

THE EFFECTS OF FIRM CHARACTERISTICS ON SYSTEMATIC RISK OF FIRMS QUOTED AT THE NAIROBI STOCK EXCHANGE: AN EMPIRICAL STUDY

This management research project is my original work and has not been
presented for a degree in any other University.

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This research project has been submitted for examination with my approval
as the University Supervisor.

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A MANAGEMENT RESEARCH PROJECT SUBMITTED IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION AT UNIVERSITY OF
NAIROBI, FACULTY OF COMMERCE

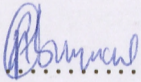
NOVEMBER 2003

DECLARATION

This study is dedicated to my parents:

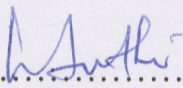
This management research project is my original work and has not been presented for a degree in any other University.

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DEDICATION

This study is dedicated to my parents: *successful without support of others to whom I express gratitude.*

Mrs. Rispa M. Weyenga *go to my supervisor Mr. Otieno Odhiambo Luther for his untiring patience and guidance throughout the research*

Mr. William Weyenga *to my lecturers at the faculty of commerce for their rigorous teaching and guidance during both my undergraduate and graduate studies at the University.*

My friends, colleagues at the Kenya Revenue Authority, library staff at both Main campus and Lower Kabete campus and fellow students have also contributed to my success. I thank them for their encouragement, challenges and the sharing of knowledge.

I sincerely thank my family for their patience and understanding throughout this very involving period.

Finally, and most importantly, I thank the almighty God, for his provision of strength and ability to perform during this trying period.

ACKNOWLEDGMENT

This study would not have been successful without support of others to whom I express gratitude.

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ABSTRACT

The business environment, in which firms operate, is characterized by scarcity of resources and numerous uncertainties and as such, investors need to factor in the element of risk in business decisions. In financial theory, it is predicted that the higher the risk of an investment, the higher the expected return demanded by an investor. The capital asset pricing model leads to the conclusion that there are two types of risk in the economy: systematic and unsystematic risk. In efficient markets unsystematic risk (the assets risk that can be diversified away) should not be important to the investor. The systematic risk is measured by the beta coefficient.

A central role of financial information is to alter investors' belief about the assets return and risk. For a fully diversified investor, information about unsystematic risk will be of little value; but will need asset information useful in altering assessment of market risk (beta). This is because for a fully diversified portfolio the problem of risk reduces to choosing portfolio level for beta.

This paper investigates the determinants of the beta coefficient of firm's stock returns through analysis of the firms underlying characteristics. We examine those firm characteristics that have an impact on the individual firm's stock movements in relation to the market. In this study, the influence of a firm's financial leverage, operating leverage, size, profitability, dividend payout ratio, business risk, liquidity and growth on beta are examined. The study aims to establish whether there is a relationship between certain firm characteristics and systematic risk.

The research findings are mixed with the relationship between firm characteristics and systematic risk being found to be relatively weak when betas are derived from unweighted returns are regressed against the firm characteristics. There is however a significant relationship between firms financial characteristics and systematic risk when betas derived from the weighted returns are used. Using five-year predictor variables, growth, liquidity and size are found to be statistically significant. The relationship is stronger when three year average independent variables are used with profitability, growth, dividend payout ratio and firm size being significant. This indicates that these firm characteristics can be useful in the prediction of systematic risk of firms.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 General Background

In today's business environment characterized by scarcity of resources and numerous uncertainties, investors need to factor in the element of risk in decision making. Whereas it is agreed on the importance of risk in investment decisions there is controversy as to what constitutes risk and how it should be measured. It is predicted that the higher the risk of an investment, the higher the expected return demanded by an investor. The capital asset pricing model developed by Sharpe (1964) leads to the conclusion that there are two types of risk in the economy: systematic and unsystematic risk. In efficient markets unsystematic risk (the assets risk that can be diversified away) should not be important to the investor.

An efficient market is defined as one in which every security's price equals its investment value at all times- Sharpe, Alexander and Bailey (1999). In an efficient market a set of information is fully and immediately reflected in market prices. Eugene Fama (1970) identified three forms of information efficiency. These are the weak form, semi-strong form and the strong form of market efficiency. The weak form efficient market hypothesis holds that information contained in the historical prices is fully reflected in the current prices. The semi strong form of market efficiency holds that publicly available information is fully reflected in the current stock prices. The strong form of efficient market holds that both publicly and privately held information is fully reflected in the security prices. The term efficiency refers to the speed at which privately held information becomes public. The speed may not be fast enough and as a consequence there will be gap between the level of information between the investor and the firm for instance giving rise to gaps or information asymmetry. When one refers to efficient capital markets, they mean that the securities prices fully reflect all available information. According to Elton and Gruber (1995), this is a strong hypothesis and they posit that a necessary condition for investors to have incentive to trade until the prices reflect all the information, is that the cost of information acquisition is zero. Since the prices are positive, a realistic definition is that prices reflect information until

the marginal costs of obtaining the information and trading no longer exceed the marginal benefit.

In an efficient market, an investor should not require a higher expected return for bearing unsystematic risk. Systematic risk cannot be diversified away. For securities like shares it arises from a correlation between returns from the investment (an individual share) and returns from the stock market as a whole. Since the investor cannot avoid systematic risk, he or she expects to be adequately compensated for it. Rationally, an investor requires a higher expected return than the risk free interest rate for bearing positive amounts of systematic risk. The interpretation is that at portfolio level the unsystematic risk can be diversified away and that only systematic risk will persist at portfolio level. According to the market model, the total risk of any security i , measured by variance and denoted σ_i^2 consists of systematic risk and unique risk. The variance of the security can be expressed as follows;

$$\sigma_i^2 = \beta_{iI}^2 \sigma_I^2 + \sigma_{ie}^2 \dots\dots\dots(1)$$

Where:

σ_I^2 denotes the variance of returns on the market index,

$\beta_{iI}^2 \sigma_I^2$ is the market risk of the security i and

σ_{ie}^2 is the unique risk of the security i

For a portfolio of securities, Sharpe has shown that the total portfolio variance can be expressed by the following equation;

$$\sigma_p^2 = \beta_{pI}^2 \sigma_{pI}^2 + \sigma_{ep}^2 \dots\dots\dots(2)$$

Where:

$$\beta_{pI}^2 = \left[\sum_{i=1}^n X_i \beta_i \right]^2$$

$$\sigma_p^2 = \sum_{i=1}^n X_i^2 \sigma_{ci}^2$$

The random error components of the security returns are assumed to be uncorrelated. As the number of securities in the portfolio increases the systematic risk does not change significantly. However unique risk is substantially reduced.

The potential effects of diversification are powerful and permit investor to potentially minimize his or her exposure to investment risk. An understanding of systematic risk is therefore critical to sound financial and investment decisions. To facilitate this understanding the investor requires information. The assumption is that investors need information useful in selecting the assets to invest. It is such information that enable investors attach prices to assets or form expectations; and from the prices, we derive return and risk of an asset. It is therefore a reasonable supposition that betas are revised on the basis of new information, specifically that there are variables in financial statements that are useful in explaining variations in beta coefficients.

There have been various studies on the relationship between risk and return of securities listed on various securities exchange notably in the developed markets. There have been studies on the New York Stock Exchange and these include; Sharpe and Cooper (1972) who found a positive relationship between return and risk, although it was not completely linear. Black, Jensen, and Scholes (1972), found a positive relationship between monthly excess return and portfolio beta although the intercept was higher than the zero value expected. Fama and MacBeth (1973) demonstrated empirically that the relationship between expected return and beta was linear. Such studies include those that focused on the statistical properties of one measure of risk that has had wider acceptance in the academic community Blume (1971). Most of these studies rely on two measures of risk, namely the standard deviation and beta coefficient. Standard deviation is a measure of total risk and beta is the measure of systematic risk.

In Kenya, Sawaya (2000) undertook a study about market risk on firms quoted on the Nairobi Stock Exchange. He found that some firms had significant beta coefficient implying that it was an important element in determination of the stock return movements in the NSE. Other studies at the NSE include Gitari (1990), Muli (1991), Wambugu (1992), Munywoki (1998) and Ndegwa (2001).

Whereas previous studies have underscored the importance of the beta coefficient, they did not seek to explain why some of the firms had

significant beta coefficient and why beta varies from one company to another. That set of studies does not explain where the beta comes from i.e. which parameters drive beta. A central role of financial information is to alter investors' belief about the assets return and risk. For a fully diversified investor, information about unsystematic risk will be of little value; but will need asset information useful in altering assessment of market risk (beta). This is because for a fully diversified portfolio the problem of risk reduces to choosing portfolio level for beta.

This paper investigates the determinants of the beta coefficient of firm's stock returns through analysis of the firms underlying characteristics. We examine those firm characteristics that have an impact on the individual firm's stock movements in relation to the market. In this study, the influence of a firm's financial leverage, operating leverage and size, profitability, dividend payout ratio, business risk, liquidity and growth on beta are examined.

1.1.1 Rationale of beta as a measure of risk

Beta as a measure of risk has its background in Markowitz (1959) mean variance portfolio theory. One period mean - variance portfolio theory assumes the investor relies only on two parameters when choosing the portfolio, namely the expected one period return and the variance of that return. Beta is assumed to reflect the proportion of an assets return that is linearly related to the return on market portfolio:

$$R_i = \alpha_i + \beta_i R_m + \varepsilon_i \dots \dots \dots (3)$$

Where:

R_m = return on the market

R_i = return on the i th security

β_i = the beta coefficient of the i th security

α_i = intercept of the i th security

ε_i = random error term

$\alpha_i + \beta_i R_m$ = systematic portion of returns

The interpretation of beta coefficient as a measure of risk rests upon the empirical validity of the market model. The model asserts that the return on an asset is a linear function of the market factor common to all assets and independent factors unique to the asset, Blume (1971).

The validity of the market model has been extensively examined in the finance literature especially on the developed securities markets. The principal conclusions arising from studies on the New York stock Exchange are: the linearity assumption is adequate; the variables ε_i cannot be assumed to be independent between securities because of existence of industry effects. However, industry effects account for only 10% of the variations and can be ignored, King (1966). The unique factors ε_i correspond more closely to non-normal stable variates than to normal ones. This means that the variances and covariances of the unique factors do not exist. Nonetheless Blume (1971) made an assumption of the existence of this statistic in justifying the beta coefficient as a measure of risk. Fama and Jensen (1969) had shown that the beta coefficient can still be interpreted as a measure of risk under the assumption that the ε_{is} are non-normal variates.

The beta coefficient can be interpreted and justified as a measure of risk from two different perspectives; the portfolio approach and the equilibrium approach.

Portfolio approach

Most ideas on portfolio theory date back to an article written by Harry Markowitz in 1952. He showed how an investor could reduce standard deviation of portfolio returns by choosing stocks whose returns do not exactly move together. The single most important development in investment theory was Harry Markowitz insight that because investors are concerned with the return on their entire portfolio of assets, the risk of any individual project or security is relevant only in so far it contributes to the risk of that portfolio. The contribution of stocks to portfolio risk depends on the stock return sensitivity to changes in the value of the market portfolio. Markowitz model provided the foundation for the modern portfolio management. This is what Sharpe (1963) exploited to develop a simple model for risk analysis, the market model.

Sharpe (1963) formulation overcomes the practical problems associated with the Markowitz technique, namely the substantial data requirements and computational load.

Equilibrium approach

Using the market model, Sharpe (1964) and Lintner (1965), clarified by Fama (1968), developed a theory of equilibrium in the capital markets, the Capital Asset Pricing Model (CAPM). This theory or the model relates the risk premium of an individual security to the risk premium of the market by the following equation.

$$E(R_i) - R_f = B_i (E(R_m) - R_f) \dots\dots\dots (4)$$

CAPM posit that the risk premium for an individual security is proportional to the risk premium for the market. The coefficient of proportionality can be interpreted as a measure for risk for the individual securities. The theory of equilibrium though theoretically sound is based on numerous assumptions, which obviously do not hold in the real world. However, as Milton Friedman recipient of the 1976 Nobel Prize in economics remarks:

"The relevant questions to ask about the assumptions of a theory is not whether they are descriptively realistic, for they are never, but whether they are sufficiently good approximations for the purpose in hand. And this question can only be answered by seeing whether the theory works, which means it yields sufficiently accurate predictions".

The empirical work of Friend and Blume (1970) suggest that prediction of this model is seriously biased and that this is attributable to the inaccuracy of one key assumption in relation to the borrowing and lending at the same rates for all investors. On this basis the Sharpe and Lintner's theory of equilibrium is viewed as weaker and less robust in comparison with the portfolio approach.

In the financial world beta have two main uses. It can be used by investment analyst to design portfolios to match the risk preferences of their clients, that is choose high beta assets for those class of investors who prefer high return/high risk. Secondly, financial managers use beta to estimate the equity cost of capital that is a useful input in investment appraisal. The cited advantage of using CAPM over other methods of

estimating the cost of equity is that it enables the finance manager to calculate a cost which reflects investors perception of the riskiness of a company's shares.

The values of beta may change from one period to the next. In which case to enable finance managers to make necessary adjustments it becomes necessary to identify variables that cause changes in the beta coefficients. The changes in beta coefficients may arise from the estimation errors and/or from the firm's changing risk profile because of changing or entering new industries or by changing the level of gearing.

Degree of operating leverage

1.1.2 Determinants of the Equity Beta coefficient

A company's beta depicts the sensitivity of the aggregate value of the firm to the changes in the value of the market portfolio. But the aggregate value of the firm depends on both the demand for a company's products, its operating process and resulting operating costs. Financing the operations of the firm using debt introduces financial risk. In summary, the aggregate value of the company depends on the business that it is in and how it is financed. The returns that accrue to the equity investors depend on the beta of the firm and financial leverage. In finance literature variables suggested as having useful influence on beta include, the type of business the firm is in (Sharpe, Alexander and Bailey(1999), Myers and Brealey (1993), Levy and Sarnat(1994)), the degree of operating leverage (Levy and Sarnat(1994)), and the firm's financial leverage (Sharpe, Alexander and Bailey(1999), Levy and Sarnat (1994)). Other variables that have been suggested to influence beta are , firm size, profitability, dividend payout ratio, business risk, liquidity and growth.

Type of business of the firm

Since betas measure the risk of a firm relative to the market index, the more sensitive a business is to the market condition, the higher is its beta. Thus, every thing else remaining constant, cyclical firms can be expected to have higher betas than non-cyclical firms. For instance companies involved in housing and automobiles, two sectors of the economy that are very sensitive to the economic conditions, should have higher betas than companies in the food processing, tobacco and utilities sectors, which are relatively insensitive to the business cycles.

smaller betas. Elton and Gruber (1995)

It can be argued that the degree to which a product is discretionary will affect the beta of the firm manufacturing the product. Thus betas for food processing firms or utility companies should be lower than betas for the specialty retailers since the consumers can defer purchase of the latter firms products during bad economic times.

It should be noted that a cyclical firm has revenues and operating income that tend to move strongly with the economy – up when the economy is doing well and down during recession.

Degree of operating leverage

The degree of operating leverage is a function of the cost structure of a firm and is usually defined in terms of relationship between fixed costs and total costs. A firm with a high operating leverage will have a higher variability in EBIT than a firm producing similar products with low operating leverage. Other things remaining the same the higher variance in operating income will lead to a higher beta for a firm with a higher degree of operating leverage.

The scenario has a consequence for major strategic decisions of the firm i.e. in determination of its long-term (future) direction. Investment in plant and the state of the art technology would bring hidden costs and therefore reduce the flexibility of the firm to respond to economic downturns, and thus it may become more risky.

The firm's financial leverage

Other things remaining the same, an increase in financial leverage will increase the equity beta of a firm. Financial leverage multiplies the underlying business risk. It therefore stands to reason that firms with a higher business risk will be reluctant to take on financial leverage. Also firms that operate in relatively stable business should be more willing to take financial leverage for instance the utilities.

Firm size

The size of the firm is another variable that can influence a firm's risk. Large firms are presumed to be less risky compared to smaller firms due to ease of accessibility to capital markets and therefore should have smaller betas. Elton and Gruber (1995)

Dividend payout ratio

Dividend payout is viewed as being negatively correlated to systematic risk as measured by beta under one of two arguments. First since management is more reluctant to cut dividends than raise them, high payout ratio is indicative of confidence on part of the management concerning the level of future earnings. Secondly dividend payments are less risky than capital gains; hence the company that pays out more of its earnings in dividends is less risky. Elton and Gruber (1995).

1.2 Statement of the problem

A key notion in finance is that the goal of the firm is to maximize value and as such firms structure their resources to achieve this goal. Duett, Merikas and Tsiritakis (1996). The study and understanding of risk is of paramount importance in determining the value the firm or an enterprise. In finance literature it is normal to address risk from the perspective of portfolio that is concentrate only on market risk, Markowitz (1952), Sharpe (1963), Lintner (1965).

