficients is zero. The latter was based on a t-statistic formed by dividing the time series average of the monthly regression coefficients by the time series standard error of this average, which properly accounted for any serial correlation among the estimated regression coefficients across months. The beta coefficients were statistically significant and small, but the residual risk had no effect on the security returns.

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Banz (1981) applied CAPM to test the so-called 'size effect' on stock returns. In the study, small stocks in terms of market capitalization earned more returns than what CAPM prescribed. Roll (1981) also showed small firms' betas as biased downward since they trade less frequently than do large firms. Gibbons (1982) used maximum likelihood tests and rejected both the standard and Black-Scholes (1972) zero beta CAPM. Basu (1983) discovered a 'value effect' stipulating that high book-to-market value stocks earn a higher return than low book-to-market value stocks. The study on the France market (Hawawini et al. 1983), points to a positive relationship between returns and beta. Geanakoplos and Shubik (1990) showed CAPM as a special case of the general equilibrium model with incomplete asset markets. They concluded that CAPM holds true under general dividends as long as all agents have mean variance utility functions. Lo and MacKinlay (1990) tested biases relating to data snooping and concluded that it could explain the observed deviations from the model.

Fama and French (1992) combined size and book-to-market value and found the CAPM betas having no explanatory power for cross-sectional returns. Jegadeesh and Titman (1993) injected a momentum effect on CAPM in criticizing the model. They concluded that stocks that have done well in the past (winners) tend to do well in the future and past losers tend to lose in the future too. They attributed this momentum feature to investor's under reaction.

The study for Japan (Hawawini 1991: Chan 1991) supports the models' prediction of a positive relationship between beta and returns. This contrasts with the empirical findings in Canada (Calvet and Lefoll 1989), Belgium (Hawawini 1989), Finland and Sweden (Ostermark 1991), the United Kingdom (Chan and Chui 1996), Singapore (Wong and Tan 1991) and Korea and Taiwan (Cheung et al. 1993), which suggest either no or an inconsistent

relationship between return and market risk. These CAPM studies were following the unconditional, systematic, and positive trade-off between average returns and beta.

Pettengill et al. (1995) recognized a conditional relationship by following a different approach in testing the CAPM using positive and negative excess market returns period. Their argument is that since the CAPM is estimated with realized returns as proxies for expected returns, it is likely that negative realized risk premia will be observed in some periods. The model of Pettengill et al. is conditional on the realized risk premium, whether it is positive or negative. They found a positive (negative) relationship between realized returns and beta during periods of positive (negative) excess market returns. Ho et al. (2003), followed Pettengill's (1995) methodology on the Hong Kong stock market and found a conditional relationship between the risk variable and average cross-sectional realized returns, that take opposite directions during 'up' and 'down' markets.

A study on the Polish Warsaw stock market, (Zhang and Wihlborg 2003), reported empirical evidence in support of CAPM in pricing the listed firms and estimating the cost of capital. Zhang and Wihlborg (2004) also conducted a study on the pricing of equity in five other European emerging capital markets in Cyprus, Czech Republic, Greece, Hungary, Russia, and Turkey with the purpose of estimating the CAPM return and risk relationship. The study indicated a positive relationship between betas and returns. However, a conditional rather than an unconditional relationship between betas and returns was more evident. The study found beta to be a useful measure for investors and portfolio managers when making investment decisions.

Despite the criticism subjected to CAPM, the model has remained the solid foundation in asset pricing. It is a popular asset-pricing model for researchers and even

practitioners in investment management. This is attributable to its simplicity and intuitive appeal, and due to the lack of better alternative models (Gordon et al. 2001). Importantly, most of the aforementioned studies concurred that a positive relationship existed between realized returns and risk as measured by beta, stipulating a linear relationship. Moreover, there seems to be no model that has been able to phase out CAPM completely in theory or practice.

2.5 Specific Studies on the NSE

The exchange has undergone several studies on its history, efficiency, and performance. Several researchers dedicated their time on risk-return and the pricing behavior of the market.

Omosa (1989) applied time-series (Box-Jenkins: ARIMA) models on 12 stocks to test the predictive power of selected asset pricing models. Forecasted future share prices were tested against the actual ones using ROI, ARIMA, and CAPM and the differences reported were not significant. The models, generally, were not good predictors of the prices, a failure that the study attributed to their inefficiencies or the imperfection in the market. ARIMA however performed better compared to the other models. On a different perspective, Kenyan publicly quoted companies exhibited a positive relationship between systematic risk and return in a study by Gitari (1990). The results also indicated a negative relationship between unsystematic risk and return.

Muli (1991) estimated systematic return-risks for the NSE on 45 listed companies and identified the proportion of undiversified market risks as 4% and a return of about 6%. Using a 1-year government bond with a coupon rate of 15 % (July 1991), the full market return obtained was 21%. The Mean-Variance model was the main methodology followed. The

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study was conducted at a time when the market was at its low stages of development since there was no trading floor and only had six stockbrokers.

A more recent study related to market risk and return is one conducted by Munywoki (1998). The study followed a similar approach to determine the market risk and return, and reported a risk of 3.55% and a market return of 14.80%, on share prices and market data to the end of 1997. Adding this to a 15% one-year Treasury bond produced a total return of 29.8% then.

2.6 Theoretical Framework

2.6.1 The Model

CAPM was used as a central model for data analysis, cast in terms of historic returns Copeland and Weston (1985) as follows:

$$R_{it} = R_{ft} + \beta_{i\,t}[(R_{mt}) - R_{ft}] \quad \text{----------} \quad 3.1$$

Where *i* represent individual stocks and *t* indexes months, and

R_{it} - stock *i*'s expected return: estimated as

$$R_{it} = ((P_{t-1} - P_t) + D_t)/P_{t-1} \quad \text{----------} \quad 3.2$$

Where:

R_t - is the log-return in month t,

P_t - is the last traded price in month t,

D_t - is the dividend during month t,

P_{t-1} - is the last traded price in month 't-1'

R_{ft} - the return on the risk-free rate

$\beta_{i\ t}$ -the stock's sensitivity to the market: estimated by regressing the stock i's return against the market return.

R_{mt} - the market's return: Computed as, R_{it}, above using the market's monthly NSE index in place of share prices.

It is unlikely that excess market returns will perfectly explain stock *i*'s excess stocks returns, and some residual error $e_{it.}$ is expected (Copeland and Weston 1985)

$$R_{it} = R_{ft} + beta_i [(R_{mt}) - R_{ft}] + e_{it} \quad \text{---------- 3.3}$$

The CAPM assumes that the y-intercept or alpha for the stock is zero. In other words, when the excess return on the market is zero, the excess return of the individual stock will also be zero. Equation 3.3 uses monthly returns for stock, *i* in estimating the relationship between an individual stock's return and its systematic risk, based on beta (Van Horne 2001). For each month t, the excess return on a stock i is explained by a constant, $R_{f,t}$, the excess return for the market during period t, $(R_{m,t}) - R_{f,t}$, the sensitivity of stock *i*'s excess returns to changes in the excess returns of the market proxy, b_i, and a random error. The y-intercept and the slope are estimated for each of the stocks and tested. The beta measures the risk associated with one particular asset in relation to the overall market.

2.6.2 Proof of the CAPM

If *w* invested in *i* and (*1-w*) in the market portfolio *M* according to Sabal (2002), the expected return and standard deviation (risk) are:

$$E(R_p) = w\,E(R_i) + (1\text{-}w)E(R_M)$$

$$\sigma_P = \sqrt{w^2\sigma^2 + (1\text{-}w)^2\,\sigma^2_m + 2w\,(1\text{-}w)\,\sigma_{im}}$$

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A minimum variance frontier, shown by plotting expected return against risk (variance), has its slope at any point given by:

$$\frac{\partial E(R_p)}{\partial \sigma_P} = \frac{\partial E(R_p) / \partial w}{\partial \sigma_P / \partial w}$$

Where

$$\frac{\partial E(R_p)}{\partial w} = E(R_i) - E(R_m)$$

$$\frac{\partial \sigma_P}{\partial w} = \frac{1}{2\sigma_P} \quad [2w\sigma^2) - 2(1-w)\sigma^2_m + 2\sigma_{im}(1-2w)]$$

For $w = 0$, both must have the same slope,

$$\frac{E(R\,M) - R_f}{\sigma_m}$$

Therefore,

$$\left.\frac{\partial E(R_p)}{\partial \sigma_P}\right|_{W=0} = \frac{E(R_i) - E(R_m)}{\sigma_{im} - \sigma^2_m} = \frac{E(R\,M) - R_f}{\sigma_m}$$

And

$$E(R_i) - E(R_m) = \left(\frac{\sigma_{im}}{\sigma^2_m} - 1\right)[E(R\,M) - R_f]$$

But $\beta = \frac{\sigma_{im}}{\sigma^2_m}$,

Thus

$$E(R_i) - R_f = \beta[E(R\,M) - R_f]$$

$$E(R_i) = R_f + \beta[E(R\,M) - R_f]$$

2.6.3 Model Specification

Equation 3.3 represents the CAPM model that was estimated in the study to capture expected risk and return in the NSE market. The expected return (R_{it}) that the CAPM captures is the present value of the expected future cashflows discounted using an interest rate that best captures the risk involved in a particular security. R_{it} is the capital gain at the

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period t, obtained from the monthly closing prices from NSE DataStream. Similarly, R_{mt} is the market gain at period t, obtained from the monthly NSE-20 Share Index values and used as a market proxy. As a tentative answer to the research problem on the applicability of CAPM model in NSE, the study sought to find out the linearity (or lack of it) exhibited in the market and whether those risks reflected in the market are priced. In testing the validity of the model in its application to asset pricing in the NSE market, a cross-sectional regression, with the estimated betas as the independent variables, was applied as per Copeland and Weston (1985) and is as follows:

$$R_{it} - R_{ft} = a + b\beta_{i\,t} + e_{it} \quad \text{----------} \quad 3.4$$

Where:

$R_{it} - R_{ft}$ - the excess return on an individual portfolio

$\beta_{i\,t}$ -the estimated betas of the portfolio.

e_{it} - the error term

a and *b* - the intercept and slope coefficients

This is the CAPM model except that the risk-free rate has been subtracted from both sides and an intercept *a,* added.