In developed countries beta is widely researched and used. There are firms both in the USA and UK that provide betas in a regular basis. In the US, Merrill Lynch, Pierce, Fenner and Smith, Inc., provide such a service - *Security Risk Evaluation*. In UK London Business School provides risk measures through its *Risk Measurement Service Publication*. In Kenya, Maroko Investments Advisory services have published betas of companies listed in Nairobi Stock Exchange (NSE) in *Investors HandBook on Nairobi Stock Exchange*. Sawaya (2000) computed betas for companies listed at the NSE and found several of them significant.

Most of these firms that publish beta use past price changes to form estimates. Some use weekly data for two years while others use monthly data for five years. The question as raised by Brealey and Myers (1993) is: "What should we do if our asset (share) has no such convenient price record? Our advice is to search for characteristics of the asset (share) that are associated with high or low betas". This study therefore seeks to establish the determinants of equity risk for firms listed at Nairobi Stock Exchange.

Portfolio theory shows that the relevant risk is the systematic or market risk since investors are able to diversify away the unsystematic risk. It is the market risk that will be investigated in this study.

Nonetheless there are individual firm characteristics which impact on the systematic risk of the individual firm as measured by the beta coefficient. The establishment of the existence of a relationship between the specific firm characteristics and systematic risk should be valuable to both the practitioner and the academician.

The economic survey carried out in Kenya in year 2002 has indicated that the state of the economy is depressed a trend that has been attributed to reduced production capacity and lower corporate earnings. This scenario implies that investors have to be well informed prior to making investments. An understanding of the firm characteristics that have an impact on the market risk should therefore be valuable to the investor either at the individual or institutional level. Therefore the research seeks to examine the determinants of beta coefficient of firm's common stock through analysis of the underlying firm characteristics.

1.3 Objectives of the study

The study is conducted with the aim of establishing whether there is a relationship between certain firm characteristics and systematic risk. The focus will be on firms exhibiting significant beta coefficients at the NSE.

We specifically seek to determine the relationship between the individual firm's financial characteristics and systematic risk for the companies listed on NSE.

1.4 An overview of the study

The study constitutes of five chapters. The first chapter is the introduction and covers the background, statement of the problem and objectives of the study. The second chapter constitutes the literature review and covers the risk concepts and literature considered relevant for the study. The third chapter covers the research design, population, data collection and analysis. The fourth chapter covers the research findings. The fifth chapter covers the conclusion and recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical background

2.1.1 Definition of risk

According to Myers and Brealey (1993), one way of defining risk is to say more things may happen than will happen. In terms of investment in securities, risk can be thought of as the possibility that the actual return of holding the security will deviate from the expected return, Van Horne (2000). The greater the magnitude of the deviation from the expectation and the probability of its occurrence the greater the risk of the security.

2.1.2 Measures of Risk

There are various types of measures of risk depending on whether we are dealing with an individual security or portfolio of securities.

Individual security

For an individual security the expected return E(R) can be expressed by the following equation;

$$E(R) = \sum_{i=1}^n R_i \cdot P_i \dots\dots\dots(5)$$

where

R_i is the return for the ith possibility

P_i is the probability of concurrence of that return

n is the total number of possibilities

The standard deviation, which is the square root of the squared deviations from the expected return, is given by the expression below;

$$\sigma = \left(\sum_{i=1}^n [(R_i - E(R_i))^2 \cdot P_i] \right)^{1/2} \dots\dots\dots (6)$$

$$\text{Cov } R_i R_j = \text{cor } R_i R_j \cdot \sigma_i \sigma_j \dots\dots\dots (10)$$

Portfolio of two securities

In case of a portfolio of two securities the portfolio return is given by the following expression;

$$E(R_p) = wE(R_x) + (1-w) E(R_y) \dots\dots\dots (7)$$

Where; w is the proportion of investment in asset x and the balance (1-w) is the proportion invested in asset y.

The portfolio variance is given by the expression below;

$$\sigma_p^2 = w^2 \sigma_x^2 + (1-w)^2 \sigma_y^2 + 2w(1-w)\text{Cov } R_x R_y \dots\dots\dots (8)$$

Where

$$\text{Cov } R_x R_y = \sum_{i=1}^n (R_x - E(R_x))(R_y - E(R_y)) \cdot P_i$$

A portfolio of several securities

The standard deviation cannot be computed by taking a weighted average of the standard deviations of the assets in the portfolio. In a portfolio comprising several assets, the standard deviation of the possible portfolio returns is given by the equation below:

$$\sigma_p = \left(\sum_{i=1}^m \sum_{j=1}^m W_i W_j \sigma_{ij} \right)^{1/2} \dots\dots\dots (9)$$

Where;

m is the total number of securities in the portfolio

W_i is the proportion of funds invested in security i

W_j is the proportion of funds invested in security j

σ_{ij} is the covariance between possible returns for security i and j

Note that covariance can also be expressed as below:

$$\text{Cov } R_i R_j = \text{cor } R_i R_j \cdot \sigma_i \sigma_j \dots\dots\dots(10) \quad (12)$$

Where;

$\text{Cor } R_i R_j$ is the expected correlation between the returns of securities i and j and;

σ_i and σ_j are the standard deviations of security i and j respectively.

Due to the large number of variance and covariance terms involved in the computation of portfolio standard deviation the above formula suffers an operational disadvantage.

Measuring market (systematic) risk

The risk of a well diversified portfolio of securities is measured by the covariance of the individual asset returns with those of the market portfolio. The covariance is a non-standardized measure of systematic risk that does not give an indication as to how the systematic risk of one asset compares with others in the market. The covariance, as a measure of systematic risk, can be normalized by dividing it by the market portfolio variance, Damodaran (1999), Reilly (1979). This yields a measure of systematic risk referred to as beta (β).

The systematic risk, beta, can be expressed by the following equation

$$\beta_i = \text{Cov } (R_i ,R_m) / \sigma_m^2 \dots\dots\dots(11) .$$

Given that the covariance of the market portfolio against itself is variance then the beta of the market portfolio is 1(one). A beta of 1 indicates that the asset returns move exactly the same way with the market. A beta of greater than one indicates that the assets return move more than the market while that less than 1 indicates that movements of the asset returns is less than that of the market.

Due to the large number of variance and covariance terms involved in the computation of portfolio standard deviation the above formula suffers an operational disadvantage. This calls for another method or model of measuring systematic risk. Sharpe (1963) introduced the market model, which is expressed in the format below;

$$R_i = a + B_i R_m + E_i \dots\dots\dots(12)$$

Where; B_i is the beta of the i th security and E_i is the random error term.

Thus from the model beta of a firm can be computed by regressing a firm's security returns against those of the market portfolio for a given number of observations.

2.1.3 Types of Risks

Unsystematic risk versus Systematic risk

Sharpe (1981) decomposes the risk of a risky asset into four components: specific risk, industry risk, common factor risk and market related risk. The first three are related to specific security and general characteristics of industry from which the firm is drawn. Sharpe (1981) refers to this risk element as constituting non-market risk element of a security.

Broadly, risk of a firm can be decomposed into two general categories: Firm specific or unique risk and systematic risk. Firm specific risk is that type of risk that is unique or specific to a given firm. Firm specific risk, stems from differences in management skills, technological changes, asset mixes e.t.c. This type of risk is also referred to as unsystematic risk or diversifiable risk. The unsystematic risk, according to traditional portfolio theory, can be largely eliminated through diversification and hence the terminology diversifiable risk. However, there is a dimension of risk that cannot be diversified away and this is referred to as systematic risk. This type of risk is also referred to as market risk or undiversifiable risk.

In a portfolio of securities, as the number of assets is increased the unsystematic risk element reduces. Systematic risk can be viewed as the minimum level of risk that can be obtained by means of diversification across a large number of randomly chosen assets. In a well-diversified

portfolio of securities the systematic risk is the relevant risk. This is in line with the contention by Myers and Brealey that the risk of a well-diversified portfolio depends on the market risk of the securities in the portfolio.

Since unsystematic risk can be reduced through diversification, investors will only be compensated for the systematic risk, which is determined, by economy-wide factors and not those unique to a company or a firm. A logical expectation is that the higher the levels of risk the higher the returns. This would be in line with the assumption that investors are rational.

Business risk versus financial risk

A firm's business risk is related to the industry to which it belongs and general condition of the economy. For instance business risk of public utilities is normally significantly less than that for manufacturing firms, Levy and Sarnat (1994). This reflects the tendency for fluctuations in demand for services of utilities such as telephone, electricity and water companies to be small relative to those experienced by industrial companies, the demand for whose products tend to be more unstable. This instability often reflects changes in fashion or real income of consumers or shifts in the level of competition. Even in the absence of debt the expectation would be to find a high variability in earnings per share (EPS) for industrial firms than for public utilities. Business risk is a function of the general economic conditions and is not related to the financial structure of the firm. Thus variability of a firm's net operating income (NOI), a firm's income before any interest payment is an appropriate measure of business risk.

The introduction of financial leverage (debt) intensifies the variability of EPS and this additional variance in earnings induced by financial leverage is the financial risk.

2.2. Systematic risk and accounting variables

Beta is a risk measure that arises from the relationship between the return on a stock and the return on the market. However the risk of a firm should be determined by some combination of firms fundamental and the market characteristics of the firms stocks. The determination of

this relationship should be helpful in the understanding of beta better and forecast of betas – Elton and Grubber (1995).

The study of individual firms risk as related to their underlying characteristics begins with seminal work by Beaver, Kettler, and Scholes (1970), which examined the relationship of certain accounting variables such as dividend payout ratio, (asset) growth, leverage, liquidity, size, earning variability and earnings beta to the firms systematic risk. The Beaver et al study was based on 307 firms for two periods 1947-1956 and 1957-1965 and they found a strong and significant association between the accounting variables and the firms systematic risk (beta). All the variables had the expected signs.

Earlier work by Fisher and Hall (1969) focused on individual firm's risk-return relationship through an empirical analysis of the mean and the higher moments of rate of return distribution. In a much earlier study Fisher (1959) demonstrated that a firms size and leverage were important risk determinants of corporate bonds.

Bildersee (1975) sampled 71 manufacturing and retail firms that had both common and non-convertible preferred stocks traded on the NYSE over the period 1956 – 1966. Correlations between the security return estimates of common stock beta and eleven (11) accounting variables were first examined on a univariate basis, then a multiple regression was run. Bildersee used a stepwise regression program to choose those accounting variables that contributed most to explaining variations in the dependent variable (common stock beta). The final regression reported by Bildersee (1975) contained the following six independent variables;

X_1	=	Debt to common equity ratio
X_2	=	Preferred equity to common equity ratio
X_3	=	Sales to common equity ratio
X_4	=	Current assets to current liabilities ratio
X_5	=	Standard deviation of earnings-to-price ratio
X_6	=	Accounting beta estimated from the model.

Market values were used for preferred and common equity measures (and for bonds where available); book values for all other variables were used.

Bildersee (1975) found that using univariate analysis the highest correlation coefficient was that of debt to equity ratio, which explained 13% for variations in the security return estimate of beta (common stock

beta). However in multiple regression with five other variables (Preferred equity to common equity ratio, Sales to common equity ratio, Current assets to current liabilities ratio, Standard deviation of earnings-to-price ratio and Accounting beta), 24% of the variations in the common stock beta were explained.

Barr Rosenberg (1973 and 1976) has proposed a system that combines both the historical beta and fundamental betas. By combining the techniques of historical betas and fundamental betas into one system Rosenberg hopes to gain advantages of each without being subject to disadvantage of either.

Rosenberg's fundamentally derived betas have been shown to be more accurate than historically derived estimates. Six risk indexes are based on current fundamental characteristics of each company and are measures for the following;

Market variability

Measures the impact of certain factors on relationship between the market variability of returns and security.

Earnings variability

Measures the variability of earnings: earnings variability contributes to risk.

Low valuation and 'unsuccess'.

Designed to measure the variability returns (risk) inherent in consistently low-market valuation stocks with dismal operating records.

Immaturity and smallness

Differentiates between the older and larger firms that have accumulated substantial fixed assets and have a more secure economic position and lower degree of risk and small, younger and riskier firms.

Growth orientation

Measures the risk associated with the so-called high-multiple (P/E) stocks.

Financial structure

Measures financial risk by incorporating leverage (long-term debt and equity as a percentage of book value), coverage of fixed charges, the

ratio of debt to total assets, liquidity and net monetary debt. In general the more highly leverage a financial structure, the greater the risk to common stock holders.

Rosenberg and McKibben (1973) found that there were persistent differences in betas of different industries. This led Rosenberg and Marathe (1975) to introduce a set of dummy variables into the analysis to capture the differences. Whereas the Rosenberg technique is conceptually easy to grasp, the many variables render it difficult to grasp the meaning of the parameterized model.

Whereas the model is too new for extensive testing to have been carried out, Rosenberg and Marathe initial testing indicates that the model involving both fundamental data and historical betas leads to better estimates of future betas than in either type of estimate in isolation. Other studies apart from Rosenbergs include; Melicher (1974) and Melicher and Rush (1974) Thompson (1978), Hochman (1983).

Bowman (1979) aimed to provide a theoretical basis for empirical research into the relationship between systematic risk and financial accounting variables. He demonstrated that there is a theoretical relationship between a firm's systematic risk and firm's leverage and accounting beta. However he did not find any direct theoretical relationship between systematic risk and earnings variability, dividends, size or growth of a firm. Bowman's study developed further on research by Hamada (1972) who had shown that systematic risk of a firm's common stock should positively be correlated with the firm's leverage. Hamada found that conditional on the validity of Modigliani and Miller's model, leverage accounts for a substantial portion of the systematic risk. Hamada's study was based on a sample of 304 firms listed on the New York Stock Exchange for the period 1948-1967.

Mandelker and Rhee (1984) further examined the relationship between systematic risk and financial leverage using a sample 255 manufacturing firms. They found a positive correlation between the portfolio betas and financial leverage. The high correlation is attributed to the use of portfolios, which reduces measurement errors. The theoretical models underlying the prediction that capital structure is a determinant of beta or variance assume that both debt and equity are measured using current market value. However most empirical tests of this prediction use book values for all debt due to difficulties in obtaining market value for all

classes of debt. Bowman (1980) collected (where available) market values for both debt and equity for a sample of 92 firms. He examined correlation between capital structure and systematic risk and found significant positive correlation for all measures of capital structure.

2.3 Beta as a Measure of Risk

Reilly and Brown (1999) contends that a theory should not be judged on the basis of its assumptions, but on how well it explains the relationships that exist in the real world. In testing a model such as CAPM two major questions of concern touch on the stability of beta as a measure of risk and on the relationship between risk (beta) and the rate of return on risky assets.

Stability of betas

Numerous studies have examined the stability of beta and reached similar conclusions. Levy (1971) examined weekly rates of return for 500 NYSE stocks and concluded that the risk measure was not stable for individual stocks over short period of time. However stability of beta for portfolio of stocks increased dramatically. He further showed that the larger the portfolio of stocks and the longer the period the more stable the beta of the portfolio. His tests also showed that betas tended to regress towards the mean. The high beta portfolio tends to decline over time towards unity (1), whereas low beta portfolios tended to increase over time towards unity. A study by Blume (1975) provided similar results. Tole (1980) also found that there was substantially greater stability in beta as the portfolio size increased.

Systematic risk and return relationship

The ultimate question regarding CAPM is whether it is useful in explaining the return on risky assets. The question posed would be whether there is a positive linear relationship between systematic risk as measure by beta and the rates of return. Sharpe and cooper (1972) found a positive relationship between return and risk, although it was not completely linear. They found that the returns increased with risk class except for the highest risk classes, where the returns leveled off and declined slightly.

Douglas (1969) examined the risk return relationship by analyzing a systematic risk variable and variance of return measure relative to return. The results indicated intercepts that were larger than the prevailing risk

free rates. Further although the co-efficient for total risk variable (variance) was generally significant, the co-efficients for the systematic risk variables were not significant.

Miller and Scholes (1972) noted that the Douglas results could be caused by errors in measurement of stock betas. They found that unsystematic risk and betas are highly correlated and the distribution of returns for the stocks was very skewed.

Black, Jensen and Scholes (1972) examined the risk and return for portfolios and found a positive linear relationship between monthly excess returns and portfolio beta. The study covered a long period of time from 1931 to 1965 divided into four sub-periods.

Fama and MacBeth (1973) extended the Black, Jensen and Scholes tests to include two additional factors, linearity in the risk-return relationship and the impact of residual variation (unsystematic risk). The result of the Fama and MacBeth tests show that while estimated values for these factors were not zero for each interval examined, their average values tend to be insignificantly different from zero. They demonstrated that the risk (beta) return relationship was linear. Their overall results supported CAPM.

Other studies

The concept of beta as a measure of systematic risk is widely used by both the academic and practitioners. Notwithstanding this usage, some researchers cast doubt on beta as a single risk factor to explain expected return on securities. Fama and French (1992,1996) reduce the importance of beta as the sole measure of risk by advocating a different model that can draw on relation between risk and return based factors other than beta. The factors of their model are;

- i. The excess return on the market
- ii. The return on portfolio of small stocks minus the return on portfolio of large stocks
- iii. The return on portfolio of high- book-to-market stocks minus the return on a portfolio of low- book-to-market stocks

They argue that their model can capture most CAPM anomalies. Fama and French argue that their model explains the expected return on stocks with respect to the three factors mentioned above better than the model

that is based on beta only. Thus Fama and French concluded that there is no relationship between beta and returns. Various researchers have disputed these results.

Amihud, Chritennen and Mendelsson (1992) used same data as in the Fama and French study of 1992, performed different statistical tests and showed that betas do infact explain returns during the same period.

MacKinlay (1995) and others argue that the conclusion relating to use of additional risk factors is premature. MacKinlay also argue that the Fama and French model cannot explain the deviation from the CAPM. Black (1993) argues that the positive relationship between the expected return and beta still holds.

Despite the raging controversies surrounding the use of beta as a measure of risk, beta is still the most important factor for quantifying a firm's risk.

2.4 Local studies at the Nairobi Stock Exchange

There have been a number of studies at the Nairobi Stock Exchange (NSE) touching on the subject of risk and return relationship spanning a period of over one decade. Some of these studies are discussed below.

Gitari (1990) sought to determine the relationship between risk and returns among publicly quoted companies in Kenya. He found that there existed a statistically insignificant positive relationship between systematic risk and returns. The lack of strong correlation between systematic risk and return indicated that investors may be over or under compensated for taking high risks. He also found that the relationship between unsystematic risk and returns was negative and statistically insignificant. This was in conformity with finance theory. He also found that the nature of the risk return relationship was independent of the industry in which the company operates reinforcing conclusion and their relationship between risk and return. However, this is not so because the betas of agricultural sector seemed to be very steady due to low trading whereas those of the commercial sector are very volatile.

Muli (1991) carried out a study on estimation of systematic risk for Nairobi Stock Exchange, which indicated 4% risk and return of 6%. He considered Treasury bonds having coupon rate of 15% (July 1991). The

full market rate of 21% was consistent with the general market interest rates in the commercial sector. However this study was carried out in 1991 when the stock market was at a very low stage of development. One limitation was lack of trading floor, which might have affected diversification effectiveness of the market and therefore the activity level.

Wambugu (1992) studied the effects of firms' capital structure on the risk of common stocks at the Nairobi Stock Exchange and found that capital structure had a positive effect on the total risk of common stocks. However the study was undertaken at a time when the NSE had not witnessed sufficient growth and development. The NSE had barely been registered as a company with a trading floor and the regulatory body the Capital Markets Authority was in the formative stages. The study focused on total risk rather than the systematic risk which is the relevant risk.

Munywoki (1998) came closer to justifying the relationship between risk and return as positive though it is noted that no adjustments were made to the stock prices to take into account the effect of bonuses. We also note that in his study the mean-variance criterion was used to compute the market risk and market capitalization with prices not adjusted to formulate the weights on the portfolio. The results obtained revealed a market risk of 3.55% and market return of 14.80%. The market return of 14.80% added to the coupon rate on the one year CBK Treasury bond gives total of 29.80%. He claimed that this did not deviate much from the general market interest rates which ranged between 28% and 32% towards the end of 1997.

Odipo (2000) sought to determine whether accounting numbers could be employed to determine market risk in case stock market measures are not available. He found that accounting beta had some useful information content and concluded that there was a theoretical relationship between market-based measures of systematic risk and accounting numbers. However the study did not seek to relate stock market risk as measured by beta to the accounting variables.

Sawaya (2000) examined the statistical properties of the beta coefficient as a measure risk of common stocks listed on the NSE, he found that the commercial sector and the industrial sector were dominant in having significant positive correlation between returns and the market return. He

attributed this to high trading of shares in the two sectors. However he did not seek to determine whether there were some firm characteristics which could explain the significance of the beta coefficient. This is the focus of our study.

Ndegwa (2001) carried out a research aimed at determining existence of a relationship between business risk and market risk. She found that there was very low relationship between earnings variability and systematic risk for individual companies. However there was significant relationship for the market as a whole. We therefore note that none of the studies sought to explain the beta coefficients or market risk by relating it to the firm characteristics.

2.5 Summary and comments

Previous researches have shown that systematic risk can be linked to the underlying firm characteristics. This has been covered well in the developed countries such as those in the west. However very little ground has been covered in the developing countries such as Kenya. The only study covered was on the effect of capital structure on the risk of common stock but which focused on total risk as opposed to the systematic risk. This study will therefore add value in the understanding of the relationship between market risk and the underlying firm characteristics in a developing economy.

The study I will undertake will be focussed on eight firm financial characteristics namely financial leverage, operating leverage, firm size, profitability, dividend payout ratio, business risk, liquidity and growth. The study will mainly be guided by earlier work by Beaver, Kettler, and Scholes (1970).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

The main purpose of the study is to establish whether there is a relationship between certain firm characteristics and systematic risk. The study is concerned with among others the firm characteristics identified in the study by Beaver, Kettler, and Scholes (1970). The financial variables selected for the purpose of this study are the financial leverage, operating leverage, firm size, profitability, dividend payout ratio, business risk, liquidity and growth.

The financial leverage, operating leverage, profitability, dividend payout ratio, business risk, liquidity and growth have been selected as explanatory variables because prior research, including Hamada (1972), Bowman (1979 and 1980), Hill and Stone, (1980), Rubinstein (1973) and Lev (1974), demonstrated analytically that positive relationship exist between beta and these variables, and provided empirical evidence supporting theoretical relationships. Firm size is considered as an explanatory variable because prior studies on the association between market risk and accounting variables have shown that beta is negatively correlated with firm size. Such studies include the Beaver et al (1970). Large firms are often thought to be less risky than small firms, if for no other reason than that they have better access to the capital markets, hence they should have lower betas.

3.1 The Population

The population of interest comprise of all the companies quoted at the Nairobi Stock Exchange (NSE) for the period 22nd March 1996 to 31st December 1999. The reason for selecting firms quoted on the NSE is the ease of accessing data both for the stock price movements and financial performance. All listed companies are required as per the Capital markets Authority regulations to file the financial statements annually. The data relating to unlisted companies may not be easily accessible on a timely basis.

3.2 Sample

The companies quoted on the NSE are considered a suitable sample for the whole population in any case; our interest is to predict betas for unlisted companies.

The prediction will be done mainly for companies whose beta coefficients are statistically significant. The companies selected for study include those in the agriculture sector, commercial and industrial sectors. The financial sector is omitted due to difficulties in asset and liability classification and to avoid distortion. The details of companies with significant betas in Sawaya (2000) study are shown in tables 1 and 2 below.

Table 1: Regression Analysis results (Weighted Returns)

Company	No. of Obs	Beta coefficient	Alpha coeffic.	Market return	Asset return	t-ratio beta	t-ratio alpha	SE beta	SE alpha	R-sq %
KPLC	196	2.070	1.540	0.220	1.995	8.850	2.99	0.234	2.990	28.6
Bamburi	196	2.040	0.071	0.220	0.520	13.420	0.21	0.152	0.210	48
E.A Portland	196	1.450	-0.079	0.220	0.240	5.310	-0.13	0.273	-0.130	12.6
K. Airways	196	1.370	-0.351	0.220	-0.050	9.090	-1.06	0.151	-1.060	29.8
CFC Bank	196	1.320	-0.165	0.220	0.125	5.480	-0.31	0.241	-0.310	13.4
Unga	196	1.260	1.170	0.220	1.447	2.250	0.95	0.560	0.950	2.5
Total	196	1.090	-0.672	0.220	-0.432	6.050	-1.7	0.180	-1.700	15.8
NBK	196	1.040	-0.538	0.220	-0.309	5.500	-1.29	0.189	-1.290	13.4
HFCK	196	0.984	-0.056	0.220	0.160	7.320	-0.19	0.134	-0.190	21.6
Firestone	196	0.872	0.197	0.220	0.389	4.700	0.48	0.186	0.480	10.2
ICDC	196	0.844	0.490	0.220	0.676	5.230	1.38	0.161	1.380	12.3
Uchumi	196	0.830	0.357	0.220	0.540	3.800	0.74	0.218	0.740	6.9
KCB	196	0.824	-0.324	0.220	-0.143	5.650	-1.01	0.146	-1.010	14.1
Std Newspapers	196	0.807	0.603	0.220	0.781	2.160	0.73	0.374	0.730	2.3
Jubilee	196	0.736	-0.103	0.220	0.059	4.530	-0.29	0.162	-0.290	9.5
NIC	196	0.700	0.108	0.220	0.262	4.050	0.28	0.173	0.280	7.8
K. Nat. mills	196	0.699	-0.092	0.220	0.062	2.860	-0.17	0.244	-0.170	4
E.A Cables	196	0.642	-0.249	0.220	-0.108	3.300	-0.58	0.195	-0.580	5.3
Kenol	196	0.622	0.036	0.220	0.173	3.180	-0.1	0.196	-0.100	6.9
Stanchart	196	0.619	0.146	0.220	0.282	6.500	0.7	0.095	0.700	17.8
Barclays	196	0.550	-0.074	0.220	0.047	5.390	-0.33	0.102	-0.330	13
Sasini	196	0.550	0.230	0.220	0.351	3.330		0.165	0.000	
Diamond Trust	196	0.546	-0.202	0.220	-0.082	4.480	-0.75	0.122	-0.750	9.3
TP Serena	196	0.483	0.170	0.220	0.276	3.820	0.61	0.126	0.610	7
BAT	196	0.403	0.079	0.220	0.168	3.630	0.32	0.111	0.320	6.3
REA Vipingo	196	0.388	-0.503	0.220	-0.418	2.880	-1.7	0.135	-1.700	4.1
CMC Holdings	196	0.351	0.053	0.220	0.130	2.670	0.18	0.131	0.180	3.5
Brookebond	196	0.193	-0.227	0.220	-0.185	1.830	-0.98	0.105	-0.980	1.7

Source: Sawaya, A.N., 2000, Unpublished MBA research Project, University of Nairobi

Table 2: Regression Analysis results (Unweighted Returns)

Company	No. of Obs	Beta coeffic	Alpha coeffic.	Market return	Asset return	t-ratio beta	t-ratio alpha	SE beta	SE alpha	R-sq %
Dunlop	196	19.400	-1.130	0.260	3.914	10.930	-1.340	1.775	0.843	38.00
Carbacid Invest.	196	2.460	0.740	0.260	1.380	3.560	0.570	0.691	1.298	6.10
Unga	196	1.930	0.950	0.260	1.452	2.950	0.780	0.654	1.218	4.30
KPLC	196	1.760	1.530	0.260	1.988	5.850	2.720	0.301	0.563	14.90
Bamburi	196	1.310	0.180	0.260	0.521	5.660	0.420	0.231	0.429	14.10
CFC Bank	196	1.280	-0.203	0.260	0.130	4.360	-0.370	0.294	0.549	8.90
Std Newspapers	196	1.220	0.468	0.260	0.785	2.780	0.570	0.439	0.821	3.80
Total	196	1.100	-0.717	0.260	-0.431	5.060	-1.760	0.217	0.407	11.60
ICDC	196	0.935	0.435	0.260	0.678	4.860	1.210	0.192	0.360	10.80
E.A Cables	196	0.900	-0.339	0.260	-0.105	3.950	-0.800	0.228	0.424	7.40
Firestone	196	0.869	0.164	0.260	0.390	3.900	0.390	0.223	0.421	7.20
Kenol	196	0.764	-0.096	0.260	0.103	3.970	-0.270	0.192	0.356	7.50
HFCK	196	0.753	-0.034	0.260	0.162	4.400	-0.110	0.171	0.309	9.00
K. Nat. mills	196	0.750	-0.131	0.260	0.064	2.590	-0.240	0.290	0.546	3.30
KCB	196	0.748	-0.336	0.260	-0.142	4.200	-1.010	0.178	0.333	8.30
Jubilee	196	0.743	-0.133	0.260	0.060	3.820	-0.360	0.195	0.369	7.00
Athi R. Mining	196	0.666	-0.284	0.260	-0.111	2.480	-0.570	0.269	0.498	3.10
NBK	196	0.653	-0.478	0.260	-0.308	2.760	-1.080	0.237	0.443	3.80
Sasini	196	0.635	0.182	0.260	0.347	3.270	0.500	0.194	0.364	5.20
E.A Portland	196	0.635	0.075	0.260	0.240	1.850	0.120	0.343	0.625	1.70
NIC	196	0.603	0.106	0.260	0.263	2.890	0.270	0.209	0.393	4.10
Diamond Trust	196	0.598	-0.236	0.260	-0.081	4.120	-0.870	0.145	0.271	8.00
Express	196	0.584	-0.646	0.260	-0.494	2.980	-1.770	0.196	0.365	4.40
Crown Berger	196	0.564	-0.192	0.260	-0.045	2.330	-0.430	0.242	0.447	2.70
K. Airways	196	0.530	-0.189	0.260	-0.051	2.540	-0.048	0.209	3.938	3.20
Uchumi	196	0.521	0.405	0.260	0.540	1.960	0.820	0.266	0.494	1.90
CMC Holdings	196	0.513	-0.002	0.260	0.131	3.330	-0.010	0.154	0.200	5.40
TP Serena	196	0.453	0.160	0.260	0.278	2.990	0.560	0.152	0.286	4.40
Stanchart	196	0.446	0.167	0.260	0.283	3.710	0.740	0.120	0.226	6.60
George Williamson	196	0.416	0.347	0.260	0.455	2.360	1.050	0.176	0.330	2.80
REA Vipingo	196	0.401	-0.521	0.260	0.417	2.500	-1.740	0.160	0.299	3.10
BAT	196	0.392	0.067	0.260	0.169	2.940	0.270	0.133	0.248	4.30
Kakuzi	196	0.383	0.058	0.260	0.158	2.070	0.170	0.185	0.341	2.20
Barclays	196	0.351	-0.044	0.260	0.047	2.770	-0.190	0.127	0.232	3.80
E.A Breweries	196	0.341	0.363	0.260	0.452	1.980	1.120	0.172	0.324	2.00
Brookebond	196	0.276	-0.255	0.260	-0.183	2.220	-1.100	0.124	0.232	2.50

Key:

Coeffic. - Coefficient

Obs - observation

SE- standard Error

R-sq- coefficient of determination

Source: Sawaya, A.N., 2000, Unpublished MBA research Project, University of Nairobi

3.3 Hypotheses

The relevant hypotheses for the purpose of the study are as follows;

H_0 : There is no relationship between a firm's financial characteristics and systematic risk.

H_a : There is a relationship between a firm's financial characteristics and systematic risk.

3.4 Data Analysis.

3.4.1 Data analysis techniques

For the purpose of the study the average ratios for financial leverage, operating leverage, firm size, profitability, dividend payout ratio, business risk, liquidity and growth are computed for a three years and five years period to 1999. An annual average ratio for operating leverage is also computed for a ten year period ending 1999. The independent variables to be used in the study are defined below:

Financial leverage

Financial leverage for the purpose of the study is the ratio of the value of debt to the value of equity. The figures for debt and equity values will be obtained from the financial statements of the companies and other relevant data at the NSE.

Operating leverage

Operating leverage is estimated by taking the ratio of change in earnings before tax (EBIT) to the change in the sales or turnover of the firm. The relevant figures for EBIT and turnover are extracted from the financial statements of the companies and other relevant data at the NSE.

Firm size

Firm's size is measured as the logarithm of the total assets of the firm. The relevant figures for assets are extracted from the financial statements of companies and other relevant data at the NSE. The firm's market capitalization to the total market capitalization is not used in this study, as it is not a direct measure of size.

Dividend payout ratio

Dividend payout ratio is measured as the ratio of the dividends paid to earnings of the firm. The relevant figures for dividends and earnings are extracted from the financial statements of the companies and other relevant data at the NSE.

Profitability ratio

Profitability is measured as the coefficient of variation of the earnings of the firm. The relevant figures earnings are extracted from the financial statements of the companies and other relevant data at the NSE.

Growth ratio

Growth is measured as the ratio of annual change in total assets of the firm. The relevant figures for assets are extracted from the financial statements of the companies and other relevant data at the NSE.

Liquidity ratio

Liquidity is measured as the ratio of current assets to current liabilities of the firm. The above ratio is also referred to as the current ratio. The relevant figures for current assets and current liabilities are extracted from the financial statements of the companies and other relevant data at the NSE.

Business risk

Business risk is measured as the logarithm of the variability of the earnings before interest and taxes (EBIT) for the firms. The relevant figures for earnings before interest and taxes are extracted from the financial statements of the companies and other relevant data at the NSE.

3.4.2 Linear Regression

Research questions in business frequently revolve around the study of relationship between two or more variables. Various objectives may be served by such analysis. The strength, direction, shape and other features of the relationship may be discovered (Cooper and Schindler (1998)). Regression analysis can be categorized into two types namely the simple or bivariate linear regression and the multiple or multivariate linear regression. A bivariate linear regression enables the researcher to find out whether an independent variable is a predictor of a depended variable. A multiple linear regression is used

when the researcher attempts to determine whether a group of variables predict a given dependent variable.

In this study we shall use both the bivariate and multivariate linear regression analysis. Multivariate linear regression has been used in previous studies such as those of Bildersee (1975), Rosenberg and Mckibben (1973). We rely on the significant betas computed in an early study by Sawaya (2000), which were computed by applying bivariate linear regression of the stock returns against the market returns using the market model to estimate betas for the period 22nd March 1996 to 31st December 1999. The companies selected for study include those in the agriculture sector, commercial and industrial sectors. The slope of the market model corresponds to the beta of the stock and measures the risk of the stock.