If CAPM is true, then:

i. *a=0:* The intercept, *a*, should not be significantly different from zero.

ii. The market is linear in beta.

iii. Beta should be the only factor explaining the rate of return on a risky asset. (*b* should be statistically significant).

iv. The coefficient of beta, *b*, should be equal to $R_m - R_f$.

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ii. The market is linear in beta.

iii. Beta should be the only factor explaining the rate of return on a risky asset. (*b* should be statistically significant).

iv. The coefficient of beta, *b*, should be equal to $R_m - R_f$.

Because the market portfolio is generally riskier on average, it should have a higher return on the long time intervals, hence $b > 0$. The implication is that Equation's (3) excess return, $(R_m - R_{f,}) > 0$.

2.7 Overview of Literature

It is imperative that CAPM has undergone numerous theoretical and empirical tests since the study by Sharpe and Lintner (1965). The empirical evidence of the model as interesting as it has been is mixed. Earlier classical works of Sharpe and Lintner (1965), Black and Scholes (1972), and Fama and MacBeth (1973) supported the model, while those of Banz (1981), Gibbons (1982), and Basu (1983) had a different approach to the model creating a modification of the Sharpe and Linter model. The most critic model is that of Roll (1981) which developed an entirely different model that captured different factor loadings from CAPM, namely the APT. Other studies reveal mixed findings such as that by Lo and MacKinlay (1990), and Geanakplos and Shubik (1990). As the criticism continued, various modifications to the model were made creating an evolutionary history of alternative asset pricing models such as the CCAPM and APT. of the various other studies undertaken on the model, some cite inconsistent relationship such as Fama and French (1992), as others cite conditional relationship such as Pettengill et al. (1995), Ho et al. (2003) and Zhang and Wihlborg 2003).

The empirical studies lead to the conclusions that the CAPM must be rejected for two reasons. First, the intercept is significantly different from zero. Second, much of the returns unexplained by the CAPM can be explained by various anomalies such as firm-size (Banz 1981), Price/Earnings Ratio or book-to-market value (Fama and French 1992). But this does

not mean that expected returns are unrelated to beta. This is what the study stipulates to investigate concerning the risk return trade-off.

Further, several studies done on the NSE in relation to the market risk and return followed the Mean-Variance approach in estimating the unsystematic risk and return; Gitari (1990), Muli (1991), and Munywoki (1998). Moreover, companies originally listed on the exchange have changed in that some have been de-listed, others suspended, while others were listed. The economy has also changed especially with incept of the coalition government in 2003, posing different political eras and the amount of risk exposure since the study by Munywoki (1998).

Nevertheless, the model has survived tremendous criticisms and has not been phased out yet even by its most critical alternative APT. Its simplicity and intuitive nature has been given as its reason for being extensively used as an asset pricing model to date (Gordon et al. 2001). The mixed empirical evidence and the development of the various alternative models egged on the need to test the model in the Kenyan Nairobi Stock Exchange in providing its characteristics as an emerging market. Moreover, few tests on the model have been done specifically for the Kenyan stock market. This was the motivating factor in testing its application in the Nairobi Stock Exchange.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

In line with the study's objective, the research design was descriptive and cross sectional in nature and consisted of both qualitative and quantitative data in examining the relationship between the study's variables at a given point in time. Qualitative data were mainly obtained through a survey technique that was carried out using the questionnaire method and answered by a selected sample of investment management firms. Quantitative data were historical values obtained in the form of series from the NSE DataStream.

3.2 Study Population

The population of study included all companies listed on the Nairobi Stock Exchange between January 1997 and December 2003 on which a sample was selected. There are forty-eight listed and active companies in the Nairobi Stock Exchange, classified under equity market in the Main Investment Market and the Alternative Investment Market Segment (See Table A4 in Appendix IV).

There were only three newly listed companies between 1997 and 2003, which included African Lakes Corporation, Mumias Sugar Company, and ICDC Investments Company Limited. Two companies, Hutchings Biemer and African Lakes Corporation, were suspended in the same period as five others, including Pearl Dry Cleaners, Lornho Motors, Theta Group and Regent Undervalued Assets, were de-listed for non-compliance with listing requirements.

3.3 Sampling Technique

The study followed a sequential sampling technique in obtaining a viable set of stocks. The technique was selected for the reason that the data needed involved prices for which some shares, due to their inactive nature, had blank spaces. The sample considered only thirty actively traded securities, for which a price existed in every month of consideration, sorted through pre-ranking by trading frequency for all listed stocks and selected in the following sequence.

The data were first filtered according to firms that either were suspended or did not trade during the period under consideration, in which case, a share price was not available to calculate returns. All listed companies share prices were then ranked based on frequency in trading during the month under consideration, from which the first thirty highly ranked stocks were selected. All other ranked stocks not included in the sample were filtered for not having traded for at least once in a month for the period under considered.

3.4 Data Type, Source, and Collection

Data collected were mainly secondary in nature from the NSE share prices and market index databases. For each company, the closing share price for every month was taken for the period 1997-2003 giving an eighty-four months' data. The data for the thirty stocks and the market index were then converted into monthly returns. Primary data were obtained using semi-structured questionnaire technique from investment institutions and stockbrokers involved in portfolio management. Both open- and close-ended questions were included in collecting qualitative and specific information (Appendix XI). The questionnaire was self-administered through taking the document to the particular institutions and later

collection of the filled documents. Securing interviews with the targeted practitioners proved difficult in terms of time on their part.

The questions sought to clarify first, the viable portfolio recommended to investors by the institutional fund managers and its value, and the most important asset characteristics for inclusion of any stock in a portfolio. Secondly, the survey inquired on the financial tools used by the institutional managers in relation to whether financial models, fundamental or technical analysis were applied in stock valuation or if intuition was the main criteria used. Thirdly, if financial models were critical in the valuation process, was CAPM used and to what extent, including any other asset pricing model applied. Lastly, the survey raised question in regard to how the institutions rated CAPM as an asset pricing model.

3.5 Data Refinement and Analysis

Data collected on the sample firms and the market proxy was transformed into monthly returns and subjected to statistical tests, using econometric tools such as E-Views for regression analysis and descriptive statistics. To compute the returns, the share prices and the market index capital gains were computed using Equation 3.2 as:

$$R_{it} = ((P_{t-1} - P_t) + D_t) / P_{t-1}$$

Where: R_t - is the stocks return in month 't',

P_t - is the last traded price in month t,

D_t - is the dividend during month t,

P_{t-1} - is the last traded price in month 't-1'

Using these returns, the excess monthly returns for the stock $(R_i - R_f)$ and the market $(R_m - R_f)$ were obtained, based on Equation 3.1 variables of the Sharpe-Lintner (1965) CAPM. Regression analysis estimates of beta were run on these excess returns data obtained for the

first twenty four months from January 1997 to December 1998. The stocks were then ranked from the smallest beta stocks to the largest, and sorted into five risky portfolios from Portfolio 1 (smallest risk) to Portfolio 5 (largest risk). The group of thirty sampled stocks thus consisted of five portfolios each with six stocks based on beta for the 24 - month period from January 1997 to December 1998.

In testing the validity of the model in its application to asset pricing in the NSE market, a cross - sectional regression analysis, the Fama-MacBeth (1973) process. The process involves cross-sectional regressions consisting of two steps. First, use of ordinary least squares (OLS) to fit linear regression models for monthly returns, and secondly, testing the hypothesis that the time series average of the monthly regression coefficients is zero. For this study, the application was performed with the portfolios' excess returns as the dependent variables and the post-ranking betas as the independent variables. The post-ranking portfolio betas for the period from January 1999 to December 2003 were estimated through regression on the monthly excess returns for each of the stocks and the market proxy. The betas obtained were assigned to each stock in each of the five portfolios and then equally weighted betas computed for all the portfolios. The regression model applied, with the portfolios betas as the independent variables, is the Equation 3.4 model: $R_{i,t} - R_{f,t} = a + b\beta_{i\,t} + e_{it}$.

Using t-tests, the average values of *a* and *b* were subjected to hypothesis testing at 95 % confidence limit. The two-pass regression makes errors largely random across securities within a portfolio and eliminating bias for positive and negative sampling errors (Chen 1983). This use of full-period post-ranking betas help to minimize the errors in variables and at the same time enhances the precision of beta estimation. The purpose of the procedure was

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to test the proposition that at any point in time, there is a linear and positive relationship between CAPM's coefficients and expected returns of the stocks listed in NSE.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The exchange is fundamentally organized into four independent market segments. The first is the Main Investment Market Segment (MIMS), followed by Alternative Investment Market Segment (AIMS), Fixed Income Securities Market Segment (FISMS) and the Futures and Options Market Segment (FOMS). The study focused on the equity market, MIMS and AIMS. The MIMS has four main sectors namely, the Agricultural Sector, the Commercial and Services Sector, the Financial and Investment Sector, and the Industrial and Allied Sector. The AIMS consist of those stocks that do not fully meet some laid standards of the stock market. Most of the stocks in this segment are characterized by thin trading, and hence were eliminated from the sample.

For the thirty sampled stocks, and with the available data, different observations were made concerning the stocks traded in the NSE market. An observable characteristic of the market was thin trading as many stocks had gaps in recorded daily share prices with some missing out on more than two months. The most affected segment was the Alternative Market Segment as only the Standard Newspaper Group Company was included in the sample. During the entire period also, most stocks and hence the market were on a downward trend, an observation that fell in line with the recessionary periods experienced in the economy.

4.2 Descriptive and Inferential Statistics

4.2.1 Descriptive Statistics

The descriptive statistics are for the five portfolios of dependent returns. Table 4.1 reports the summary statistics for the market.

Table 4.1: Summary Statistic for the monthly percentage market returns (1999-2003)

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Market Index	-10.1155	8.675443	0.88475	3.076677	7.842528	0.019816

Source: Own Construction

The table records the mean, standard deviation, skewness, and kurtosis of thirty-one time series (thirty shares and the market index). The market has a mean return of -10.12 and a standard deviation of 8.67 as a measure of risk. Kurtosis shows the peakedness or flatness of the distribution, while skewedness shows the side to which the distribution slants. The distribution in Table 8 (Appendix II) contains low probability values for twenty-five cases, with the market included, proving normality by kurtosis and skewedness references.