We shall use the multiple linear regressions to relate the market risk as represented by beta coefficients to the financial variables. The beta coefficients for the firms derived from weighted returns are regressed against five-year average and also against three-year average of the independent variables using a Minitab package. This is also repeated with betas derived from unweighted returns.

The format of the model will be as shown below:

$$Y = a + B_1 X_1 + B_2 X_2 + \dots + B_n X_n + E \dots\dots\dots(13)$$

Where;

Y= the dependent variable

B_i = the coefficient of regression associated with each independent variable.

a = the constant term for all independent variables.

X_i = the independent variables

E= the error term

This is in line with Elton and Gruber (1995) contention that a logical step in developing fundamental betas is to incorporate the effects of relevant fundamental variables simultaneously into the analysis. This

is achieved by relating beta to several fundamental variables via multiple regression analysis.

In developing our model we assume that the relationship between market risk and each of the explanatory financial accounting variables above is linear and additive. The model will use both significant betas computed using weighted realized returns and unweighted realized returns. The details companies with significant betas are shown as tables 1 and 2 above. The financial statements for the period 1990 to 1999 will be useful in prediction of betas for the period 1996 to 1999.

Statistical tests that shall be applied in the study are the t-ratio, coefficient of determination, R^2 , and the F-ratio. The level of significance shall be at 5%.

A regression analysis yields a statistic commonly referred to as the correlation coefficient R. This is a measure of the degree of linear relationship between two or more variables. The correlation coefficient may take any value between plus one (+1) and minus one (-1). The sign of the coefficient define the direction of the relationship i.e. positive or negative. The square of the coefficient of correlation R^2 (R-squared) is the coefficient of determination and it measures the amount of variation explained by the independent variable(s). For example R^2 of 0.77 indicates that 77 percent the variation in the dependent variable is explained by the independent variable. The rest 23 percent cannot be explained by the variables in the regression equation.

In our model, R-squared indicates that a proportion of the variations in the beta coefficient for the sample of companies studied that is explained by the eight-descriptor (independent) variables. The R-squared is normally adjusted to reflect the models goodness of fit for the population under consideration. The net effect of this adjustment is to reduce the R-squared slightly to make it comparable to other R-squared from equations with different number of independent variables.

Analysis of variances measures whether or not the regression model represents a set of regression coefficients that in total are statistically

different from zero. The critical value of F is found from tables, with the degree of freedom for the numerator equaling k , the number of independent variables, and for the denominator, $n-k-1$ where n is the number of observations. The equation with an F -value greater than the critical F -value is statistically significant. An alternative to determining whether the regression coefficient is significant or not is by reference to the probability values at a given level of significance. At 5% level of significance a regression coefficient is significant if the F -value has a probability value less than 0.10.

There is a measure of statistical significance of each of the regression coefficients. The computed F -values are compared with those in the F -distribution tables for the relevant degrees of freedom. The regression equations are judged whether they are significantly different from zero. From the position arrived at above, it is decided whether the regression equation shows a relationship between the dependent variable and independent variable. It can also be judged whether the regression coefficients are individually or jointly statistically significant.

The t -ratios can also be utilized to determine whether a regression coefficient is significant or not. When the computed t -ratio is greater than the critical t -ratio at a given level of significance then the regression coefficient is significantly different from zero. An alternative to determining whether the regression coefficient is significant or not is by reference to the probability values at a given level of significance. At 5% level of significance a regression coefficient is significant if the t -ratio has a probability value less than 0.10.

4.1 Research Results

The multiple regressions run by regressing the beta coefficient against eight descriptor variables shows mixed results.

CHAPTER FOUR

4.0 FINDINGS

The hypothesis to be tested are reproduced below:

- H₀: There is no relationship between a firm’s financial characteristics and systematic risk.
- H_a: There is a relationship between a firm’s financial characteristics and systematic risk.

The measure of systematic risk is beta coefficient at two levels, weighted and unweighted as reported in Sawaya (2000). The predictor variables are financial leverage, operating leverage, firm size, profitability, dividend payout ratio, business risk, liquidity and growth. These are presented in appendix 3(a) and 3(b). Two levels of beta are used in the study due to the difference in the mean (0.104) and standard error of the means (0.021) of the two betas as shown in appendix 4.

The t-ratios are used to determine the statistical significance or insignificance of the regression coefficients. The regression coefficients with t-ratios greater than 1.96 or probability, p-values less than 0.1 are considered to be statistically significant. For the overall regression model, the F-values or probability of the same being less than a critical value is used. The regression model is considered to be significant if the probability, p- value, is less than 0.1.

4.1 Research Results

The multiple regressions run by regressing the beta coefficient against eight descriptor variables shows mixed results.

4.1.1 Weighted returns derived betas

The results of regressing beta derived from weighted returns (refer table 3(a) below) indicate significant relationship between beta and independent variables when five- year average predictor variables are used together with a ten-year average operating leverage predictor. The R-squared of 66.1 percent indicates that significant proportion of the variations in beta is explained by the independent variables. The adjusted R-squared of 36.0% reflect the models goodness of fit for the population. The overall constant term is significant in the regression model. The independent variables that are statistically significant at 5% significant level are growth, asset size, and liquidity. Growth and liquidity have the expected (positive and negative) sign, which shows that they are positively and negatively correlated with beta respectively. This is consistent with previous study by Beaver, Kettler and Scholes (1970). However firm size has a positive sign, which is not expected and contradicts the Beaver et al (1970) findings. The other five independent variables in the overall model do not significantly affect the beta coefficient. Table 3(b) below shows the results of regressing beta against eight five-year average predictor variables. The results are similar to those in table 3(a) except that firm size is marginally insignificant.

TABLE 3(a) : REGRESSION RESULTS BETA DERIVED WEIGHTED RETURNS WITH FIVE YEAR AVERAGE VARIABLES (OPERATING LEVERAGE ANNUAL AVERAGE)

Predictor	Expected sign	Coefficient	SE Coeff	T-ratio	P	VIF	Status
Constant		-7.322	2.864	-2.56	0.031		Significant
Lev5YrA	+	-0.3717	0.6792	-0.55	0.598	1.8	Insignificant
Pro5YrA	+	0.0269	0.5665	0.05	0.963	1.3	Insignificant
Gr5YrA	+	0.03009	0.01149	2.62	0.028	3.7	Significant
LTA5YrA	-	1.1632	0.6224	1.87	0.094	6.6	Significant
CR5YrA	-	-0.18008	0.08518	-2.11	0.064	2.9	Significant
LBR5YrA	+	0.0461	0.4242	0.11	0.916	4.5	Insignificant
DPR5YrA	-	0.7320	0.5195	1.41	0.192	2.7	Insignificant
OPLAYrA	+	-0.05247	0.04293	-1.22	0.253	2.7	Insignificant
S = 0.4410 R-Sq = 66.1% R-Sq(adj) = 36.0%							
The regression equation is; BetaWei = - 7.32 - 0.372 Lev5YrA + 0.027 Pro5YrA + 0.0301 Gr5YrA + 1.16 LTA5YrA - 0.180 CR5YrA + 0.046 LBR5YrA + 0.732 DPR5YrA - 0.0525 OPLAYrA							
Analysis of Variance							
Source	DF	SS	MS	F	P		
Regression	8	3.4121	0.4265	2.19	0.132		Insignificant
Residual Error	9	1.7505	0.1945				
Total	17	5.1626					

Note: Refer to appendix 2 for definition of variables

TABLE 3(b) : REGRESSION RESULTS BETA DERIVED WEIGHTED RETURNS WITH FIVE YEAR AVERAGE VARIABLES

Predictor	Expected sign	Coef	SE Coef	T-ratio	P	VIF	
Constant		-6.030	2.429	-2.48	0.035		Significant
Lev5YrA	+	-0.3308	0.6943	-0.48	0.645	1.8	Insignificant
Pro5YrA	+	0.0593	0.6033	0.10	0.924	1.4	Insignificant
Gr5YrA	+	0.02772	0.01127	2.46	0.036	3.4	Significant
LTA5YrA	-	0.9817	0.5860	1.68	0.128	5.6	Insignificant
CR5YrA	-	-0.17300	0.08714	-1.99	0.078	2.9	Significant
LBR5YrA	+	0.0490	0.4398	0.11	0.914	4.6	Insignificant
DPR5YrA	-	0.5115	0.4541	1.13	0.289	2.0	Insignificant
OPL5YrA	+	-0.01601	0.01625	-0.99	0.350	1.9	Insignificant
S = 0.4524 R-Sq = 64.3% R-Sq(adj) = 32.6%							
BetaWei = - 6.03 - 0.331 Lev5YrA + 0.059 Pro5YrA + 0.0277 Gr5YrA + 0.982 LTA5YrA - 0.173 CR5YrA + 0.049 LBR5YrA + 0.512 DPR5YrA - 0.0160 OPL5YrA							
Analysis of Variance							
Source	DF	SS	MS	F	P		
Regression	8	3.3204	0.4150	2.03	0.156		Insignificant
Residual Error	9	1.8422	0.2047				
Total	17	5.1626					

Note: Refer to appendix 2 for definition of variables

It can be noted that using five-year average data gives results that are not statistically significant for overall equation though there is a relationship between the dependent variable beta and the eight-predictor variables. However a stepwise regression shows that taken alone, firm asset size is correlated to the systematic risk (beta coefficient) of the firms. However the sign of the regression coefficient is not as expected being positive instead of negative.

Table 4(a) below contains the results of regressing beta derived from weighted returns against three-year average predictor variables. The regression indicates that there is significant relationship between beta and independent variables. The R-squared show that 70.1 percent of the variations in beta is explained by the independent variables. The adjusted R-squared of 43.6 percent reflect the models goodness of fit for the population. The overall constant term is significant in the regression model. The independent variables that are statistically significant are profitability, growth, and asset size and dividend payout ratio. Only growth has the expected negative sign in consistence with the Beaver et al (1970) study. The other four independent variables namely leverage, liquidity, level of business risk and operating leverage in the overall

model does not significantly affect the beta coefficient. At the 5 percent significant level the overall regression equation is statistically significant.

Table 4(b) below shows that similar results are obtained on regressing beta against eight five-year average predictor variables.

TABLE 4 (a): REGRESSION RESULTS BETA DERIVED WEIGHTED RETURNS WITH THREE YEAR AVERAGE VARIABLES (OPERATING LEVERAGE ANNUAL AVERAGE)

Predictor	Expected sign	Coef	SE Coef	T	P	VIF	Status
Constant		-9.077	3.020	-3.01	0.015		Significant
Lev3YrA	+	0.2253	0.5408	0.42	0.687	1.4	Insignificant
Pro3YrA	+	-6.392	2.993	-2.14	0.061	1.5	Significant
Gr3YrA	+	0.04152	0.01978	2.10	0.065	2.2	Significant
LTA3YrA	-	1.5244	0.6443	2.37	0.042	7.9	Significant
CR3YrA	-	0.08873	0.06990	1.27	0.236	2.3	Insignificant
LBR3YrA	+	-0.1250	0.4137	-0.30	0.769	5.1	Insignificant
DPR3YrA	-	1.0200	0.4658	2.19	0.056	3.6	Significant
OPLAYrA	+	-0.05898	0.04418	-1.33	0.215	3.2	Insignificant
S = 0.4140 R-Sq = 70.1% R-Sq(adj) = 43.6%							
The regression equation is							
BetaWei = - 9.08 + 0.225 Lev3YrA - 6.39 Pro3YrA + 0.0415 Gr3YrA							
+ 1.52 LTA3YrA+ 0.0887 CR3YrA - 0.125 LBR3YrA + 1.02 DPR3YrA							
- 0.0590 OPLAYrA							
Analysis of Variance							
Source	DF	SS	MS	F	P		
Regression	8	3.6204	0.4526	2.64	0.085		Significant
Residual Error	9	1.5422	0.1714				
Total	17	5.1626					

Note: Refer to appendix 2 for definition of variables

values. Further, a two-step regression, which considers the asset size and profitability, shows that both total assets and profitability taken together are significantly correlated to the level of systematic risk of the firms. However both did not have the expected signs.

Summary of the study

The results show that using a three-year period to derive the average independent variables yields better results in comparison with the five-year period. In the case of the three-year period we reject the null hypothesis and accept the alternative that there is a relationship between beta and the firm characteristics.

TABLE 4 (b): REGRESSION RESULTS BETA DERIVED WEIGHTED RETURNS WITH THREE YEAR AVERAGE VARIABLES

Predictor	Expected sign	Coef	SE Coef	T	P	VIF	Status
Constant		-7.034	2.017	-3.49	0.007		Significant
Lev3YrA	+	0.1127	0.5199	0.22	0.833	1.4	Insinificant
Pro3YrA	+	-8.537	3.147	-2.71	0.024	1.9	Siginificant
Gr3YrA	+	0.03683	0.01773	2.08	0.068	1.9	Significant
LTA3YrA	-	1.0890	0.5069	2.15	0.060	5.4	Significant
CR3YrA	-	0.06594	0.06049	1.09	0.304	1.9	Insignificant
LBR3YrA	+	0.1224	0.3897	0.31	0.761	5.0	Insignificant
DPR3YrA	-	0.8141	0.3359	2.42	0.038	2.0	Significant
OPL3YrA	+	-0.02951	0.01752	-1.68	0.126	1.6	Insignificant
S = 0.3951 R-Sq = 72.8% R-Sq(adj) = 48.6%							
The regression equation is BetaWei = - 7.03 + 0.113 Lev3YrA - 8.54 Pro3YrA + 0.0368 Gr3YrA + 1.09 LTA3YrA + 0.0659 CR3YrA + 0.122 LBR3YrA + 0.814 DPR3YrA - 0.0295 OPL3YrA							
Analysis of Variance							
Source	DF	SS	MS	F	P		
Regression	8	3.7580	0.4697	3.01	0.061		Significant
Residual Error	9	1.4046	0.1561				
Total	17	5.1626					

Note: Refer to appendix 2 for definition of variables

The three-year average data gives results that are statistically significant. The relationship between the dependent variable beta and the eight-predictor variables is relatively strong as depicted by the large R-squared values. Further, a two-step regression, which considers the asset size and profitability, shows that both total assets and profitability taken together are significantly correlated to the level of systematic risk of the firms. However both did not have the expected signs.

Summary of the study

The results show that using a three-year period to derive the average independent variables yields better results in comparison with the five-year period. In the case of the three-year period we reject the null hypothesis and accept the alternative that there is a relationship between beta and the firm characteristics.

4.1.2 Unweighted returns derived betas

The results of regressing beta derived from unweighted returns indicate that there is a weak relationship between beta and independent variables both when five year and three year average variables are used. This is illustrated by relatively low values of the R-squared and the t-ratios and F-ratios that are less than the critical values. The overall constant term is significant in the regression model. The detailed results are detailed in tables 5 and 6 below. However, a stepwise regression shows that taken alone, firm asset size is correlated to the systematic risk (beta coefficient) of the firms. The regression coefficients both using three-year and five-year average variables have the expected sign i.e. negative. This result is consistent with the Beaver et al (1970) study in which size was found to be negatively correlated with systematic risk.

TABLE 5: REGRESSION RESULTS BETA DERIVED UNWEIGHTED RETURNS WITH FIVE YEAR AVERAGE VARIABLES

Predictor	Expected sign	Coef	SE Coef	T	P	Status
Constant		17.271	7.315	2.36	0.027	Significant
Lev5Yr	+	-2.813	3.876	-0.73	0.475	Insignificant
Pro5YrA	+	1.158	3.850	0.30	0.766	Insignificant
Gr5YrA	+	0.07849	0.05445	1.44	0.162	Insignificant
LTA5YrA	-	-3.002	2.513	-1.19	0.244	Insignificant
CR5YrA	-	-0.4036	0.4534	-0.89	0.382	Insignificant
LBR5YrA	+	0.648	2.355	0.28	0.786	Insignificant
DPR5YrA	-	-0.000	1.601	-0.00	1.000	Insignificant
OPLAYrA	+	-0.07088	0.09720	-0.73	0.473	Insignificant
S = 3.248 R-Sq = 26.9% R-Sq(adj) = 2.6%						
The regression equation is BetaUnw = 17.3 - 2.81 Lev5Yr + 1.16 Pro5YrA + 0.0785 Gr5YrA - 3.00 LTA5YrA - 0.404 CR5YrA + 0.65 LBR5YrA - 0.00 DPR5YrA - 0.0709 OPLAYrA						
Analysis of Variance						
Source	DF	SS	MS	F	P	
Regression	8	93.39	11.67	1.11	0.393	Insignificant
Residual Error	24	253.15	10.55			
Total	32	346.54				

Note: Refer to appendix 2 for definition of variables

TABLE 6: REGRESSION RESULTS BETA DERIVED UNWEIGHTED RETURNS WITH THREE YEAR AVERAGE VARIABLES

Predictor	Expected sign	Coef	SE Coef	T	P	Status
Constant		18.795	8.069	2.33	0.029	Significant S
Lev3Yr	+	-1.971	3.251	-0.61	0.550	Insignificant
Pro3YrA	+	-22.38	20.22	-1.11	0.279	Insignificant
Gr3YrA	+	0.03926	0.06219	0.63	0.534	Insignificant
LTA3YrA	-	-2.927	2.518	-1.16	0.256	Insignificant
CR3YrA	-	0.0804	0.3666	0.22	0.828	Insignificant
LBR3YrA	+	0.589	2.311	0.25	0.801	Insignificant
DPR3YrA	-	-0.074	1.231	-0.06	0.952	Insignificant
OPLAYrA	+	-0.0534	0.1005	-0.53	0.600	Insignificant
S = 3.343 R-Sq = 22.6% R-Sq(adj) = 0.0%						
The regression equation is BetaUnw = 18.8 - 1.97 Lev3Yr - 22.4 Pro3YrA + 0.0393 Gr3YrA - 2.93 LTA3YrA + 0.080 CR3YrA + 0.59 LBR3YrA - 0.07 DPR3YrA - 0.053 OPLAYrA						
Analysis of Variance						
Source	DF	SS	MS	F	P	
Regression	8	78.30	9.79	0.88	0.550	Insignificant
Residual Error	24	268.24	11.18			
Total	32	346.54				

Note: Refer to appendix 2 for definition of variables

On firms financial characteristics and systematic risk when betas derived from the weighted returns are used. Using five-year predictor variables, growth, liquidity and size are found to be statistically significant. The relationship is stronger when three year average independent variables are used with profitability, growth, dividend payout ratio and firm size being significant. This indicates that the firms' characteristics can be used in the prediction of systematic risk of firms. The results show that the three year average data has more predictive power and therefore will be useful to managers considering prediction of betas.

5.1 Limitations of the study

- The study has relied on the betas computed using the market model. This method of computing betas has been criticized before. Thus the results of obtained from the study may be questionable on this account.
- The sample of companies selected from the Nairobi Stock Exchange, which may not reflect the entire population of companies in Kenya.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

The objective of this study was to determine whether there is a relationship between financial characteristics of firms and systematic risk and therefore whether these characteristics could be used in the prediction of systematic risk.

The research findings are mixed with the relationship between firm characteristics and systematic risk being found to be relatively weak when betas derived from unweighted returns are regressed against the firm characteristics. However, stepwise regression shows that firm size is correlated with systematic risk. This shows that with unweighted returns derived betas, firm size is a useful firm characteristic to be taken into account in prediction of systematic risk.

There is however a significant relationship between firms financial characteristics and systematic risk when betas derived from the weighted returns are used. Using five-year predictor variables, growth, liquidity and size are found to be statistically significant. The relationship is stronger when three year average independent variables are used with profitability, growth, dividend payout ratio and firm size being significant. This indicates that the firms' characteristics can be used in the prediction of systematic risk of firms. The results show that the three year average data has more predictive power and therefore will be useful to managers considering prediction of betas.

5.1 Limitations of the study

- The study has relied on the betas computed using the market model. This method of computing betas has been criticized before. Thus the results of obtained from the study may be questionable on this account.
- The sample of companies selected from the Nairobi Stock Exchange, which may not reflect the entire population of companies in Kenya.

- The financial variables have been estimated from the financial statements of various companies quoted on the Nairobi Stock exchange. These financial statements are prepared using varying accounting bases. To this extent the results of the study may be affected.
- The model for prediction of betas is based on the assumption that betas are computed on the assumption that the responsiveness of all betas to an underlying financial variable is the same. This could be subject to criticism.
- The study has excluded the companies listed on the stock exchange but belonging to the financial sector. The exclusion of these companies might affect the results of the study.

5.2 Recommendations For Further Research

- The study focused on the relationship between betas and the financial variables for the market as a whole. Perhaps future research could determine several beta coefficients for each individual company and determine relationship between the individual firm financial characteristics and systematic risk.
- Future studies could also consider including companies in the financial sector of the NSE, which were not covered by the current study.

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APPENDICES

APPENDIX 1: LIST OF COMPANIES AND CODES

Company	Code
1 Brooke Bond Ord 10.00	EBOND
2 Egasda Ord 1.25	EGAADS
3 George Williamson Kenya Ord 5.00	GWK
4 Kakuzi Ord 5.00	KAKUZI
5 Kapchorua Tea Co Ord 5.00	KAPCHO
6 Rea Vipingo Plantations Ord 5.00	REAV
7 Sasini Tea & Co Tea Ord 5.00	SASINI
8 Car & General Ord 5.00	CarGen
9 CMC Holdings Ord 5.00	CMC
10 Express Ord 5.00	EXPRESS
11 Kenya Airways Ord 5.00	KENAIR
12 Marshalls Ord 5.00	MARSH
13 Nation Media Group Ord. 5.00	NMG
14 Standard Newspaper Group Ord. 5.00	SMG
15 Tourism Promotions Services Ord 5.00	SERENA
16 Uchumi Supermarket Ord. 5.00	UCHUMI
17 Athi River Mining Ord. 5.00	ATHI
18 Bamburi Cement Ord. 5.00	BAMB
19 BOC Kenya Ord. 5.00	BOC
20 British American Tobacco Ord 10.00	BAT
21 Carbacid Investments Ord. 5.00	CARB
22 Crown Burger Ord. 5	CORG
23 Dunlop Kenya Ord 5.00	DUN
24 EA Portland Cement Ord	PORTL
25 East African Breweries Ord 5.00	EABL
26 East African Cables Ord 5.00	EACABLES
27 East African Packaging Ord 5.00	EAPACK
28 Firestone East Africa Ord. 5.00	FIRE
29 Kenya National Mills Ord. 5.00	KNM
30 Kenya Oil Company Ord. 5.00	KENOL
31 Kenya Power & Lighting Ord. 20	KPL
32 Total Kenya Ord. 5	Total
33 Unge Group Ord. 5	Unge

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APPENDIX 1: LIST OF COMPANIES AND CODES

	Company	Code
1	Brooke Bond Ord 10.00	Bbond
2	Egaads Ord 1.25	EGAADS
3	George Williamson Kenya Ord 5.00	GWK
4	Kakuzi Ord 5.00	KAKUZI
5	Kapchorua Tea CoOrd 5.00	KAPCHO
6	Rea Vipingo Plantations Ord 5.00	REAV
7	Sasini Tea & Coffee Ord 5.00	SASINI
8	Car & General Ord 5.00	CarGen
9	CMC Holdings Ord 5.00	CMC
10	Express Ord 5.00	EXPRESS
11	Kenya Airways Ord 5.00	KENAIR
12	Marshalls Ord 5.00	MARSH
13	Nation Media Group Ord. 5.00	NMG
14	Standard Newspaper Group Ord. 5.00	SMG
15	Tourism Promotion Services Ord 5.00	SERENA
16	Uchumi Supermarket Ord. 5.00	UCHUMI
17	Athi River Mining Ord. 5.00	ATHI
18	Bamburi Cement Ord. 5.00	BAMB
19	BOC Kenya Ord. 5.00	BOC
20	British American Tobacco Ord 10.00	BAT
21	Carbacid Investments Ord. 5.00	CARB
22	Crown Berger Ord. 5	Cberg
23	Dunlop Kenya Ord 5.00	DUN
24	EA Portland Cement Ord. 5.00	PORTL
25	East African Breweries Ord 5.00	EABL
26	East African Cables Ord 5.00	EACABLES
27	East African Packaging Ord 5.00	EAPACK
28	Firestone East Africa Ord. 5.00	FIRE
29	Kenya National Mills Ord. 5.00	KNM
30	Kenya Oil Company Ord. 5.00	KENOL
31	Kenya Power & Lighting Ord. 20	KPL
32	Total Kenya Ord. 5	Total
33	Unga Group Ord. 5	Unga

Appendix 2: Abbreviations of Financial Variables

	Abbreviation	Details
1	Lev5YrA	Financial Leverage 5-Year Average
2	Lev3YrA	Financial Leverage 3-Year Average
3	Pro5YrA	Profitability 5-Year Average
4	Pro3YrA	Profitability 3-Year Average
5	Gr5YrA	Growth 5-Year Average
6	Gr3YrA	Growth 3-Year Average
7	TA5YrA	Total Assets 5-Year Average
8	TA3YrA	Total Assets 3-Year Average
9	LTA5YrA	Logarithm Total Assets 5-Year Average
10	LTA3YrA	Logarithm Total Assets 3-Year Average
11	CA5YrA	Current Assets 5-Year Average
11	CA3YrA	Current Assets 3-Year Average
12	CL5YrA	Current Liabilities 5-Year Average
13	CL3YrA	Current Liabilities 3-Year Average
14	CR5YrA	Current Ratio 5-Year Average
15	CR3YrA	Current Ratio 3-Year Average
16	BR5YrA	Business Risk 5-Year Average
17	BR3YrA	Business Risk 3-Year Average
18	LBR5YrA	Logarithm Business Risk 5-Year Average
19	LBR3YrA	Logarithm Business Risk 3-Year Average
20	DPR5YrA	Dividend Payout Ratio 5-Year Average
21	DPR3YrA	Dividend Payout Ratio 3-Year Average
22	OPL5YrA	Operating Leverage 5-Year Average
23	OPL3YrA	Operating Leverage 3-Year Average
24	OPLAYrA	Operating Leverage Annual Average
25	BetaUnW	Beta Unweighted
26	BetaWei	Beta Weighted

Appendix 3(a): Financial Variables and Betas derived from weighted returns

Name	SecB	SecA	Lev5YrA	Lev3YrA	Pro5YrA	Pro3YrA	Gr5YrA	Gr3YrA	TA5YrA	TA3YrA	LTA5YrA	LTA3YrA	CA5YrA	CA3YrA	CL5YrA	CL3YrA	CR5YrA	CR3YrA
Bbond		1 A	0.095	0.036	0.0357	0.1171	-3.117	-4.359	6709524.8	6255974.667	6.827	6.796	6709524.8	6255974.667	1208777.4	947306.6667	5.551	6.604
REAV		1 A	0.230	0.269	0.0684	0.1077	9.159	12.629	813426.2	881670	5.910	5.945	813426.2	881670	337761	335905	2.408	2.625
SASINI		1 A	0.001	0.000	0.0518	0.1099	46.214	0.620	2456524.6	2496324	6.390	6.397	2456524.6	2496324	334881.6	372560	7.336	6.700
CMC		2 C	0.284	0.376	0.0692	0.1232	17.055	12.044	4012325.064	4454925.667	6.603	6.649	4012325.064	4454925.667	3355497.3	3609882.667	1.196	1.234
KENAIR		2 C	0.335	0.369	0.9370	0.1313	22.179	20.859	12084904.4	14098000	7.082	7.149	12084904.4	14098000	4957919.2	5175333.333	2.437	2.724
NMG		2 C	0.173	0.170	0.1881	0.1042	22.911	14.084	1994454	2298933.333	6.300	6.362	1994454	2298933.333	725638.2	850966.6667	2.749	2.702
SERENA		2 C	0.250	0.261	0.0883	0.1064	19.796	19.796	1114095.5	1152392	6.047	6.062	1114095.5	1152392	317704.5	322776.3333	3.507	3.570
UCHUMI		2 C	0.009	0.005	0.2543	0.1076	10.058	10.243	1582689.8	1767532.333	6.199	6.247	1582689.8	1767532.333	1208254.2	1324456	1.310	1.335
BAMB		3 I	0.019	0.030	0.0990	0.1053	30.717	8.168	11702972	12193666.67	7.068	7.086	11702972	12193666.67	2868776	2755333.333	4.079	4.425
BAT		3 I	0.124	0.068	0.1984	0.1021	6.417	4.236	6337155	6577248	6.802	6.818	6337155	6577248	3471256.8	3520559	1.826	1.868
PORTL		3 I	0.782	0.750	-0.0140	0.0769	76.844	1.605	5540543.476	5794425.333	6.744	6.763	5540543.476	5794425.333	728923.576	741435.6667	7.601	7.815
EACABLES		3 I	0.002	0.004	0.2418	0.0914	8.032	7.526	363809.6	399783.3333	5.561	5.602	363809.6	399783.3333	276193	288075.3333	1.317	1.388
FIRE		3 I	0.077	0.060	0.3725	0.0948	14.506	9.899	2448433.6	2672323	6.389	6.427	2448433.6	2672323	1517115	1545355.667	1.614	1.729
KNM		3 I	0.303	0.338	-0.0054	0.0527	8.971	5.898	1980011.8	2148068.333	6.297	6.332	1980011.8	2148068.333	3928347.4	4318234.667	0.504	0.497
KENOL		3 I	0.066	0.006	0.1804	0.0929	23.131	26.574	1230962.2	1467058	6.090	6.166	1230962.2	1467058	770744	948939	1.597	1.546
KPL		3 I	0.374	0.333	0.0938	0.0623	14.712	6.887	19215216	20996998.67	7.284	7.322	19215216	20996998.67	12545919	13159656	1.532	1.596
Total		3 I	0.606	0.618	0.1385	0.0466	16.034	13.707	3247079.2	3498845.333	6.511	6.544	3247079.2	3498845.333	4095450.6	4488258	0.793	0.780
Unga		3 I	0.227	0.254	0.0151	-0.0511	8.064	8.443	2767196	2988832.667	6.442	6.476	2767196	2988832.667	2033006.8	2204680	1.361	1.356

Appendix 3(a): Financial Variables and Betas derived from weighted returns

Name	SecB	SecA	BR5YrA	BR3YrA	LBR5YrA	LBR3YrA	DPR5YrA	DPR3YrA	OPL5YrA	OPL3YrA	OPLAYrA	BetaWei
Bbond		1 A	393449	380672	5.595	5.581	0.665	0.586	-2.136	-1.438	0.574	0.193
REAV		1 A	31921	30057	4.504	4.478	0.243	0.134	-13.041	-19.139	-10.313	0.388
SASINI		1 A	110994	106840	5.045	5.029	0.885	0.810	3.817	5.255	2.477	0.55
CMC		2 C	99493	110244	4.998	5.042	0.113	0.105	-3.421	-3.421	-0.945	0.351
KENAIR		2 C	1099276	1210194	6.041	6.083	0.151	0.252	0.300	0.714	-0.107	1.37
NMG		2 C	128487	148911	5.109	5.173	0.179	0.201	-2.680	-5.801	-1.167	0.807
SERENA		2 C	6844	6844	3.835	3.835	0.979	0.641	1.029	0.694	1.029	0.483
UCHUMI		2 C	67542	65491	4.830	4.816	0.814	0.783	-1.041	-2.219	-0.503	0.83
BAMB		3 I	531770	562160	5.726	5.750	0.480	0.526	2.554	2.332	2.237	2.04
BAT		3 I	379821	414937	5.580	5.618	0.661	0.611	9.463	13.408	4.550	0.403
PORTL		3 I	134873	195952	5.130	5.292	0.291	0.301	6.912	4.467	4.121	1.45
EACABLES		3 I	32798	32858	4.516	4.517	1.363	1.813	1.008	4.045	0.666	0.642
FIRE		3 I	106004	107537	5.025	5.032	0.704	0.696	2.330	2.889	1.574	0.872
KNM		3 I	204450	244856	5.311	5.389	0.567	0.158	-27.260	4.659	-9.915	0.699
KENOL		3 I	99260	107842	4.997	5.033	0.273	0.240	2.478	4.114	-1.332	0.622
KPL		3 I	724920	824957	5.860	5.916	0.241	0.349	-2.682	-5.314	-0.973	2.07
Total		3 I	236527	234413	5.374	5.370	0.606	0.663	3.580	3.122	1.099	1.09
Unga		3 I	216702	256619	5.336	5.409	0.357	0.157	-20.234	7.492	-5.115	1.26