4.2.2 Inferential Statistics

However, the main test used for normality in this case is the Jarque-Bera test, which is x^2 distribution under the null hypothesis of normality (Defusco et al. 2001). It measures the differences of kurtosis and skewedness of the distribution with those from the normal distribution. With the two as degrees of freedom, the 5% critical value for x^2 is 5.99. The null hypothesis of normality in the distribution cannot be rejected at the 5% confidence level in twenty-three cases of the thirty-one series (Appendix II -Table 8). The distribution of

percentage of share price changes is Gaussian in 74.2% of the cases. Among the Gaussian cases are some of the major companies (Barclays, Nation Media, KCB, EABL, Kenya Airways and Carbacid) and the market index itself, indicating that the returns distribution of the NSE market as a whole, is normal.

Table 15 (Appendix IX) summarizes the results on Augmented Dickey-Fuller (ADF) and Durbin - Watson (DW) unit root tests performed on the market and portfolio returns. Portfolios 1, 2, 4, 5, and the market registered no serial correlation as the t-statistics lie to the right of the critical value, -2.9118, according to the ADF tests. For the DW tests, the null hypothesis for serial correlation cannot be rejected for all the portfolios since they all round off to the nearest two.

4.2.3 Portfolio and Market Return Relationship

In testing the relationship between risk and average returns, Figures 4.1, 4.2, 4.3, 4.4, and 4.5 were obtained by plotting the market return against the portfolio returns. Portfolio 1 is the smallest portfolio by beta ranking, followed by portfolios 2, as the second smallest portfolio, then 3, 4, to the largest portfolio 5 (Appendix VII - Table 13). The results for the relationship between portfolio 1 and the market returns were as follows:

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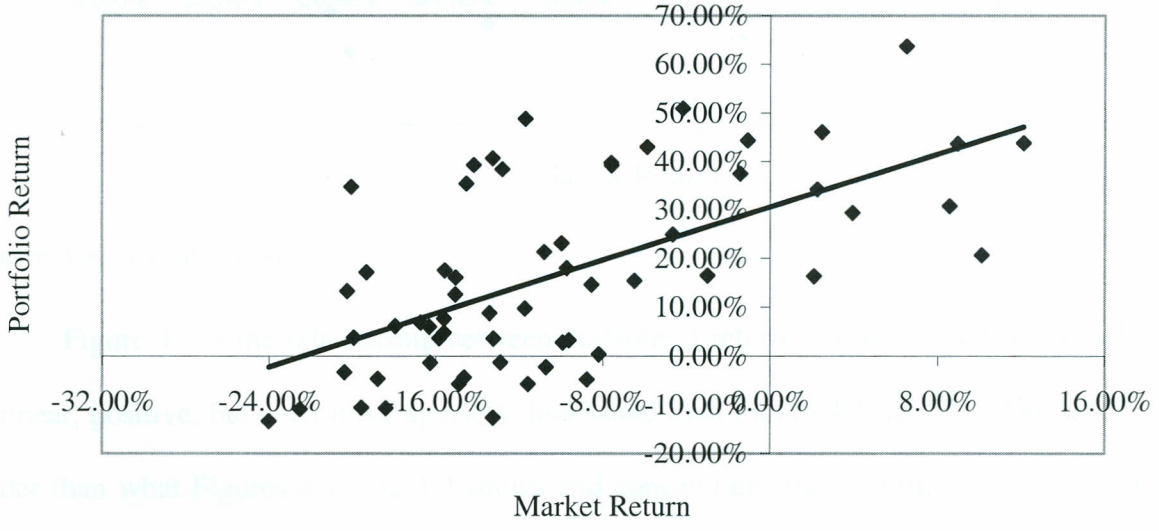
Figure 4.1: Portfolio1 Return and Market Return Relationship

Source: Own Construction

The relationship between portfolio 1 return and market return is linear but sparsely distributed. This indicates that the variation between the predicted and actual returns is bigger than the line can predict, implying a weak relationship. The scatter is more to the negative than the positive for the reason that most of market returns observations were negative.

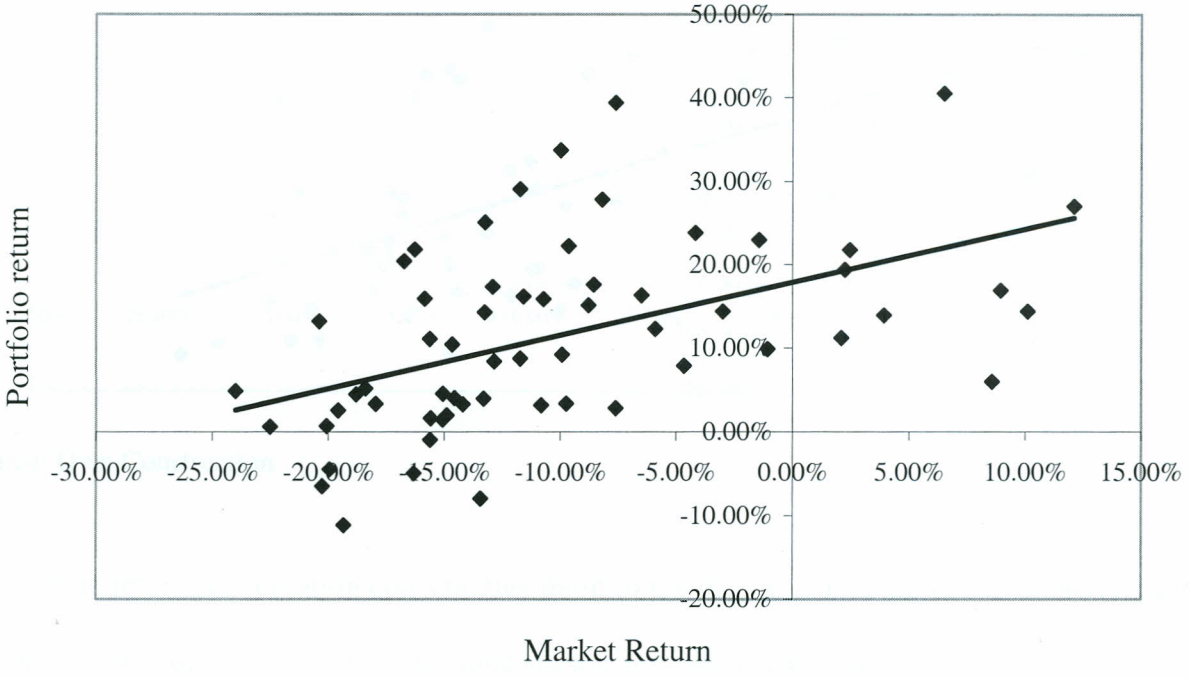
Figure 4.2: Portfolio 2 Return and Market Return



Source: Own Construction

Figure 4.2 shows the relationship between portfolio 2 return and market return as linear but sparsely distributed. The scatter is wider than what Figure 4.1 depicts but is still more to the negative than to the positive for the same reason that most of market returns observations were negative. The variation between the predicted and actual returns for the portfolio is also bigger than the line can predict, and the slope is flatter in comparison to that in Figure 4.1, implying a weak relationship.

Figure 4.3: Portfolio 3 Return and Market Return



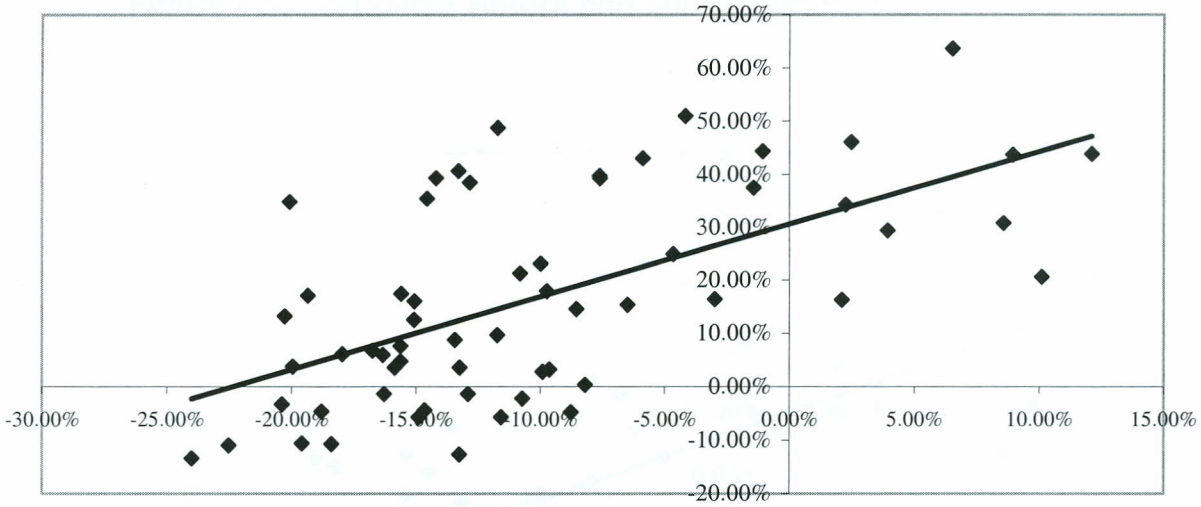
Source: Own Construction

Figure 4.3 is the relationship between portfolio 3 return and the market return, which is linear, positive, but even more sparsely distributed than Figure 4.1, and 4.2. The scatter is wider than what Figures 4.1, and 4.2 shows and concentrates more to the negative than the positive for the same reason that most of market returns observations were negative. This proves that the variation between the predicted and actual returns for the portfolio is also

bigger than the line can predict, and the slope is flatter in comparison to that in Figures 4.1, and 4.2, implying a weak relationship.

Figure 4.4 plots the relationship between portfolio 4 returns and the market return. The relationship is linear and positive, but a greater number of cases are far from the line of fit than in Figures 4.1, 4.2, and 4.3.

Figure 4.4: Portfolio 4 Return and Market Return Relationship



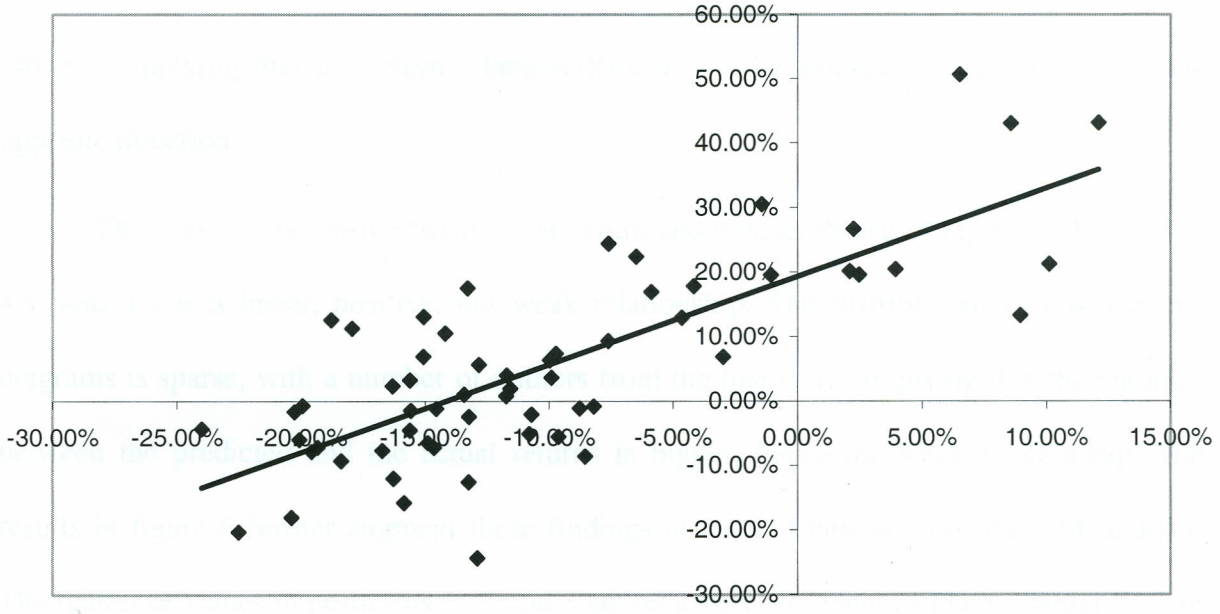
Source: Own Construction

The returns observation concentrates more to the negative than the positive like those in the previous three figures for the same reason that the market on average was a 'down' market as most return observations were negative. This proves that the variation between the predicted and actual returns for the portfolio is also bigger than the line can predict, and the relationship is weak.

Figure 4.5 plots the relationship between portfolio 5 returns and the market return. The relationship is linear and positive; but is relatively less sparsely distributed as compared

to Figure 4.4. The returns observation concentrates more to the negative than the positive like those in the previous four figures for the same reason that the market, on average, was a 'down' market as most return observations were negative. The variation between the predicted and actual returns for the portfolio is also bigger than what the line of fit is predicting, showing that the relationship between the portfolio's return and the market is weak.

Figure 4.5: portfolio 5 Return and Market Return Relationship



Source: Own Construction

The illustration in Figure 4.6 plots the portfolios average returns, for the overall period from January 1999 to December 2003, against their estimated betas that help enforce the linear relationship in the market.

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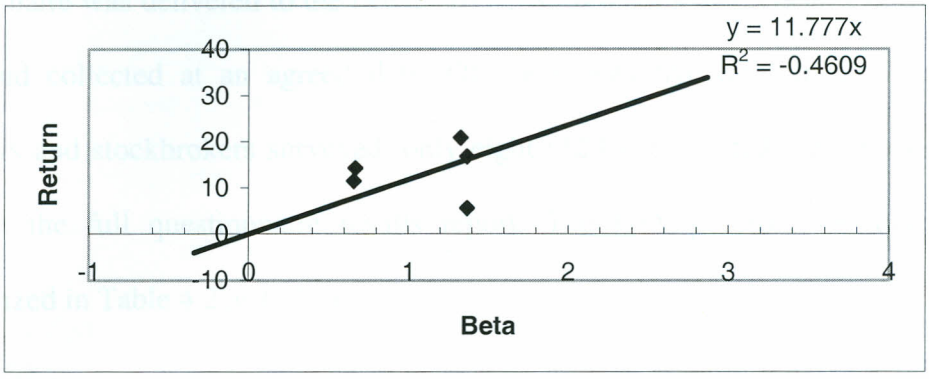
Figure 4.6: Portfolio Average Return - Beta Relationship



Source: Own Construction

The line of fit crosses at 11.78% on the Y-axis with an explanatory power of -46.09% implying that the return - beta relation is on the weaker side and moves in the opposite direction.

The overall relationship between the return and risk, as shown in Figures 4.1, 4.2, 4.3, 4.4, and 4.5 is a linear, positive, but weak relationship. The distributions of cases in the diagrams is sparse, with a number of outliers from the line of fit, implying that the variance between the predicted and the actual returns is bigger, hence the weak relationship. The results in figure 6 further augment these findings of weak relationship in the NSE market. The scatter of values in portfolios 1, 2, and 3 are relatively close and displays a better fit than those in portfolios 4, and 5. Given that the portfolios are arranged according to beta, from the smallest to the largest in the order of portfolio 1 to 5, it is imperative from the figures, to say that the relationship in low beta portfolios 1, 2, and 3 is better explained by the market than is the case with high beta portfolios 4 and 5.

The study also examined the proposition that institutional investors do consider CAPM as a significant model in portfolio selection and management. A questionnaire was

used to collect such information from a selected group of institutional investors. The questionnaire was delivered to the twenty-five institutional managers and stockbrokers, to be filled and collected at an agreed date. Of the twenty-five total institutional investment managers and stockbrokers surveyed, only eight (32%) responded (see appendix V - Table A-5) on the full questionnaire results report. The findings from the questionnaire are summarized in Table 4.2 as follows:

Table 4.2: Questionnaire Results Summary

Variable	Respondents	% of Respondents
Total Surveyed	25	100%
Total Respondent	8	32%
Viable portfolio (5-10stocks)	3	37.5%
CAPM Application	3	37.5%
Model Combination	4	50%
APT application	2	25%
Financial model Application	5	62.5%
Financial statement Analysis	5	62.5%

Source: Field Data (2005)

Market participants do not seem keen in the CAPM model as only 37.5% of the respondents apply it during portfolio management. Of those who use the model, 50% apply it together with other models, implying that 62.5% of twenty-five institutional investors surveyed believe that the model is irrelevant. In the findings, the most viable portfolio had between 5-10 stocks and the minimum viable amount to invest was between Kshs 500,000-

1,000,000. About 50% of respondents preferred gaining stocks and blue chips were a famous category with over 62.5% preference (see appendix IV - Table A-5).

In application of financial tools, financial models are frequently used in analyzing stocks, but not by as many respondents as compared to their application to fundamental and technical analysis. Financial statement analysis, which is company specific, is the most viable alternative criterion used, as evidenced by the 62.5% respondents who apply it. The probability of price appreciation is seen as a significant approach in stocks' selection by half of the respondents. This indicates that speculation is present in the market. About 50% of the respondents, in their opinion, believe that beta and hence CAPM is alive, implying that the model is an important risk measurement variable. Its most critical alternative, APT does not seem to respond well among the investment managers as only 25% of the participants had used it.

4.3 Regression Results

The results in Tables 4.3, 4.4 and 4.5 that follow give some insights into the characteristics of asset pricing in the market for the 60-months period from January 1999 to December 2003.

4.3.1 Portfolio and Market Return Regression Statistics

Table 3, below, was obtained by regressing the time series of portfolio returns against the market return for the 60-months period from January 1999 to December 2003. The t-test statistics results are attached in parentheses for each portfolio coefficients of beta and the constant.

Table 4.3: Portfolio - Market Return Regression Statistics

Portfolio	Beta	Constant	Multiple R	R Squared	Adjusted R Squared
1	1.691 (11.43)*	0.271 (13.818)*	0.832	0.692	0.687
2	1.77 (7.285)*	0.245 (7.528)*	0.691	0.477	0.468
3	1.047 (6.951)*	0.118 (5.941)*	0.674	0.454	0.445
4	1.084 (7.851)*	0.15 (8.208)*	0.717	0.515	0.507
5	1.774 (11.206)*	0.133 (6.351)*	0.827	0.684	0.678

Note: The figures in parentheses indicate the t- test statistics. * Indicates significance at 5% level
Source: Field Data

The purpose was to test the beta - return relationship with the overall market using the CAPM model. Beta is significant in all the portfolios at 95% confidence level, indicating that it is an important risk measure for the portfolios in the market.

To further test the beta-return relationship and for the purposes of testing the models existence in the market, a cross -sectional regression was applied using the variables in Table 4.4, for which the results are as summarized.

Table 4.4: Portfolio Beta and Average Returns

Portfolio	Beta	Average Return
1	1.33	20.86
2	1.37	16.78
3	0.66	11.46
4	0.67	14.25
5	1.37	5.56
Market		**-10.12**
Average Beta	**1.08**	

Source: Field Data (2005)

The average beta is 1.08, implying an overall portfolio risk premium of 8% over and above the market, while the average market return is –10.12%. The high-risk premium and the negative average return help explain the relationship in the market, and concur with the descriptive results previously obtained.

4.3.2 Cross-Sectional Regression Statistics

The cross - sectional regression analysis, the Fama-MacBeth (1973) process, was performed with the portfolios' average excess returns as the dependent variables and the post-ranking betas in Table 4.4 as the independent variables. The average returns for each of the equally - weighted portfolio were used as dependent variables and the subsequent estimated betas as independent variables The cross-sectional regression results in Table 4.5 reveal support in the models' ability to describe the data.

Table 4.5: Cross - Sectional Regression Output

$$R_{i,t} - R_{f,t} = a + b\beta_{i\,t}\,it + e_{it}$$

P (T_c < t-statistic) two-tail: T_c = 3.1824 at 5% level

	a	*b*
Coefficients	0.9719	0.0079
t-statistic	(1.7479)	(0.2076)
R-Squared	-0.3145	
Standard Error	0.4348	

Source: Field Data

The market exhibits a linear relationship, but in the opposite direction with an adjusted R-squared of -0.3145. The t-statistics for the intercept, *a,* of 1.74 is less than t-critical of 3.18 at 95% level, indicating that the intercept is not significantly different from zero. Similarly, *b,* is also significant given that its t-statistic of 0.21 is within the range of the t-critical of the two tailed test. The relationship is however not so strong, given the adjusted R- squared of 31.4%, suggesting that, additional variables may be needed to explain the behavior of shares prices in the NSE. To validate this, the residuals' effects were examined and the results obtained are summarized in Table 4.6.