Appendix 3(b): Financial Variables and Betas derived from unweighted returns

Code	SecB	SecA	Lev5Yr	Lev3Yr	Pro5YrA	Pro3YrA	Gr5YrA	Gr3YrA	TA5YrA	TA3YrA	LTA5YrA	LTA3YrA	CA5YrA	CA3YrA	CL5YrA	CL3YrA	CR5YrA	CR3YrA
Bbond	1	A	0.095	0.036	0.0357	0.1171	-3.117	-4.359	6709524.8	6255974.667	6.827	6.796	6709524.8	6255974.667	1208777.4	947306.6667	5.551	6.604
EGAADS	1	A	0.006	0.000	0.1371	0.1188	5.098	10.767	192912.9944	214021.779	5.285	5.330	192912.9944	214021.779	67058.537	84885.85833	2.877	2.521
GWK	1	A	0.129	0.092	0.0768	0.1169	11.084	19.766	1621155.2	1799905.333	6.210	6.255	1621155.2	1799905.333	354230.8	413401	4.577	4.354
KAKUZI	1	A	0.129	0.144	0.0520	0.1170	14.045	18.462	2577216.8	3016311.333	6.411	6.479	2577216.8	3016311.333	437509.2	476187	5.891	6.334
KAPCHO	1	A	0.023	0.023	0.1031	0.1193	10.046	15.737	419602	442758.6667	5.623	5.646	419602	442758.6667	144472.8	168215.6667	2.904	2.632
REAV	1	A	0.230	0.269	0.0684	0.1077	9.159	12.629	813426.2	881670	5.910	5.945	813426.2	881670	337761	335905	2.408	2.625
SASINI	1	A	0.001	0.000	0.0518	0.1099	46.214	0.620	2456524.6	2496324	6.390	6.397	2456524.6	2496324	334881.6	372560	7.336	6.700
CarGen	2	C	0.310	0.336	-0.0634	0.1157	-4.617	-5.698	767498.6	673943	5.885	5.829	767498.6	673943	322270.8	260483.3333	2.382	2.587
CMC	2	C	0.284	0.376	0.0692	0.1232	17.055	12.044	4012325.064	4454925.667	6.603	6.649	4012325.064	4454925.667	3355497.3	3609882.667	1.196	1.234
EXPRESS	2	C	0.274	0.307	0.0262	0.1258	4.713	1.350	887398.496	865350	5.948	5.937	887398.496	865350	483424	460683	1.836	1.878
KENAIR	2	C	0.335	0.369	0.9370	0.1313	22.179	20.859	12084904.4	14098000	7.082	7.149	12084904.4	14098000	4957919.2	5175333.333	2.437	2.724
MARSH	2	C	0.327	0.402	0.0136	0.0983	8.061	-14.781	2043155.2	2096437.333	6.310	6.321	2043155.2	2096437.333	1272853.4	1257842.333	1.605	1.667
NMG	2	C	0.173	0.170	0.1881	0.1042	22.911	14.084	1994454	2298933.333	6.300	6.362	1994454	2298933.333	725638.2	850966.6667	2.749	2.702
SMG	2	C	0.610	0.713	-0.0064	0.1001	29.753	33.884	375980.4	453190.6667	5.575	5.656	375980.4	453190.6667	256356.6	293861	1.467	1.542
SERENA	2	C	0.250	0.261	0.0883	0.1064	19.796	19.796	1114095.5	1152392	6.047	6.062	1114095.5	1152392	317704.5	322776.3333	3.507	3.570
UCHUMI	2	C	0.009	0.005	0.2543	0.1076	10.058	10.243	1582689.8	1767532.333	6.199	6.247	1582689.8	1767532.333	1208254.2	1324456	1.310	1.335
ATHI	4	I	0.312	0.291	0.0229	0.1003	10.998	10.998	1090439.043	1152440	6.038	6.062	1090439.043	1152440	255297.3068	284744	4.271	4.047
BAMB	4	I	0.019	0.030	0.0990	0.1053	30.717	8.168	11702972	12193666.67	7.068	7.086	11702972	12193666.67	2868776	2755333.333	4.079	4.425
BOC	4	I	0.006	0.007	0.1669	0.1070	7.129	5.037	1146703.4	1246905	6.059	6.096	1146703.4	1246905	561466.8	668923	2.042	1.864
BAT	4	I	0.124	0.068	0.1984	0.1021	6.417	4.236	6337155	6577248	6.802	6.818	6337155	6577248	3471256.8	3520559	1.826	1.868
CARB	4	I	0.000	0.000	0.1995	0.0924	10.359	11.745	538307.8	589843.3333	5.731	5.771	538307.8	589843.3333	250712.4	311716.6667	2.147	1.892
Cberg	4	I	0.327	0.244	0.0515	0.0812	4.868	-7.696	1030158.6	975523.6667	6.013	5.989	1030158.6	975523.6667	648705.2	572138.3333	1.588	1.705
DUN	4	I	0.021	0.011	0.2332	0.0825	21.017	18.368	98945.6	117314	4.995	5.069	98945.6	117314	71402.4	80047.33333	1.386	1.466
PORTL	4	I	0.782	0.750	-0.0140	0.0769	76.844	1.605	5540543.476	5794425.333	6.744	6.763	5540543.476	5794425.333	728923.576	741435.6667	7.601	7.815
EABL	4	I	0.180	0.167	0.0678	0.0895	5.311	5.518	13500419.6	14335306.67	7.130	7.156	13500419.6	14335306.67	4730464.2	5020230.333	2.854	2.856
EACABLES	4	I	0.002	0.004	0.2418	0.0914	8.032	7.526	363809.6	399783.3333	5.561	5.602	363809.6	399783.3333	276193	288075.3333	1.317	1.388
EAPACK	4	I	0.280	0.312	0.0289	0.0779	4.976	-4.312	795486.74	786988.6667	5.901	5.896	795486.74	786988.6667	579324.272	555750.6667	1.373	1.416
FIRE	4	I	0.077	0.060	0.3725	0.0948	14.506	9.899	2448433.6	2672323	6.389	6.427	2448433.6	2672323	1517115	1545355.667	1.614	1.729
KNM	4	I	0.303	0.338	-0.0054	0.0527	8.971	5.898	1980011.8	2148068.333	6.297	6.332	1980011.8	2148068.333	3928347.4	4318234.667	0.504	0.497
KENOL	4	I	0.066	0.006	0.1804	0.0929	23.131	26.574	1230962.2	1467058	6.090	6.166	1230962.2	1467058	770744	948939	1.597	1.546
KPL	4	I	0.374	0.333	0.0938	0.0623	14.712	6.887	19215216	20996998.67	7.284	7.322	19215216	20996998.67	12545919	13159656	1.532	1.596
Total	4	I	0.606	0.618	-0.1385	0.0466	16.034	13.707	3247079.2	3498845.333	6.511	6.544	3247079.2	3498845.333	4095450.6	4488258	0.793	0.780
Unga	4	I	0.227	0.254	0.0151	-0.0511	8.064	8.443	2767196	2988832.667	6.442	6.476	2767196	2988832.667	2033006.8	2204680	1.361	1.356

Appendix 3(b): Financial Variables and Betas derived from unweighted returns

Code	SecB	SecA	BR5YrA	BR3YrA	LBR5YrA	LBR3YrA	DPR5YrA	DPR3YrA	OPL5YrA	OPL3YrA	OPLAYrA	BetaUnw
Bbond	1	A	393449	380672	5.595	5.581	0.665	0.586	-2.136	-1.438	0.574	0.276
EGAADS	1	A	18678	20667	4.271	4.315	0.646	0.745	3.039	3.657	3.231	0.395
GWK	1	A	109640	118094	5.040	5.072	0.485	0.279	4.526	4.147	2.681	0.416
KAKUZI	1	A	90704	92914	4.958	4.968	0.524	0.579	0.454	-7.735	1.080	0.383
KAPCHO	1	A	30139	30403	4.479	4.483	0.255	0.373	12.612	-3.600	5.077	0.065
REAV	1	A	31921	30057	4.504	4.478	0.243	0.134	-13.041	-19.139	-10.313	0.401
SASINI	1	A	110994	106840	5.045	5.029	0.885	0.810	3.817	5.255	2.477	0.635
CarGen	2	C	43054	52976	4.634	4.724	0.421	0.000	-15.467	-21.733	-4.915	0.926
CMC	2	C	99493	110244	4.998	5.042	0.113	0.105	-3.421	-3.421	-0.945	0.513
EXPRESS	2	C	27315	27402	4.436	4.438	0.472	0.404	-29.728	-44.429	-8.994	0.584
KENAIR	2	C	1099276	1210194	6.041	6.083	0.151	0.252	0.300	0.714	-0.107	0.53
MARSH	2	C	55086	62477	4.741	4.796	0.359	0.308	-1.679	-7.090	-0.693	1.22
NMG	2	C	128487	148911	5.109	5.173	0.179	0.201	-2.680	-5.801	-1.167	0.525
SMG	2	C	20041	24764	4.302	4.394	0.055	-0.075	8.050	12.760	13.633	0.709
SERENA	2	C	6844	6844	3.835	3.835	0.979	0.641	1.029	0.694	1.029	0.453
UCHUMI	2	C	67542	65491	4.830	4.816	0.814	0.783	-1.041	-2.219	-0.503	0.521
ATHI	4	I	8538	8538	3.931	3.931	0.300	0.215	5.087	9.019	5.087	0.666
BAMB	4	I	531770	562160	5.726	5.750	0.480	0.526	2.554	2.332	2.237	1.31
BOC	4	I	58998	69906	4.771	4.845	0.530	0.468	8.591	8.591	8.591	0.12
BAT	4	I	379821	414937	5.580	5.618	0.661	0.611	9.463	13.408	4.550	0.392
CARB	4	I	33631	41628	4.527	4.619	0.313	0.337	0.996	0.753	1.300	2.46
Cberg	4	I	49203	46850	4.692	4.671	1.773	2.628	16.540	-8.280	6.917	0.564
DUN	4	I	9495	9648	3.977	3.984	0.514	0.550	1.261	-0.246	-0.115	19.4
PORTL	4	I	134873	195952	5.130	5.292	0.291	0.301	6.912	4.467	4.121	0.635
EABL	4	I	323653	358785	5.510	5.555	1.261	1.361	6.587	12.706	3.417	0.341
EACABLES	4	I	32798	32858	4.516	4.517	1.363	1.813	1.008	4.045	0.666	0.9
EAPACK	4	I	43464	46632	4.638	4.669	0.191	0.000	21.409	21.409	21.409	0.266
FIRE	4	I	106004	107537	5.025	5.032	0.704	0.696	2.330	2.889	1.574	0.869
KNM	4	I	204450	244856	5.311	5.389	0.567	0.158	-27.260	4.659	-9.915	0.75
KENOL	4	I	99260	107842	4.997	5.033	0.273	0.240	2.478	4.114	-1.332	0.764
KPL	4	I	724920	824957	5.860	5.916	0.241	0.349	-2.682	-5.314	-0.973	1.76
Total	4	I	236527	234413	5.374	5.370	0.606	0.663	3.580	3.122	1.099	1.1
Unga	4	I	216702	256619	5.336	5.409	0.357	0.157	-20.234	7.492	-5.115	1.93

Appendix 4: Correlation between betas from weighted and unweighted returns

9/20/03 12:23:14 PM

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Retrieving worksheet from file: A:\Beta.xls

Results for: Beta.xls

1 = Agriculture 2 = Commercial 4 = Industrial

Descriptive Statistics: BetaUnw, BetaW

Variable	N	Mean	Median	TrMean	StDev	SE Mean
BetaUnw	18	0.792	0.635	0.754	0.463	0.109
BetaW	18	0.896	0.753	0.866	0.551	0.130

Variable	Minimum	Maximum	Q1	Q3
BetaUnw	0.276	1.930	0.498	0.950
BetaW	0.193	2.070	0.463	1.288

Descriptive Statistics: BetaUnw, BetaW by SecB

Variable	SecB	N	Mean	Median	TrMean	StDev
BetaUnw	1	3	0.437	0.401	0.437	0.182
	2	5	0.5084	0.5210	0.5084	0.0316
	4	10	1.041	0.885	1.011	0.492
BetaW	1	3	0.377	0.388	0.377	0.179
	2	5	0.768	0.807	0.768	0.395
	4	10	1.115	0.981	1.084	0.588

Variable	SecB	SE Mean	Minimum	Maximum	Q1	Q3
BetaUnw	1	0.105	0.276	0.635	0.276	0.635
	2	0.0141	0.4530	0.5300	0.4830	0.5275
	4	0.156	0.392	1.930	0.721	1.423
BetaW	1	0.103	0.193	0.550	0.193	0.550
	2	0.176	0.351	1.370	0.417	1.100
	4	0.186	0.403	2.070	0.637	1.598

Correlations: BetaUnw, BetaW

Pearson correlation of BetaUnw and BetaW = 0.720
P-Value = 0.001
Conclusion = Tell You Same Thing. One can be indifferent to weighted or unweighted.

Discriminant Analysis: SecB versus BetaUnw, BetaW

Linear Method for Response: SecB
Predictors: BetaUnw BetaW

Group	1	2	4
Count	3	5	10

Summary of Classification

Put into	True Group....		
Group	1	2	4
1	3	2	3
2	0	3	1
4	0	0	6
Total N	3	5	10
N Correct	3	3	6
Proportion	1.000	0.600	0.600

N = 18 N Correct = 12 Proportion Correct = 0.667

Squared Distance Between Groups			
	1	2	4
1	0.00000	0.76315	2.81573
2	0.76315	0.00000	1.94461
4	2.81573	1.94461	0.00000

Linear Discriminant Function for Group			
	1	2	4
Constant	-0.6385	-1.2669	-3.8349
BetaUnw	2.8172	1.4924	5.5313
BetaW	0.1191	2.3106	1.7149

Summary of Misclassified Observations

Observation	True Group	Pred Group	Group	Squared Distance	Probability
4 **	2	1	1	0.08926	0.534
			2	1.16684	0.312
			4	2.57724	0.154
7 **	2	1	1	0.05875	0.466
			2	0.39882	0.393
			4	2.45114	0.141
10 **	4	1	1	0.04000	0.502
			2	0.56908	0.385
			4	3.01883	0.113
11 **	4	2	1	5.721	0.113
			2	2.305	0.624
			4	4.040	0.262
14 **	4	1	1	0.6798	0.349
			2	0.8600	0.318
			4	0.7706	0.333
* 15 **	4	1	1	0.7148	0.379
			2	1.2696	0.288
			4	0.9754	0.333

Appendix 5(a): Correlation matrix of variables (weighted returns)

9/20/03 10:33:16 AM

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Retrieving worksheet from file: A:\weightedVariables.xls

Correlations: Lev5YrA, Lev3YrA, Pro5YrA, Pro3YrA, Gr5YrA, Gr3YrA, TA5YrA, TA3YrA

	Lev5YrA	Lev3YrA	Pro5YrA	Pro3YrA	Gr5YrA	Gr3YrA	TA5YrA	TA3YrA
Lev3YrA	0.984							
	0.000							
Pro5YrA	-0.096	-0.079						
	0.704	0.757						
Pro3YrA	-0.284	-0.282	0.361					
	0.253	0.256	0.141					
Gr5YrA	0.459	0.429	-0.105	0.093				
	0.055	0.075	0.679	0.715				
Gr3YrA	0.004	0.045	0.458	0.105	-0.082			
	0.987	0.859	0.056	0.677	0.746			
TA5YrA	0.213	0.170	0.240	0.056	0.076	-0.154		
	0.395	0.501	0.337	0.825	0.765	0.541		
TA3YrA	0.225	0.186	0.287	0.057	0.079	-0.105	0.998	
	0.370	0.460	0.249	0.823	0.754	0.678	0.000	
LTA5YrA	0.310	0.268	0.175	0.022	0.180	-0.261	0.880	0.869
	0.211	0.283	0.488	0.931	0.474	0.296	0.000	0.000
LTA3YrA	0.314	0.274	0.204	0.021	0.182	-0.221	0.885	0.877
	0.204	0.270	0.418	0.934	0.470	0.379	0.000	0.000
CA5YrA	0.213	0.170	0.240	0.056	0.076	-0.154	1.000	0.998
	0.395	0.501	0.337	0.825	0.765	0.541	*	0.000
CA3YrA	0.225	0.186	0.287	0.057	0.079	-0.105	0.998	1.000
	0.370	0.460	0.249	0.823	0.754	0.678	0.000	*
CL5YrA	0.307	0.287	0.133	-0.182	-0.163	-0.033	0.830	0.842
	0.215	0.248	0.599	0.470	0.519	0.897	0.000	0.000
CL3YrA	0.319	0.302	0.131	-0.197	-0.160	-0.012	0.809	0.823
	0.196	0.224	0.605	0.432	0.526	0.961	0.000	0.000
CR5YrA	0.116	0.060	-0.222	0.275	0.699	-0.472	0.088	0.057
	0.647	0.813	0.376	0.269	0.001	0.048	0.729	0.823
CR3YrA	0.122	0.062	-0.205	0.295	0.638	-0.492	0.128	0.093
	0.629	0.808	0.414	0.235	0.004	0.038	0.614	0.714
BR5YrA	0.153	0.133	0.596	0.092	-0.054	0.031	0.857	0.872
	0.545	0.598	0.009	0.717	0.832	0.902	0.000	0.000