Table 4.6: Predicted Betas and Residuals Effect on Returns

Observations	Portfolio Beta	Average Return	Predicted Beta	Residuals
1	1.33	20.86	1.13553	0.194471
2	1.37	16.78	1.10352	0.26648
3	0.66	11.46	1.06118	-0.401783
4	0.67	14.25	1.08367	-0.413672
5	1.37	5.56	1.01550	0.354503
Coefficient (t-test)				**-1.63 (-1.85)**
R-Squared				**-0.33**

Source: Field Data

The table shows the predicted betas and the residual with their effects on returns. The residuals t-test of -1.85, fall within the t-critical value of 3.18 at 95% level, indicating that the residuals have an effect on the returns and suggesting that beta is not the only risk measured

in the market. This is also supported by the R-squared value of -0.33, which being on the lower side, augments the presence of beta in the risk component of an asset's return. The study, however, did not investigate any other variables, other than beta, that could help predict an asset's return as this was beyond its scope.

4.4 Discussion of Results

Following the Jarque-Bera X-squared test for normality in the distribution, the market percentage of share price changes is Gaussian in 74.2% of the cases. Among the Gaussian cases are some of the major companies (Barclays, Nation Media, KCB, EABL, Kenya Airways and Carbacid) and the market index itself, indicating that the returns distribution of the NSE market as a whole, is normal.

From a local perspective, the study agrees with Omosa (1989) that the CAPM's predictive power is low, but does exist, and Gitari (1990) findings of the relationship between unsystematic risk and return. However, the study found the average return for the market as -10.12% and the risk premium of 8%. Adding this to a 10.14% average 91-Day Treasury bill return produces a total return of 0.02%. Muli (1991) and Munywoki (1998) found a return of 6% and 14.80% respectively, with a risk of 4% and 3.55% in the periods 1991, and 1998. The market characteristic in these two studies is an 'up' market as the total returns in each study were 21% and 29.8% respectively.

The study found the beta coefficient to be statistically significant but with a lower value, and the residual risk as having effect on the returns which is the same conclusion reached by Sharpe-Linter version of CAPM. The methodology followed involved a first estimation of betas using time series regression, and then using the estimated betas as

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explanatory variables, the Fama and MacBeth (1973) process. These findings are in line with the empirical findings of Fama and MacBeth (1973), except that the residual risks for the Fama and MacBeth (1973) study had no effect on the security returns. The studies for France (Hawawini et al. 1983) and Japan (Hawawini 1991: Chan et al. 1991), shared similar findings of a positive relationship between beta and returns.

The study also concurs with other studies done in other emerging markets and particularly those in the European world conducted by Zhang and Wihlborg (2004) on the pricing of equity. The six European emerging capital markets were Cyprus, Poland, Czech Republic, Greece, Hungary, Russia, and Turkey. The markets indicated a positive relationship between betas and returns and found beta to be a useful measure for investors and portfolio managers when making investment decisions. However, a conditional rather than an unconditional relationship between betas and returns was more evident. However, this was beyond the scope of this study on the Kenyan NSE market.

The practitioners do not seem to value the model as only a few (37.5%) apply the model in investment management. None of the institutional investors cited complexity as a reason for not applying it, indicating that most of the practitioners are aware of the model. The participants' lack of emphasis on the model, given that the market supports the model, implies that the investment managers are missing in its professional value for risk measurement.

The market exhibits an asset pricing mechanism for risk in that beta, as priced under CAPM, is significant in determining the returns of assets in the market. It comes out as a significant economic tool that can be used to price risk during investment. Despite this, the model is relatively applied since only 37.5% of the practitioners in the market use it.

4.5 Testing the Significance of the Estimated Parameters

Table 5 displays the t-statistics value of 1.75 for the intercept, *a*, (Equation 3.4, 21) at the 95% confidence level with a t-critical value of 3.18. The value falls within the t- critical indicating that the intercept is not significantly different from zero. This means that the study accepts the proposition that beta is priced in the NSE market.

The study also examined if the coefficient of beta, *b*, (Equation 3.4, .21) is equal to $R_m - R_f$. The t-statistic value for the slope, *b,* is 0.21. This is within the t – critical area of 3.18, indicating that the return premium is not different from $R_m - R_f$. this implies that beta is a critical factor in explaining the rate of return on a risky asset in the NSE market, and the excess market return is fundamental in the decision on stocks selection.

The market return is an important element in explaining the behavior of securities return in the NSE market, but it is not the only factor. This can be voiced as one of the reasons behind the models' low level of application by the market participants in portfolio management. Beta is seen as a significant measure of risk in the market making CAPM an important economic model that should be used together with other models to create practitioners' professional value in investment management.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary and Conclusions

The study has assessed the asset pricing mechanisms exhibited in the Nairobi Stock Exchange as stipulated by the CAPM model. It attempted to examine the pricing of risk as measured by beta on the NSE market and the application of CAPM model in portfolio management by a selected group of practitioners.

The analysis of the chosen sample shows that over 74% of the shares, together with the NSE share Index, are normally distributed and the market is Gaussian. This implies that, if the sum of a large number of price changes across a long period is large, the chances are that each individual price change is negligible when compared to the total change. The price of a security does not tend to jump up or down by large amounts during short time periods.

The findings support the general hypothesis that the market prices the risk variable, as there exists a systematic relationship between the risk and returns. The relationship between beta and return in the NSE market in the period January 1999 to December 2003 is evident and the CAPM displays some explanatory power in asset pricing with the percentage of variance explained in the full period of observation standing at 31.4%.

Market participants do not seem keen in the model as only 37.5% of the total sample of institutional investors surveyed applies it during portfolio management. Of those who use the model, 50% apply it together with other models, while the rest 62.5% believe that the model is irrelevant.

The overall conclusion of the study is that the market return is an important element in explaining the behavior of securities return in the NSE market, but it is not the only factor. The risk is related to return and CAPM has passed a first test of its validity in the Nairobi stock Exchange, an African emerging market. However, the power of beta as an estimate of risk is not very high (adjusted R-squared is 31.4%). This may be voiced as one of the reasons behind the models' low level of application by the market participants in portfolio management. Beta reveals itself in the study as a significant measure of risk in the market. This makes CAPM an important economic model that can be used together with other models to create practitioners' professional value in investment management.

5.2 Recommendations

CAPM is certainly a risk measure based on both theoretical and empirical evidence. The study found CAPM applicable. Beta is priced in the market, and although the CAPM model's explanatory power is low in R-Squared terms, the study recommends the model's continued and increased application, together with other models to augment it in order to achieve portfolio optimization. Practitioners within the exchange as a whole should be informed of the model's importance in the pricing of risky assets in the market to add onto their professional value in portfolio management.

The study recommends the continued adoption of a CAPM approach to stock valuation despite the model's lack of compelling evidence that this it is superior to a range of theoretical alternatives. This is because of the simplification inherent in the CAPM model and owing to the fact that the alternative asset pricing models criticizing CAPM do not eliminate it altogether. The study however did not examine the range of identified assumptions within the Capital Asset Pricing Model which have been widely discussed in

academic literature and policy making contexts. The continued use of the model has some practical advantages in terms of offering a level of certainty and predictability to long term investors. Rather, despite the open conclusion that participants do not stress CAPM use, the study asserts it is the most appropriate model for continued use in identifying the inherent risk premium in a stock's return.

For investors, betas' significance in the market implies that the model is a critical economic tool to gauge the risk level of the stocks to include in a portfolio. Beta computations should therefore be provided, as this can be a useful analytical tool in guiding investors on the risk component expected for a given stock.

5.3 Limitations of the Study

The study conducted a research on thirty listed stocks on the Nairobi Stock Exchange for the period 1997-2003. It limited itself to the application of CAPM model in analyzing risk and return for these stocks during the period. No other models were tested in the study, as the time, money, and scope could not allow.

The main shortcoming of the study was the slow co-operation from the institutional investors targeted in answering the questionnaires delivered, and this delayed data collection and analysis. Institutional managers should be made aware of this problem in order to bridge the gap between research and its application. Data collection from the targeted twenty-five strategic portfolio managers and stockbrokers took a full two months. Only eight of the responses were complete and are what formed the application analysis in the study. More difficulties encountered stemmed from the brokers than with the fund managers, whose rigidity should be eased through an educative campaign on their role in knowledge creation

and application. The response thus was poor with some respondents leaving some questions unanswered, while others had the whole document blank. The questionnaires were delivered to the targeted members and collected later at an agreed time. This could have been one problem that led to the poor response than if a direct interview was conducted.

5.4 Suggestions for Further Research

The study found the markets return risk relationship weak, with residuals having an effect on the securities portfolio returns. This implies that more research is needed to assess other significant factors that may explain fully the characteristics of asset pricing in the Nairobi Stock Exchange. The study for instance did not cover any other alternative model that questions the validity of CAPM, and was only limited to the traditional and unconditional CAPM model.

One question that arises from this study is: if beta does not reflect the market very well, what is the most powerful measure of risk and how could investors be guided in their decisions? One answer could come from Fama and French (1992), who recommended the use of multi-index models. A different approach could take into analysis the size effects of the firm and/or the book to market value. APT, as its most critical alternative can be tested to see if it possesses a more explanatory power. The Pettengill et al. (1995) approach can also be examined for conditional CAPM model on the 'Up' or 'Down' market during positive and negative excess market returns. Academic researchers, therefore, have a task to fulfill in this regard for only when the assets are optimally priced can the market be termed efficient and investors fully rewarded.

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REFERENCES

Akdeniz L, Salih A, and Caner M. 2002. *Time – varying betas help in asset pricing: the threshold CAPM.* EconPapers: Vol. 6:4 - 2003. Available from http://econpapers.hhs.se/article/bepsndecml

Calvet, A. and J. Lefoll. 1989. " Risk and Return on the Canadian Capital Markets: Seasonality and Size Effects" *Finance,* 10, 21.39

Chan A. and A.P.L. Chui. 1996. " An Empirical Re-Examination of The Cross-Section Of Expected Returns: UK Evidence" *Journal of Business Finance & Accounting,* 43, .2, 309-25

Chan, L.K.C., Y. Hamao and J. Lakonishok. 1991. " Fundamentals and Stock Returns in Japan" *Journal of Finance,* 46, 1739-64

Campbell R. H. 2000. *"Asset pricing in emerging markets".* Duke University, Durham, NC. Cambridge. National Bureau of Economic Research Working Paper.

Chen, N. 1983. "Some empirical tests of the theory of arbitrage pricing." *Journal of Finance* 38 (December 1983): 1393-1414.

Cheung, Y., K. Wong and Y.Ho. 1993. " The Pricing of Risky Assets in Two emergimg Asian Markets- Korea and Taiwan" *Applied Financial Economics,* 3, 315-24

Copeland, T. E. and J.F. Weston. 1985. *Managerial finance.* 8th ed. Dryden Press, California.

Defusco, R. A., D. W. McLeavey, J. E. Pinto, and D. E Runke. 2001. *Quantitative Methods for Investment Analysis.* Association for Invetsment Management and Research.

Fama, E. and J. MacBeth, 1973. "Risk, Return, and Equilibrium: Empirical Tests" – Journal of Political Economy, 81 (3), 607-636.

Gitari, A. 1990. "An empirical investigation into the risk-return relationship among Kenyan publicly quoted companies." Unpublished MBA Project, University of Nairobi.

Gordon, J., W. Sharpe, and J. Bailey. 2001. *Fundamentals of Investments.* Prentice Hall, New Jersey.

Hawawini, G. 1991 " Stock Market Anomalies and the pricing of Equity" *Japanese Financial market Research,* 231-50

Hawawini, G., P. Michel and A. Corhay. 1989. A Look at the Validity of the Capital Asset Pricing Model in Light of Equity Market Anomalies: The case of Belgian Common Stocks" *A Reappraisal of the Efficiency of Financial Markets,* 231-50.

Hawawini, G., P. Michel and C. Viallet. 1983 " An Assessment of the Risk and Return of French Common Stocks." *Journal of Business Finance and Accounting,* 10, 333-50

Ho, R. 2003. "Market conditions and the pricing of Hong Kong equity". *The Management Centre Research papers. Research Pare 021.*

Javed, A. 2000. *Alternative capital asset pricing models: A review of theory and evidence.* Available from http://www.pide.org.pk/Abstract.htm

Jagannathan , R and Z. Wang. 1996. "The conditional CAPM and the Cross Sectional of Expected Returns". *Journal of Finance, 51,3-53.*

Jagannathan , R and Z Wang,. 1998. "An asymptotic theory for estimating beta- pricing models using cross sectional regression". *Journal of Finance, vol. LIII, No. 4, 85-109.*

Jegadeesh, N and S. Titman. 1993. "Returns to buying winners and selling losers: implications for stock market efficiency". *Journal of Finance 48, 65-91.*

Jorion P. 1996. *Financial risk management.* Oxford UK, Blackwell Publishers Inc.

Kiweu, J.M. 1991. "The behavior of share prices in the Nairobi stock exchange: An empirical investigation. Unpublished MBA Project, University of Nairobi.

Lo, A and A. Mackinlay. 1990. "Data snooping biases in tests of asset pricing models." *The Review of Financial Studies 3*, 41- 66.

The Nairobi Stock Exchange. 2003. "Market Capitalization." *December NSE Bulletin.*

Markowitz, H. M. 1959. *Portfolio Selection: Efficient Diversification of Investment.* New York, Willey.

Mbaru J. 2003. *Transforming Africa: New pathways to development.* Nairobi, East African Educational Publishers (E.A.E.P).

Muhanji, S. I. 2000. "An assessment of investment in securities in emerging capital markets: The case of Nairobi Stock Exchange." Unpublished MA Thesis, Kenyatta University.

Muli, S.M 1991. "Estimating the systematic return risk for the Nairobi Stock Exchange," Unpublished MBA Thesis, University of Nairobi.

Munywoki S.K. 1998. "An estimation of the systematic return risk at the Nairobi Stock Exchange. Unpublished MBA Thesis, University of Nairobi.

NSE (2002) "Role of the exchange in the economy," *NSE online*. Available from http//www.nse.co.ke/Role.htm

Ogum G, F. Beers, and G. Nouyrigst. 2000. *An empirical analysis of kenyan daily returns using EGARCH models.* Cahier de Recherche du CERAG, Série Recherche, no. 2002-21, 20.

Omosa, F.Y.B 1989. "Predictive ability of selected asset pricing models on the Nairobi Stock Exchange," Unpublished MBA Thesis, University of Nairobi.

Ostermark, R. 1991. " Empirical Evidence on the Capital Asset Pricing Model in Two Scandinavian Stock Exchanges." *Omega,* 19, 223-34

Reilly, F.K. 1992. *Investments:* Third Edition. The Dryden Press, Orlando USA.

Rutterford, J. 1993. *Introduction to stock exchange investment.*2nd ed. London, Macmillan Press.

Sabal J. 2002. *Financial decisions in emerging markets.* New York, .Oxford University Press.

Souflan, N 2001 *"Empirical Content of Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) Across Time".* Manchester Metropolitan University Business School Working Paper Series, WP01/03.

Sprecher C.R. 1975. *Introduction to Investment Management.* Houghton Mifflin Company, Boston.

Van Horne C.J. 2001. *Financial Management and Policy.* Prentice-Hall Inc. 12th ed. New Jersey, U.S.A.

Wong, K. A. and M. L. Tan. 1991. "An Assessment of Risk and Return in Singapore Stock Market." *Journal of Financial Economics*, 13, 561-74

Zhang J. and C. Wihlborg. 2003. The Polish Stock Market: Risk and risk premia. Available from http://www.efmaefm.org/AcceptedPapers/ZhangJianhua

Zhang J. and C. Wihlborg. 2004. Unconditional and Conditional CAPM: Evidence from Emerging European Markets. Available from http://www.snee.org/filer/papers/266.pdf

APPENDIX I

Table A-1: T-Bill, Market Index and Portfolios 1, 2, 3, 4, and 5 Returns

Month	T-Bill Rates	INDEX	1	2	3	4	5
Jan-99	10.70%	-9.98%	39.67%	23.12%	33.73%	20.75%	6.37%
Feb-99	8.95%	-8.77%	15.91%	-4.74%	15.12%	16.16%	-1.08%
Mar-99	8.84%	-14.65%	23.52%	-4.38%	10.41%	4.22%	-7.24%
Apr-99	9.03%	-10.71%	17.41%	-2.20%	15.84%	7.01%	-2.07%
May-99	9.63%	-9.91%	19.28%	2.81%	9.22%	11.97%	3.65%
Jun-99	11.44%	-11.57%	18.42%	-5.67%	16.16%	14.42%	1.97%
Jul-99	14.47%	-14.89%	15.51%	-5.68%	1.98%	9.49%	-6.47%
Aug-99	14.84%	-24.00%	12.08%	-13.35%	4.85%	6.50%	-4.33%
Sep-99	15.78%	-18.40%	7.93%	-10.67%	5.17%	3.70%	-9.30%
Oct-99	17.63%	-22.52%	11.42%	-10.88%	0.61%	4.00%	-20.30%
Nov-99	18.14%	-18.79%	0.49%	-4.61%	4.47%	-4.57%	12.62%
Dec-99	19.97%	-19.58%	11.45%	-10.54%	2.57%	7.66%	-7.82%
Jan-00	20.30%	-20.39%	8.60%	-3.26%	13.17%	12.32%	-18.06%
Feb-00	14.84%	-15.85%	8.96%	3.63%	15.90%	14.80%	-15.79%
Mar-00	11.28%	-13.24%	13.00%	3.59%	25.05%	18.98%	-2.39%
Apr-00	12.44%	-15.62%	3.33%	4.80%	11.08%	15.57%	-4.54%
May-00	11.22%	-16.28%	13.03%	-1.35%	21.79%	22.22%	-12.01%
Jun-00	10.47%	-12.90%	5.70%	-1.30%	17.34%	19.24%	-24.34%
Jul-00	9.90%	-11.73%	18.36%	9.71%	29.06%	23.92%	0.83%
Aug-00	9.25%	-9.63%	15.25%	3.26%	22.22%	20.84%	-5.52%
Sep-00	10.36%	-8.20%	19.31%	0.38%	27.83%	24.23%	-0.79%
Oct-00	10.65%	-8.55%	15.46%	14.57%	17.61%	27.47%	-8.58%
Nov-00	11.17%	-16.74%	16.53%	6.82%	20.41%	23.61%	-7.71%
Dec-00	12.41%	-13.25%	15.87%	-12.59%	14.28%	12.71%	-12.56%
Jan-01	14.76%	-15.59%	11.53%	17.49%	1.65%	3.89%	-1.43%
Feb-01	15.30%	-13.43%	17.57%	8.79%	-7.96%	3.37%	1.05%
Mar-01	14.97%	-20.27%	7.54%	13.23%	-6.46%	6.70%	-1.65%
Apr-01	12.90%	-16.32%	12.46%	6.01%	-4.94%	3.63%	2.36%
May-01	10.52%	-17.95%	6.98%	6.09%	3.37%	4.66%	11.33%
Jun-01	12.07%	-10.81%	16.11%	21.29%	3.18%	3.85%	-5.07%
Jul-01	12.87%	-15.07%	18.36%	12.58%	1.49%	7.31%	6.92%
Aug-01	12.84%	-19.95%	12.56%	3.77%	-4.45%	5.16%	-0.71%
Sep-01	12.39%	-19.34%	11.68%	17.10%	-11.15%	-4.59%	-7.20%
Oct-01	11.63%	-6.49%	19.63%	15.39%	16.30%	11.02%	22.40%
Nov-01	11.50%	-15.06%	14.08%	16.04%	4.54%	11.75%	13.10%
Dec-01	11.01%	-15.62%	16.34%	7.63%	-0.92%	4.70%	3.29%
Jan-02	10.86%	-11.71%	10.46%	48.79%	8.75%	7.60%	4.02%
Feb-02	10.61%	-12.83%	16.35%	38.42%	8.41%	11.71%	5.67%
Mar-02	10.14%	-20.08%	13.91%	34.79%	0.70%	8.98%	-5.98%
Apr-02	10.01%	-14.55%	15.70%	35.43%	4.03%	7.50%	-1.15%
May-02	9.04%	-14.20%	7.64%	39.30%	3.29%	4.67%	10.54%
Jun-02	7.34%	-5.89%	21.98%	43.02%	12.27%	21.86%	16.95%
Jul-02	8.63%	-7.61%	12.93%	39.76%	39.39%	11.14%	9.32%