BR3YrA	0.189	0.169	0.589	0.065	-0.022	0.038	0.864	0.881
	0.452	0.502	0.010	0.797	0.932	0.882	0.000	0.000
LBR5YrA	0.158	0.118	0.295	-0.123	-0.012	-0.256	0.744	0.740
	0.531	0.642	0.235	0.628	0.963	0.306	0.000	0.000
LBR3YrA	0.205	0.163	0.275	-0.150	0.035	-0.256	0.742	0.740
	0.413	0.517	0.269	0.553	0.891	0.305	0.000	0.000
DPR5YrA	-0.422	-0.441	-0.092	0.069	-0.184	-0.269	-0.385	-0.404
	0.081	0.067	0.717	0.785	0.465	0.280	0.115	0.096
DPR3YrA	-0.388	-0.414	0.090	0.161	-0.122	-0.229	-0.207	-0.219
	0.111	0.087	0.724	0.524	0.630	0.361	0.410	0.384
OPL5YrA	-0.012	-0.097	0.258	0.525	0.391	0.033	0.181	0.172
	0.962	0.701	0.302	0.025	0.109	0.896	0.473	0.495
OPL3YrA	-0.036	-0.091	0.029	-0.306	0.155	-0.181	-0.032	-0.041
	0.886	0.721	0.908	0.217	0.540	0.473	0.900	0.872
OPLAYrA	0.006	-0.077	0.176	0.320	0.409	-0.173	0.241	0.224
	0.982	0.761	0.485	0.196	0.092	0.493	0.335	0.371
	LTA5YrA	LTA3YrA	CA5YrA	CA3YrA	CL5YrA	CL3YrA	CR5YrA	CR3YrA
LTA3YrA	0.999							
	0.000							
CA5YrA	0.880	0.885						
	0.000	0.000						
CA3YrA	0.869	0.877	0.998					
	0.000	0.000	0.000					
CL5YrA	0.677	0.691	0.830	0.842				
	0.002	0.002	0.000	0.000				
CL3YrA	0.656	0.672	0.809	0.823	0.999			
	0.003	0.002	0.000	0.000	0.000			
CR5YrA	0.218	0.188	0.088	0.057	-0.332	-0.353		
	0.384	0.454	0.729	0.823	0.178	0.151		
CR3YrA	0.257	0.225	0.128	0.093	-0.320	-0.344	0.990	
	0.303	0.369	0.614	0.714	0.195	0.162	0.000	
BR5YrA	0.795	0.807	0.857	0.872	0.675	0.659	-0.016	0.031
	0.000	0.000	0.000	0.000	0.002	0.003	0.949	0.904
BR3YrA	0.797	0.810	0.864	0.881	0.693	0.677	-0.020	0.024
	0.000	0.000	0.000	0.000	0.001	0.002	0.938	0.926
LBR5YrA	0.842	0.849	0.744	0.740	0.622	0.609	-0.000	0.037
	0.000	0.000	0.000	0.000	0.006	0.007	0.999	0.883
LBR3YrA	0.846	0.855	0.742	0.740	0.622	0.610	0.012	0.048
	0.000	0.000	0.000	0.000	0.006	0.007	0.962	0.850
DPR5YrA	-0.501	-0.528	-0.385	-0.404	-0.359	-0.364	0.059	0.041
	0.034	0.024	0.115	0.096	0.144	0.138	0.815	0.872
DPR3YrA	-0.405	-0.421	-0.207	-0.219	-0.240	-0.247	0.030	0.020
	0.095	0.082	0.410	0.384	0.338	0.322	0.905	0.939

OPL5YrA	0.204	0.201	0.181	0.172	-0.082	-0.097	0.384	0.373
	0.416	0.425	0.473	0.495	0.745	0.701	0.116	0.128
OPL3YrA	0.143	0.136	-0.032	-0.041	-0.046	-0.045	0.057	0.025
	0.572	0.591	0.900	0.872	0.857	0.858	0.822	0.923
OPLAYrA	0.339	0.328	0.241	0.224	-0.035	-0.053	0.440	0.430
	0.168	0.183	0.335	0.371	0.889	0.836	0.068	0.075
BR3YrA	BR5YrA	BR3YrA	LBR5YrA	LBR3YrA	DPR5YrA	DPR3YrA	OPL5YrA	OPL3YrA
	0.998							
	0.000							
LBR5YrA	0.816	0.813						
	0.000	0.000						
LBR3YrA	0.806	0.807	0.997					
	0.000	0.000	0.000					
DPR5YrA	-0.379	-0.402	-0.465	-0.493				
	0.121	0.098	0.052	0.037				
DPR3YrA	-0.219	-0.241	-0.304	-0.334	0.897			
	0.384	0.335	0.219	0.176	0.000			
OPL5YrA	0.092	0.075	0.024	0.013	0.206	0.405		
	0.718	0.767	0.924	0.960	0.413	0.096		
OPL3YrA	0.065	0.070	0.238	0.256	0.358	0.285	0.250	
	0.797	0.784	0.341	0.306	0.145	0.252	0.317	
OPLAYrA	0.143	0.131	0.146	0.145	0.285	0.430	0.910	0.511
	0.571	0.605	0.564	0.566	0.252	0.075	0.000	0.030

Cell Contents: Pearson correlation
P-Value

Appendix 5(b): Correlation matrix of variables (unweighted returns)

Correlations: Lev5Yr, Lev3Yr, Pro5YrA, Pro3YrA, Gr5YrA, Gr3YrA, TA5YrA, TA3YrA,

	Lev5Yr	Lev3Yr	Pro5YrA	Pro3YrA	Gr5YrA	Gr3YrA	TA5YrA	TA3YrA
Lev3Yr	0.981 0.000							
Pro5YrA	-0.201 0.262	-0.198 0.268						
Pro3YrA	-0.255 0.152	-0.232 0.194	0.221 0.216					
Gr5YrA	0.386 0.027	0.360 0.040	0.036 0.844	-0.023 0.901				
Gr3YrA	-0.030 0.868	0.000 0.999	0.330 0.060	0.086 0.635	0.224 0.210			
TA5YrA	0.158 0.380	0.109 0.545	0.254 0.154	-0.064 0.723	0.137 0.446	-0.075 0.679		
TA3YrA	0.164 0.361	0.119 0.510	0.291 0.101	-0.061 0.734	0.143 0.427	-0.045 0.803	0.998 0.000	
LTA5YrA	0.243 0.173	0.194 0.278	0.158 0.379	-0.106 0.557	0.195 0.278	-0.194 0.278	0.833 0.000	0.826 0.000
LTA3YrA	0.239 0.180	0.193 0.283	0.184 0.307	-0.109 0.545	0.212 0.236	-0.149 0.409	0.837 0.000	0.833 0.000
CA5YrA	0.158 0.380	0.109 0.545	0.254 0.154	-0.064 0.723	0.137 0.446	-0.075 0.679	1.000 *	0.998 0.000
CA3YrA	0.164 0.361	0.119 0.510	0.291 0.101	-0.061 0.734	0.143 0.427	-0.045 0.803	0.998 0.000	1.000 *
CL5YrA	0.250 0.160	0.217 0.226	0.195 0.276	-0.259 0.145	-0.022 0.903	-0.039 0.830	0.858 0.000	0.867 0.000
CL3YrA	0.255 0.153	0.223 0.213	0.196 0.274	-0.270 0.128	-0.018 0.920	-0.021 0.909	0.845 0.000	0.855 0.000
CR5YrA	0.012 0.948	-0.044 0.809	-0.182 0.311	0.290 0.102	0.540 0.001	-0.073 0.685	0.111 0.539	0.093 0.606
CR3YrA	0.040 0.825	-0.018 0.923	-0.170 0.346	0.292 0.099	0.507 0.003	-0.093 0.605	0.154 0.391	0.134 0.457
BR5YrA	0.125 0.487	0.093 0.607	0.588 0.000	-0.031 0.864	0.085 0.637	0.044 0.808	0.853 0.000	0.866 0.000
BR3YrA	0.151 0.402	0.118 0.512	0.582 0.000	-0.052 0.773	0.109 0.547	0.046 0.798	0.858 0.000	0.873 0.000
LBR5YrA	0.101 0.574	0.057 0.755	0.304 0.085	-0.196 0.275	0.109 0.544	-0.140 0.437	0.766 0.000	0.765 0.000
LBR3YrA	0.132 0.464	0.089 0.624	0.290 0.102	-0.211 0.239	0.135 0.454	-0.138 0.444	0.764 0.000	0.763 0.000

DPR5YrA	-0.248	-0.321	-0.043	-0.029	-0.198	-0.322	-0.033	-0.051
OPLAYrA	0.164	0.068	0.812	0.873	0.270	0.068	0.855	0.779
DPR3YrA	-0.212	-0.293	0.071	0.003	-0.135	-0.276	0.031	0.020
	0.237	0.098	0.696	0.989	0.452	0.120	0.865	0.912
OPL5YrA	-0.045	-0.107	0.133	0.216	0.196	0.070	0.038	0.035
	0.803	0.554	0.461	0.227	0.274	0.698	0.833	0.845
OPL3YrA	-0.028	-0.051	0.104	-0.292	0.200	0.197	0.113	0.111
	0.875	0.777	0.564	0.099	0.265	0.273	0.530	0.537
OPLAYrA	0.083	0.063	-0.026	0.100	0.126	0.020	-0.048	-0.052
	0.645	0.729	0.886	0.579	0.483	0.913	0.791	0.772
BetaUnw	-0.161	-0.158	0.106	-0.151	0.077	0.155	-0.100	-0.098
	0.371	0.379	0.557	0.401	0.669	0.388	0.580	0.589
LTA5YrA	LTA5YrA	LTA3YrA	CA5YrA	CA3YrA	CL5YrA	CL3YrA	CR5YrA	CR3YrA
LTA3YrA	0.998							
	0.000							
CA5YrA	0.833	0.837						
	0.000	0.000						
CA3YrA	0.826	0.833	0.998					
	0.000	0.000	0.000					
CL5YrA	0.692	0.701	0.858	0.867				
	0.000	0.000	0.000	0.000				
CL3YrA	0.681	0.691	0.845	0.855	0.999			
	0.000	0.000	0.000	0.000	0.000			
CR5YrA	0.241	0.232	0.111	0.093	-0.244	-0.257		
	0.176	0.194	0.539	0.606	0.171	0.149		
CR3YrA	0.289	0.278	0.154	0.134	-0.219	-0.235	0.989	
	0.103	0.117	0.391	0.457	0.221	0.189	0.000	
BR5YrA	0.744	0.753	0.853	0.866	0.740	0.727	0.024	0.076
	0.000	0.000	0.000	0.000	0.000	0.000	0.894	0.674
BR3YrA	0.744	0.754	0.858	0.873	0.753	0.742	0.019	0.068
	0.000	0.000	0.000	0.000	0.000	0.000	0.914	0.705
LBR5YrA	0.868	0.873	0.766	0.765	0.682	0.674	0.074	0.122
	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.498
LBR3YrA	0.864	0.869	0.764	0.763	0.681	0.674	0.075	0.122
	0.000	0.000	0.000	0.000	0.000	0.000	0.679	0.500
DPR5YrA	-0.029	-0.047	-0.033	-0.051	-0.093	-0.099	0.019	0.018
	0.874	0.793	0.855	0.779	0.606	0.584	0.917	0.921
DPR3YrA	-0.028	-0.039	0.031	0.020	-0.038	-0.044	-0.016	-0.014
	0.879	0.827	0.865	0.912	0.836	0.806	0.931	0.937
OPL5YrA	-0.036	-0.031	0.038	0.035	-0.112	-0.118	0.190	0.164
	0.841	0.863	0.833	0.845	0.536	0.514	0.290	0.363
OPL3YrA	0.112	0.131	0.113	0.111	0.075	0.081	0.038	0.007
	0.535	0.469	0.530	0.537	0.679	0.654	0.833	0.967

OPLAYrA	-0.114	-0.114	-0.048	-0.052	-0.157	-0.163	0.104	0.081
	0.529	0.529	0.791	0.772	0.382	0.365	0.566	0.655
BetaUnw	-0.393	-0.379	-0.100	-0.098	-0.066	-0.065	-0.163	-0.157
	0.024	0.029	0.580	0.589	0.714	0.719	0.365	0.383
BR3YrA	BR5YrA	BR3YrA	LBR5YrA	LBR3YrA	DPR5YrA	DPR3YrA	OPL5YrA	OPL3YrA
	0.998							
	0.000							
LBR5YrA	0.814	0.811						
	0.000	0.000						
LBR3YrA	0.807	0.808	0.997					
	0.000	0.000	0.000					
DPR5YrA	-0.141	-0.158	-0.063	-0.094				
	0.433	0.381	0.728	0.601				
DPR3YrA	-0.062	-0.077	-0.019	-0.051	0.935			
	0.732	0.670	0.914	0.776	0.000			
OPL5YrA	-0.029	-0.039	-0.072	-0.078	0.182	0.314		
	0.871	0.829	0.692	0.668	0.309	0.075		
OPL3YrA	0.109	0.112	0.155	0.168	0.035	0.011	0.614	
	0.547	0.535	0.390	0.351	0.847	0.952	0.000	
OPLAYrA	-0.100	-0.104	-0.144	-0.135	0.032	0.109	0.869	0.650
	0.580	0.563	0.426	0.453	0.862	0.545	0.000	0.000
BetaUnw	-0.095	-0.092	-0.271	-0.272	-0.033	-0.007	-0.026	-0.007
	0.600	0.609	0.127	0.126	0.854	0.967	0.885	0.970
	OPLAYrA							
BetaUnw	-0.084							
	0.642							

Cell Contents: Pearson correlation
P-Value
Highlighted figures are significant

Appendix 6: Regression Analysis

Regression Analysis: BetaWei versus Lev5YrA, Pro5YrA, ...

The regression equation is
BetaWei = - 6.03 - 0.331 Lev5YrA + 0.059 Pro5YrA + 0.0277 Gr5YrA
+ 0.982 LTA5YrA - 0.173 CR5YrA + 0.049 LBR5YrA + 0.512 DPR5YrA
- 0.0160 OPL5YrA

Predictor	Coef	SE Coef	T	P	VIF
Constant	-6.030	2.429	-2.48	0.035	
Lev5YrA	-0.3308	0.6943	-0.48	0.645	1.8
Pro5YrA	0.0593	0.6033	0.10	0.924	1.4
Gr5YrA	0.02772	0.01127	2.46	0.036	3.4
LTA5YrA	0.9817	0.5860	1.68	0.128	5.6
CR5YrA	-0.17300	0.08714	-1.99	0.078	2.9
LBR5YrA	0.0490	0.4398	0.11	0.914	4.6
DPR5YrA	0.5115	0.4541	1.13	0.289	2.0
OPL5YrA	-0.01601	0.01625	-0.99	0.350	1.9

S = 0.4524 R-Sq = 64.3% R-Sq(adj) = 32.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	3.3204	0.4150	2.03	0.156
Residual Error	9	1.8422	0.2047		
Total	17	5.1626			

No replicates. Cannot do pure error test.

Source	DF	Seq SS
Lev5YrA	1	0.5617
Pro5YrA	1	0.1595
Gr5YrA	1	0.2972
LTA5YrA	1	1.1980
CR5YrA	1	0.7508
LBR5YrA	1	0.0194
DPR5YrA	1	0.1349
OPL5YrA	1	0.1988

Durbin-Watson statistic = 1.99

Regression Analysis: BetaWei versus Lev5YrA, Pro5YrA, ...

The regression equation is
BetaWei = - 7.32 - 0.372 Lev5YrA + 0.027 Pro5YrA + 0.0301 Gr5YrA + 1.16 LTA5YrA
- 0.180 CR5YrA + 0.046 LBR5YrA + 0.732 DPR5YrA - 0.0525 OPLAYrA

Predictor	Coef	SE Coef	T	P	VIF
Constant	-7.322	2.864	-2.56	0.031	
Lev5YrA	-0.3717	0.6792	-0.55	0.598	1.8
Pro5YrA	0.0269	0.5665	0.05	0.963	1.3
Gr5YrA	0.03009	0.01149	2.62	0.028	3.7
LTA5YrA	1.1632	0.6224	1.87	0.094	6.6
CR5YrA	-0.18008	0.08518	-2.11	0.064	2.9
LBR5YrA	0.0461	0.4242	0.11	0.916	4.5
DPR5YrA	0.7320	0.5195	1.41	0.192	2.7
OPLAYrA	-0.05247	0.04293	-1.22	0.253	2.7

S = 0.4410 R-Sq = 66.1% R-Sq(adj) = 36.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	3.4121	0.4265	2.19	0.132
Residual Error	9	1.7505	0.1945		
Total	17	5.1626			

No replicates. Cannot do pure error test.

Source	DF	Seq SS
Lev5YrA	1	0.5617
Pro5YrA	1	0.1595
Gr5YrA	1	0.2972
LTA5YrA	1	1.1980
CR5YrA	1	0.7508
LBR5YrA	1	0.0194
DPR5YrA	1	0.1349
OPLAYrA	1	0.2905

Unusual Observations

Obs	Lev5YrA	BetaWei	Fit	SE Fit	Residual	St Resid
14	0.303	0.699	1.250	0.351	-0.551	-2.06R

R denotes an observation with a large standardized residual

Durbin-Watson statistic = 1.86

Regression Analysis: BetaWei versus Lev3YrA, Pro3YrA, ...

The regression equation is

BetaWei = - 7.03 + 0.113 Lev3YrA - 8.54 Pro3YrA + 0.0368 Gr3YrA + 1.09 LTA3YrA
+ 0.0659 CR3YrA + 0.122 LBR3YrA + 0.814 DPR3YrA - 0.0295 OPL3YrA

Predictor	Coef	SE Coef	T	P	VIF
Constant	-7.034	2.017	-3.49	0.007	
Lev3YrA	0.1127	0.5199	0.22	0.833	1.4
Pro3YrA	-8.537	3.147	-2.71	0.024	1.9
Gr3YrA	0.03683	0.01773	2.08	0.068	1.9
LTA3YrA	1.0890	0.5069	2.15	0.060	5.4
CR3YrA	0.06594	0.06049	1.09	0.304	1.9
LBR3YrA	0.1224	0.3897	0.31	0.761	5.0
DPR3YrA	0.8141	0.3359	2.42	0.038	2.0
OPL3YrA	-0.02951	0.01752	-1.68	0.126	1.6

S = 0.3951 R-Sq = 72.8% R-Sq(adj) = 48.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	3.7580	0.4697	3.01	0.061
Residual Error	9	1.4046	0.1561		
Total	17	5.1626			

No replicates. Cannot do pure error test.