Table 7: T-Bill ---------- (Cont'd)

Aug-02	8.34%	-13.29%	15.89%	40.67%	3.96%	15.53%	17.53%
Sep-02	7.60%	-7.60%	20.13%	39.22%	2.86%	16.96%	24.41%
Oct-02	8.07%	-1.07%	25.10%	44.35%	9.87%	16.68%	19.54%
Nov-02	8.23%	-4.17%	40.41%	50.95%	23.83%	32.58%	17.85%
Dec-02	8.38%	8.94%	28.89%	43.69%	16.89%	12.63%	13.34%
Jan-03	8.38%	2.46%	77.72%	46.08%	21.77%	59.39%	19.61%
Feb-03	7.77%	-4.66%	25.41%	24.92%	7.89%	14.42%	12.96%
Mar-03	6.24%	-2.99%	31.45%	16.43%	14.37%	20.42%	6.88%
Apr-03	6.25%	8.56%	39.94%	30.75%	5.97%	15.42%	43.01%
May-03	5.84%	6.51%	43.50%	63.65%	40.53%	34.89%	50.63%
Jun-03	3.00%	-9.73%	29.71%	17.96%	3.37%	20.09%	7.41%
Jul-03	1.54%	2.09%	40.42%	16.29%	11.18%	11.10%	20.15%
Aug-03	1.18%	3.92%	44.69%	29.39%	13.92%	16.99%	20.46%
Sep-03	0.83%	12.10%	47.34%	43.82%	26.99%	18.75%	43.13%
Oct-03	1.00%	2.25%	40.83%	34.22%	19.39%	31.24%	26.68%
Nov-03	1.28%	10.11%	53.41%	20.64%	14.37%	22.37%	21.25%
Dec-03	1.46%	-1.44%	36.49%	37.46%	22.95%	23.66%	30.50%

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APPENDIX II

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Table A-2: Summary Statistic for the monthly percentage portfolio returns (1999-2003)

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Market Index	-10.1155	8.675443	0.88475	3.076677	**7.842528***	0.019816
BAMBURI	6.800667	19.95214	0.681862	2.484661	5.313292	0.070183
BARCLAYS	88.151	22.56123	0.644675	2.058849	**6.370473***	0.041368
BAT	63.7585	26.44849	0.997015	3.314566	**10.18776***	0.006134
BBOND	13.96967	19.55817	-0.399715	2.654252	1.896576	0.387404
BOC	23.84333	17.73131	0.452708	2.83099	2.120853	0.346308
CARB	53.98617	67.60538	1.298911	2.999431	**16.87171***	0.000217
CFC	-7.116833	12.62326	0.367867	5.195268	**13.40126***	0.00123
CMC	-2.676667	18.77346	1.397721	5.348186	**33.32117***	0
DTK	-4.359	14.75532	1.155551	4.662739	**20.26473***	0.00004
DUN	-7.484167	15.83749	1.699539	8.899286	**115.8883***	0
EABL	77.2815	33.7063	0.856786	2.59495	**7.750981***	0.020744
EAPORT	-2.566833	19.29243	0.326145	5.719431	**19.55197***	0.000057
FEA	-0.291833	12.33697	0.392438	3.218454	1.65938	0.436184
ICDC	10.99167	13.18646	0.106241	4.288555	4.263809	0.118611
JUB	4.196333	16.39358	1.870334	8.885112	**121.5679***	0
KAKUZI	-4.141167	18.26121	1.864907	8.420644	**108.2372***	0
KCB	-7.9585	27.35815	3.323665	18.47525	**709.1756***	0
KENOL	62.42417	42.83467	-0.734215	2.555405	5.884874	0.052737
KPLC	8.666	43.78264	2.509692	12.99474	**312.7224***	0
KQ	-3.657167	10.57453	-0.048288	3.803049	1.635537	0.441416
NBK	-6.559333	25.09514	2.085114	8.508393	**119.333***	0
NIC	4.607333	16.73317	0.907865	4.249097	**12.1428***	0.002308
NMG	8.638667	18.6019	1.492101	6.968942	**61.64491***	0
RVP	-9.197667	16.13379	1.742134	8.555054	**107.4969***	0
SASINI	7.234667	31.12581	1.296443	3.237767	**16.94897***	0.000209
SCBK	41.11567	33.29629	-0.673318	2.623267	4.888391	0.086796
SNG	-4.963333	31.02615	1.515527	7.203136	**67.13409***	0
TOTAL	2.4585	25.91808	1.871343	11.73735	**225.8724***	0
UCHUMI	5.3405	16.65201	-0.118085	2.498739	0.767596	0.681269
UNGA	-8.612833	28.19348	1.26682	5.684106	**34.05938***	0

APPENDIX III

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Table A-3: Full Names of Sample Listed Stocks

	Company	Full Name
	Market Index	NSE 20 - Share Index (1996=100)
1	**BAMBURI**	Bamburi Cement Ltd
2	**BARCLAYS**	Barclays Bank of Kenya Ltd
3	**BAT**	British American Tobacco Ltd
4	**BBOND**	Unilever Tea Kenya ltd / Brooke Bond
5	**BOC**	B.O.C. Kenya Ltd
6	**CARB**	Carbacid Investment Ltd
7	**CFC**	CFC Bank Ltd
8	**CMC**	CMC Holdings Ltd
9	**DTK**	Diamond Trust Bank Kenya Ltd
10	**DUN**	Olympia Capital Holdings Ltd /Dunlop
11	**EABL**	East African Breweries Ltd
12	**EAPORT**	East African Portland Cement Ltd
13	**FEA**	Firestone East African Ltd
14	**ICDC**	ICDC Investment Co. Ltd
15	**JUB**	Jubilee Insurance Co. Ltd
16	**KAKUZI**	Kakuzi Ltd
17	**KCB**	Kenya commercial Bank Ltd
18	**KENOL**	Kenya Oil Co. Ltd
19	**KPLC**	Kenya Power & Lighting Co. Ltd
20	**KQ**	Kenya Airways Ltd
21	**NBK**	National bank of Kenya ltd
22	**NIC**	NIC Bank Ltd
23	**NMG**	Nation Media Group Ltd
24	**RVP**	Rea Vipingo Plantations Ltd
25	**SASINI**	Sasini Tea & Coffee Ltd
26	**SCBK**	Standard Chartered Bank Ltd
27	**SNG**	Standard Newspaper Group Ltd
28	**TOTAL**	Total Kenya Ltd
29	**UCHUMI**	Uchumi Supermarket Ltd
30	**UNGA**	Unga Group Ltd

APPENDIX IV

Table A-4: Nairobi Stock Exchange Equity Market Segments

1: MAIN INVESTMENT MARKET SEGMENT

Agricultural

Unilever Tea Kenya Ltd Ord 10.00
Kakuzi Ord.5.00
Rea Vipingo Plantations Ltd Ord 5.00
Sasini Tea & Coffee Ltd Ord 5.00

Commercial and Services

Car & General (K) Ltd Ord 5.00
CMC Holdings Ltd Ord 5.00
Hutchings Biemer Ltd Ord 5.00
Kenya Airways Ltd Ord 5.00
Marshalls (E.A.) Ltd Ord 5.00
Nation Media Group Ord. 5.00
TPS Ltd Ord 5.00 (Serena)
Uchumi Supermarket Ltd Ord 5.00

Finance and Investment

Barclays Bank Ltd Ord 10.00
C.F.C Bank Ltd ord.5.00
Diamond Trust Bank Kenya Ltd
Housing Finance Co Ltd Ord 5.00
I.C.D.C Investments Co Ltd Ord 5.00
Jubilee Insurance Co. Ltd Ord 5.00
National Bank of Kenya Ltd Ord 5.00
NIC Bank Ltd 0rd 5.00
Pan Africa Insurance Holdings Ltd
Standard Chartered Bank Ltd

Source: NSE

Industrial and Allied

Athi River Mining Ord 5.00
B.O.C Kenya Ltd Ord 5.00
Bamburi Cement Ltd Ord 5.00
British American Tobacco Ltd
Carbacid Investments Ltd Ord 5.00
Crown Berger Ltd 0rd 5.00
Olympia Capital Holdings
E.A.Cables Ltd Ord 5.00
E.A.Portland Cement Ltd Ord 5.00
East African Breweries Ltd Ord 10.00
Firestone East Africa Ltd Ord 5.00
Kenya Oil Co. Ltd Ord 0.50
Mumias Sugar Co. Ltd Ord 2.00
Kenya Power & Lighting Company Ltd Ord 20.00
Total Kenya Ltd Ord 5.00
Unga Group Ltd Ord 5.00

2: ALTERNATIVE INVESTMENT MARKET SEGMENT

A.Baumann & Co.Ltd Ord 5.00
City Trust Ltd Ord 5.00
Eaagads Ltd Ord 1.25
Express Kenya Ltd
Williamson Tea Kenya Ltd Ord 5.00
Kapchorua Tea Co. Ltd Ord 5.00
Limuru Tea Co Ltd Ord 5.00
Standard Group Ltd Ord 5.00

APPENDIX V

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Table A-5: Questionnaire Results

SUBJECT						
	Stocks	**5-10**	**11-15**	**16-20**	**21.25**	**Over 25**
a) Viable Portfolio		3	2	1	1	1
	Kshs	**100,000-500,000**	**500,000-1,000,000**	**>1,000,000**	**>5,000,000**	
b) Minimum Investment Amount		2	3	2	1	
		Active stocks	**Large capitalization**	**Blue chips**	**Gaining Stocks**	**Losing Stocks**
c) Investment Characteristic sought		1	1	5	4	0
		Financial Model	**Fundamental Analysis**	**Technical Analysis**	**Trend Analysis**	**Intuition**
c) Financial Tools Application	Always	2	4	3	2	0
	Frequently	3	4	4	3	0
	Seldom	1	0	1	3	0
	Never	0	0	0	0	0
		Used	**Combined with others**		**Not used**	
d) CAPM Application		3	4		4	
		Used	**Combined with others**		**Not used**	
e) APT Application		2	1		4	
		Alive		**Dead**		**Not Sure**
f) Opinion as to whether beta is Dead or Alive		4		3		1
		Price Appreciation	**Liquidity**	**Financial Statement Analysis Company Specific**		
g) Other Criteria applied in stock selection		4	3	5		
Total Respondents	**8**		**32%**			
Total surveyed	**25**					

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APPENDIX VI

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Table A-6: Portfolio Cross-Sectional Regression Statistics

Regression Statistics	
Multiple R	0.11898
R Square	0.01416
Adjusted R Square	-0.31446
Standard Error	0.43476
Durbin-Watson	1.07329
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.00814	0.00814	0.04308	0.84887
Residual	3	0.56706	0.18902		
Total	4	0.57520			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.97188	0.55604	1.74785	0.17881
Average Returns	0.00785	0.03780	0.20755	0.84887
		t Critical two-tail	= 3.18245	

Lower 95%	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
-0.79770	2.74145	-0.79770	2.74145
-0.11245	0.12814	-0.11245	0.12814
	P (T<=t) two-tail	0.02083	

RESIDUAL OUTPUT

Observation	Predicted Beta	Residuals
1	1.1355281	0.194471
2	1.1035198	0.26648
3	1.0611784	-0.401783
4	1.0836715	-0.413672
5	1.0154971	0.354503

APPENDIX VII

Table A-7: Portfolio Pre-Ranking by Beta (Largest Beta Stocks – Smallest Beta Stocks)

Portfolio 1		Portfolio 2		Portfolio 3	
Security	**Beta**	**Security**	**Beta**	**Security**	**Beta**
ICDC	1.81	FIRESTONE	1.09	BPC	0.75
UNGA	1.40	SASINI	1.01	NIC	0.74
SNG	1.35	BBK	0.97	KENAIR	0.73
CMC	1.34	KCB	0.91	KAKUZI	0.72
SCBK	1.21	UCHUMI	0.88	BAT	0.68
EAPORT	1.16	CFC	0.82	TOTAL	0.65

Portfolio 4		Portfolio 5	
Security	**Beta**	**Security**	**Beta**
KENOL	0.64	BOC	0.46
NBK	0.60	NMG	0.40
CARBACID	0.59	BBOND	0.35
JUBILEE	0.54	EABL	0.33
DTK	0.53	KPLC	0.20
REAVIP	0.48	DUNLOP	-1.71

APPENDIX VIII

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Table A-8: Post - Ranking by Beta (Smallest – Largest Beta) Portfolio

Post-Ranking Beta

Portfolio 1		Portfolio 2		Portfolio 3	
Security	**Beta**	**Security**	**Beta**	**Security**	**Beta**
DUNLOP	0.91	REAVIP	1.08	TOTAL	0.36
KPLC	0.79	DTK	1.07	BAT	-0.06
EABL	3.18	JUBILEE	1.21	KAKUZI	0.61
BBOND	0.03	CARBACID	1.75	KENAIR	0.52
NMG	1.48	NBK	1.14	NIC	1.15
BOC	1.56	KENOL	1.95	BAMBURI	1.37
PORTFOLIO BETA	**1.33**		**1.37**		**0.66**

Portfolio 4		Portfolio 5	
Security	**Beta**	**Security**	**Beta**
CFC	0.67	EAPORT	1.01
UCHUMI	-0.23	SCBK	2.04
KCB	1.38	CMC	1.32
BARCLAYS	1.48	SNG	1.64
SASINI	-0.13	UNGA	1.30
FIRESTONE	0.86	ICDC	0.87
PORTFOLIO BETA	**0.67**		**1.37**

PORTFOLIO SUMMARY

PORTFOLIO	BETA	AVERAGE RETURN
1	1.33	20.86
2	1.37	16.78
3	0.66	11.46
4	0.67	14.25
5	1.37	5.56

APPENDIX IX

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Table A-9: Portfolio Augmented Dickey fuller Tests

Portfolio	Intercept	Slope	P-value	DW
1	-0.353179*	-0.537198	0.0204	1.57911
	(-2.38765)	(-3.17105)	0.0025	
2	-0.171973*	-0.21471*	0.0551	2.1978
	(-1.959825)	(-1.0067145)	0.1003	
3	-0.495560	-0.210794*	0.0013	1.9991
	(-3.3814)	(-1.646670)	0.1053	
4	-0.357056*	-0.40053	0.0121	1.96339
	(-2.59565)	(-3.2199)	0.0022	
5	-0.28719*	-0.17871*	0.0190	2.1189
	(-2.4177)	(-1.319479)	0.1925	
Market Series	-0.161107*	-0.292114*	0.0963	2.071223
	(-1.69201)	(-0.211357)	0.0391	

Notes: - * the t-tests values in parenthesis are significant at the critical value of t-tests at 5% level of significance which is -2.9118

- DW tests for the null hypothesis of no serial correlation is around 2

APPENDIX X

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Proof of the CAPM

If we invest w in i and $(1-w)$ in the market portfolio M, the expected return and standard deviation (risk) are:

$$E(R_p) = w\,E(R_i) + (1-w)E(R_M)$$

$$\sigma_P = \sqrt{w^2\sigma^2 + (1-w)^2\,\sigma^2_m + 2w\,(1-w)\,\sigma_{im}}$$

A minimum variance frontier, shown by plotting expected return against risk (variance), has its slope at any point given by:

$$\frac{\partial E(R_p)}{\partial \sigma_P} = \frac{\partial E(R_p) / \partial w}{\partial \sigma_P / \partial w}$$

Where

$$\frac{\partial E(R_p)}{\partial w} = E(R_i) - E(R_m)$$

$$\frac{\partial \sigma_P}{\partial w} = \frac{1}{2\,\sigma_P}\,[2w\,\sigma^2) - 2(1-w)\,\sigma^2_m + 2\,\sigma_{im}\,(1-2w)]$$

For $w = 0$, both must have the same slope,

$$\frac{E(R\,M) - R_f}{\sigma_m}$$

Therefore

$$\left.\frac{\partial E(R_p)}{\partial \sigma_P}\right|_{W=0} = \frac{E(R_i) - E(R_m)}{\sigma_{im} - \sigma^2_m} = \frac{E(R\,M) - R_f}{\sigma_m}$$

And

$$E(R_i) - E(R_m) = \left(\frac{\sigma_{im}}{\sigma^2_m} - 1\right)[E(R\,M) - R_f]$$

But $\beta = \frac{\sigma_{im}}{\sigma^2_m}$,

Thus

$$E(R_i) - R_f = \beta[E(R\,M) - R_f]$$

$$E(R_i) = R_f + \beta[E(R\,M) - R_f]$$

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APPENDIX XI

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QUESTIONNAIRE TO PORTFOLIO INVESTMENT MANAGERS

Name of Institution: _____

Years in Business: _____

1. How many stocks constitute a viable portfolio according to your institutional policies, and what is its minimum value? Please TICK one box in each section.

☐	At least 5 stocks	☐	Upto Kshs 100,000
☐	5 – 10 stocks	☐	Kshs 100,001 – 500,000
☐	11 -15 stocks	☐	Kshs 500,000 – 1,000,000
☐	16 – 20 stocks	☐	Kshs 1,000,001 - 5,000,000
☐	21 – 25 stocks	☐	Kshs5,000,001 – 10,000,000
☐	26 – 30 stocks	☐	Over Kshs 10,000, 000

2. Which is the most important characteristic necessary in the inclusion of a share in the portfolio?

☐ Active stocks only

☐ Large capitalization stocks only

☐ Blue chip stocks only

☐ Gaining stocks

☐ Losing stocks

☐ Others (Please specify) _____

_____

_____

3. Which of the following financial tool (s) do you use in rating stocks for inclusion in the portfolio and how often? [If financial models are used, proceed to the next question. Otherwise, answer question no. 8]

	Always	Frequently	Seldom	Never
☐ Financial Models				
☐ Fundamental analysis				
☐ Technical analysis				
☐ Trend analysis				
☐ Intuition				
☐ Others: _____ _____ _____				

4. If you use financial models as a tool of analysis, how applicable is CAPM (Capital Asset Pricing Model) to portfolio selection?

5. If you use financial models as a tool of analysis, which of these asset pricing models do you use in rating stocks? Give reasons.

   a) CAPM (Capital Asset Pricing Model)

   b) APT (Arbitrage Pricing Model)

6. According to you, is beta dead or alive? Why?

_____

_____

_____

7. Other than CAPM, which other asset pricing models do you use to rate the risks of stocks selected? Give Reasons.

a) _____

_____

_____

b) _____

_____

_____

c) _____

_____

_____

8. If no financial models are used, which other models do you apply in rating stocks to include in the portfolio?

a) _____

_____

_____

b)

_____

_____

_____

c)

_____

_____

_____

Thank you for taking your time to answer all the questions to the best of your ability. Your assistance is highly appreciated.

APPENDIX XII

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LETTER OF INTRODUCTION - QUESTIONNAIRE

I am currently a graduate student at Kenyatta University, studying for the degree of Masters of Science (Finance).

I am conducting a survey for my study entitled "An Application of Capital Asset Pricing Model in Asset Pricing on the Nairobi Stock Exchange, Kenya" as partial fulfillment of completion of my degree program.

Your participation in this exercise will be highly appreciated as an essential part of the study and hence the request for your assistance in filling out this questionnaire. It is my assurance that any information provided will be highly regarded, treated with confidentiality and for academic purposes only. The information so attained will give insights as to how investment managers value the stocks included in their portfolio and thus give insights as to how applicable CAPM has been in asset pricing on the Nairobi Stock Exchange. Further, a copy of the results so attained will be forwarded to you.

Sincerely,

Leah W. Nyambura.

Graduate Student - KU

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