Source	DF	Seq SS
Lev3YrA	1	0.4895
Pro3YrA	1	0.3024
Gr3YrA	1	0.0052
LTA3YrA	1	1.9178

CR3YrA	1	0.0549
LBR3YrA	1	0.0000
DPR3YrA	1	0.5453
OPL3YrA	1	0.4429

Unusual Observations						
Obs	Lev3YrA	BetaWei	Fit	SE Fit	Residual	St Resid
1	0.036	0.1930	0.8486	0.2556	-0.6556	-2.18R

R denotes an observation with a large standardized residual

Durbin-Watson statistic = 1.62

Regression Analysis: BetaWei versus Lev3YrA, Pro3YrA, ...

The regression equation is
 BetaWei = - 9.08 + 0.225 Lev3YrA - 6.39 Pro3YrA + 0.0415 Gr3YrA + 1.52 LTA3YrA
 + 0.0887 CR3YrA - 0.125 LBR3YrA + 1.02 DPR3YrA - 0.0590 OPLAYrA

Predictor	Coef	SE Coef	T	P	VIF
Constant	-9.077	3.020	-3.01	0.015	
Lev3YrA	0.2253	0.5408	0.42	0.687	1.4
Pro3YrA	-6.392	2.993	-2.14	0.061	1.5
Gr3YrA	0.04152	0.01978	2.10	0.065	2.2
LTA3YrA	1.5244	0.6443	2.37	0.042	7.9
CR3YrA	0.08873	0.06990	1.27	0.236	2.3
LBR3YrA	-0.1250	0.4137	-0.30	0.769	5.1
DPR3YrA	1.0200	0.4658	2.19	0.056	3.6
OPLAYrA	-0.05898	0.04418	-1.33	0.215	3.2

S = 0.4140 R-Sq = 70.1% R-Sq(adj) = 43.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	3.6204	0.4526	2.64	0.085
Residual Error	9	1.5422	0.1714		
Total	17	5.1626			

No*replicates. Cannot do pure error test.

Source	DF	Seq SS
Lev3YrA	1	0.4895
Pro3YrA	1	0.3024
Gr3YrA	1	0.0052
LTA3YrA	1	1.9178
CR3YrA	1	0.0549
LBR3YrA	1	0.0000
DPR3YrA	1	0.5453
OPLAYrA	1	0.3053

Durbin-Watson statistic = 2.21

Response is BetaWei on 8 predictors, with N = 18

best alt.

P-Value 0.205

The regression equation is $\hat{y} = 0.0000 + 0.0000x$, with $R^2 = 0.0000$.

$$S = 0.4551 \quad R\text{-Sq} = 35.8\% \quad R\text{-Sq}(\text{adj}) = 31.8\%$$

No replicates. Cannot do pure error test.

R denotes an observation with a large standardized residual

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Regression Analysis: BetaWei versus Lev5YrA

The regression equation is
BetaWei = 0.707 + 0.856 Lev5YrA

Predictor	Coef	SE Coef	T	P
Constant	0.7073	0.1847	3.83	0.001
Lev5YrA	0.8564	0.6127	1.40	0.181

S = 0.5362 R-Sq = 10.9% R-Sq(adj) = 5.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.5617	0.5617	1.95	0.181
Residual Error	16	4.6009	0.2876		
Total	17	5.1626			

No replicates. Cannot do pure error test.

Unusual Observations

Obs	Lev5YrA	BetaWei	Fit	SE Fit	Residual	St Resid
9	0.019	2.040	0.724	0.176	1.316	2.60R
11	0.782	1.450	1.377	0.367	0.073	0.19 X
16	0.374	2.070	1.028	0.158	1.042	2.03R

R denotes an observation with a large standardized residual
X denotes an observation whose X value gives it large influence.

Durbin-Watson statistic = 2.13

Stepwise Regression: BetaWei versus Lev3YrA, Pro3YrA, ...

Alpha-to-Enter: 0.15 Alpha-to-Remove: 0.15

Response is BetaWei on 8 predictors, with N = 18

Step	1
Constant	-4.132
LTA3YrA	0.77
T-Value	3.12
P-Value	0.007
S	0.448
R-Sq	37.78
R-Sq(adj)	33.89
C-p	6.6

Best alt.	
Variable	LBR3YrA
T-Value	2.68
P-Value	0.017
Variable	Pro3YrA
T-Value	-1.35
P-Value	0.197
Variable	Lev3YrA
T-Value	1.29
P-Value	0.214
Variable	DPR3YrA

-0.57

A	0.78
e	3.36
e	0.004

Lev5Yr, Lev3Yr, Pro5YrA, Pro3YrA, Gr5YrA, Gr3YrA

	Mean	Median	Trimmed	Stdev	SE Mean
0.420					
48.80	0.3959	0.1803	0.1897	0.1334	0.0327
41.98	0.3179	0.1708	0.1907	0.2000	0.0362
4.9	0.1248	0.0788	0.0957	0.1137	0.0164

lt.	11.50	14.35	17.00	14.95	13.65	
le	Gr3YrA	11.50	14.35	17.00	14.95	13.65

Gr3YRA	0.78	0.450
--------	------	-------

	0.450	0.500	0.550	0.600	0.650
Lev3YrA	0.2322	0.2598	0.2868	0.3134	0.3395
	0.72	0.73	0.74	0.75	0.76

0.72	4.2412	7.3957	6.3676	10.5125	9.8026
0.481	3416.749	1623.156	2247.534	4493.336	7818.92

Le	DPR3YrA	13	365301E	738930E	2236503	4879217	749373
e	0.64	13	1479434	568795	1326228	1443286	425316
	0.521						

e	0.531	1742086	688728	1351804	2872580	547992
le	CR3YrA	0.554	0.982	3.472	1.790	0.312

e	-0.55	2.705	1.878	2.533	2.836	3.200
e	0.589	2874.78	28704	287145	284864	400

Appendix 6: Regression Analysis

9/20/03 12:01:23 PM

Welcome to Minitab, press F1 for help.
Retrieving worksheet from file: A:\UnweightedVariables.xls

Results for: UnweightedVariables.xls

Descriptive Statistics: Lev5Yr, Lev3Yr, Pro5YrA, Pro3YrA, Gr5YrA, Gr3YrA, TA5YrA

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Lev5Yr	33	0.2089	0.1803	0.1897	0.1934	0.0337
Lev3Yr	33	0.2119	0.1700	0.1907	0.2080	0.0362
Pro5YrA	33	0.1249	0.0768	0.0997	0.1737	0.0302
Pro3YrA	33	0.09467	0.10215	0.09902	0.03297	0.00574
Gr5YrA	33	14.99	10.36	13.08	14.98	2.61
Gr3YrA	33	9.03	9.90	8.97	10.12	1.76
TA5YrA	33	3414749	1621155	2747559	4491396	781852
TA3YrA	33	3663916	1799905	2939503	4879227	849364
LTA5YrA	33	6.2322	6.2098	6.2402	0.5346	0.0931
LTA3YrA	33	6.2617	6.2552	6.2676	0.5319	0.0926
CA5YrA	33	3414749	1621155	2747559	4491396	781852
CA3YrA	33	3663916	1799905	2939503	4879227	849364
CL5YrA	33	1670234	648705	1292256	2443256	425316
CL3YrA	33	1752086	668923	1355824	2572890	447883
CR5YrA	33	2.664	2.042	2.472	1.790	0.312
CR3YrA	33	2.705	1.878	2.533	1.836	0.320
BR5YrA	33	167478	90704	127145	234584	40836
BR3YrA	33	183426	92914	138018	258254	44956
LBR5YrA	33	4.9006	4.9576	4.8983	0.5512	0.0960
LBR3YrA	33	4.9341	4.9681	4.9331	0.5600	0.0975
DPR5YrA	33	0.5355	0.4801	0.4954	0.3787	0.0659
DPR3YrA	33	0.5212	0.3729	0.4425	0.5358	0.0933
OPL5YrA	33	0.10	1.26	0.77	10.89	1.90
OPL3YrA	33	-0.13	2.33	0.94	11.75	2.04
OPLAYrA	33	1.38	1.08	1.06	6.08	1.06
BetaUnw	33	1.296	0.584	0.715	3.291	0.573

Variable	Minimum	Maximum	Q1	Q3
Lev5Yr	0.0000	0.7821	0.0222	0.3114
Lev3Yr	0.0000	0.7501	0.0170	0.3340
Pro5YrA	-0.0634	0.9370	0.0275	0.1842
Pro3YrA	-0.05112	0.13132	0.08597	0.11634
Gr5YrA	-4.62	76.84	6.77	20.41
Gr3YrA	-14.78	33.88	2.92	14.91
TA5YrA	98946	19215216	804456	3629702
TA3YrA	117314	20996999	826169	3976886
LTA5YrA	4.9954	7.2836	5.9055	6.5574
LTA3YrA	5.0693	7.3222	5.9166	6.5964
CA5YrA	98946	19215216	804456	3629702
CA3YrA	117314	20996999	826169	3976886
CL5YrA	67059	12545919	319988	2450891
CL3YrA	80047	13159656	317247	2480007
CR5YrA	0.504	7.601	1.426	3.206
CR3YrA	0.497	7.815	1.504	3.213
BR5YrA	6844	1099276	32360	210576
BR3YrA	6844	1210194	31631	239634
LBR5YrA	3.8353	6.0411	4.5100	5.3232

LBR3YrA	3.8353	6.0829	4.4998	5.3794
DPR5YrA	0.0554	1.7730	0.2639	0.6629
DPR3YrA	-0.0751	2.6282	0.2079	0.6524
OPL5YrA	-29.73	21.41	-2.41	5.84
OPL3YrA	-44.43	21.41	-4.46	4.96
OPLAYrA	-10.31	21.41	-0.96	3.77
BetaUnw	0.065	19.400	0.398	0.913

Descriptive Statistics: Lev5Yr, Lev3Yr, ... by SecB

Variable	SecB	N	Mean	Median	TrMean	StDev
Lev5Yr	1	7	0.0875	0.0948	0.0875	0.0839
	2	9	0.2859	0.2843	0.2859	0.1583
	4	17	0.2181	0.1803	0.1950	0.2230
Lev3Yr	1	7	0.0805	0.0356	0.0805	0.0983
	2	9	0.3264	0.3355	0.3264	0.1911
	4	17	0.2055	0.1666	0.1829	0.2230
Pro5YrA	1	7	0.0750	0.0684	0.0750	0.0349
	2	9	0.167	0.069	0.167	0.305
	4	17	0.1230	0.0990	0.1155	0.1063
Pro3YrA	1	7	0.11525	0.11703	0.11525	0.00456
	2	9	0.11251	0.10756	0.11251	0.01194
	4	17	0.07675	0.08947	0.08326	0.03728
Gr5YrA	1	7	13.22	10.05	13.22	15.56
	2	9	14.43	17.06	14.43	10.72
	4	17	16.00	10.36	12.69	17.25
Gr3YrA	1	7	10.52	12.63	10.52	9.13
	2	9	10.20	12.04	10.20	14.75
	4	17	7.80	7.53	7.58	7.85
TA5YrA	1	7	2112909	1621155	2112909	2234080
	2	9	2762500	1582690	2762500	3655088
	4	17	4296108	1980012	3581312	5476100
TA3YrA	1	7	2158138	1799905	2158138	2086581
	2	9	3095634	1767532	3095634	4299624
	4	17	4584798	2148068	3788484	5887528
LTA5YrA	1	7	6.094	6.210	6.094	0.524
	2	9	6.217	6.199	6.217	0.438
	4	17	6.297	6.297	6.318	0.600
LTA3YrA	1	7	6.121	6.255	6.121	0.510
	2	9	6.246	6.247	6.246	0.454
	4	17	6.328	6.332	6.346	0.593
CA5YrA	1	7	2112909	1621155	2112909	2234080
	2	9	2762500	1582690	2762500	3655088
	4	17	4296108	1980012	3581312	5476100
CA3YrA	1	7	2158138	1799905	2158138	2086581
	2	9	3095634	1767532	3095634	4299624
	4	17	4584798	2148068	3788484	5887528
CL5YrA	1	7	412099	337761	412099	374356
	2	9	1433324	725638	1433324	1637886
	4	17	2313712	770744	1781052	3062855
CL3YrA	1	7	399780	372560	399780	277912
	2	9	1506254	850967	1506254	1729423
	4	17	2439063	948939	1881625	3221741
CR5YrA	1	7	4.506	4.577	4.506	1.855
	2	9	2.054	1.836	2.054	0.769
	4	17	2.229	1.597	1.985	1.710
CR3YrA	1	7	4.539	4.354	4.539	1.982
	2	9	2.138	1.878	2.138	0.792
	4	17	2.250	1.705	1.996	1.755
BR5YrA	1	7	112218	90704	112218	130062

	2	9	171904	55086	171904	349911
	4	17	187889	106004	164043	201760
BR3YrA	1	7	111378	92914	111378	125382
	2	9	189923	62477	189923	385142
	4	17	209654	107842	182041	224281
LBR5YrA	1	7	4.842	4.958	4.842	0.453
	2	9	4.770	4.741	4.770	0.613
	4	17	4.994	5.025	5.007	0.568
LBR3YrA	1	7	4.847	4.968	4.847	0.445
	2	9	4.811	4.796	4.811	0.620
	4	17	5.035	5.033	5.050	0.581
DPR5YrA	1	7	0.5290	0.5238	0.5290	0.2302
	2	9	0.394	0.359	0.394	0.321
	4	17	0.613	0.514	0.564	0.445
DPR3YrA	1	7	0.5008	0.5789	0.5008	0.2478
	2	9	0.2911	0.2525	0.2911	0.2830
	4	17	0.651	0.468	0.563	0.681
OPL5YrA	1	7	1.32	3.04	1.32	7.81
	2	9	-4.96	-1.68	-4.96	11.13
	4	17	2.27	2.55	2.96	11.51
OPL3YrA	1	7	-2.69	-1.44	-2.69	8.65
	2	9	-7.84	-3.42	-7.84	16.42
	4	17	5.01	4.11	4.80	6.98
OPLAYrA	1	7	0.69	2.48	0.69	5.07
	2	9	-0.30	-0.69	-0.30	6.06
	4	17	2.56	1.57	2.13	6.53
BetaUnw	1	7	0.3673	0.3950	0.3673	0.1712
	2	9	0.6646	0.5300	0.6646	0.2528
	4	17	2.01	0.76	0.98	4.52

Variable	SecB	SE Mean	Minimum	Maximum	Q1	Q3
Lev5Yr	1	0.0317	0.0006	0.2304	0.0059	0.1291
	2	0.0528	0.0089	0.6100	0.2118	0.3308
	4	0.0541	0.0000	0.7821	0.0203	0.3197
Lev3Yr	1	0.0372	0.0000	0.2688	0.0000	0.1443
	2	0.0637	0.0048	0.7129	0.2152	0.3890
	4	0.0541	0.0000	0.7501	0.0091	0.3225
Pro5YrA	1	0.0132	0.0357	0.1371	0.0518	0.1031
	2	0.102	-0.063	0.937	0.004	0.221
	4	0.0258	-0.0140	0.3725	0.0259	0.1990
Pro3YrA	1	0.00172	0.10769	0.11930	0.10986	0.11884
	2	0.00398	0.09829	0.13132	0.10218	0.12449
	4	0.00904	-0.05112	0.10700	0.06961	0.09755
Gr5YrA	1	5.88	-3.12	46.21	5.10	14.04
	2	3.57	-4.62	29.75	6.39	22.54
	4	4.18	4.87	76.84	6.77	18.53
Gr3YrA	1	3.45	-4.36	19.77	0.62	18.46
	2	4.92	-14.78	33.88	-2.17	20.33
	4	1.90	-7.70	26.57	4.64	11.37
TA5YrA	1	844403	192913	6709525	419602	2577217
	2	1218363	375980	12084904	827449	3027740
	4	1328149	98946	19215216	912823	5938849
TA3YrA	1	788653	214022	6255975	442759	3016311
	2	1433208	453191	14098000	769647	3376930
	4	1427935	117314	20996999	881256	6185837
LTA5YrA	1	0.198	5.285	6.827	5.623	6.411
	2	0.146	5.575	7.082	5.917	6.457
	4	0.145	4.995	7.284	5.957	6.773
LTA3YrA	1	0.193	5.330	6.796	5.646	6.479
	2	0.151	5.656	7.149	5.883	6.505
	4	0.144	5.069	7.322	5.943	6.791
CA5YrA	1	844403	192913	6709525	419602	2577217
	2	1218363	375980	12084904	827449	3027740

	4	1328149	98946	19215216	912823	5938849
CA3YrA	1	788653	214022	6255975	442759	3016311
	2	1433208	453191	14098000	769647	3376930
	4	1427935	117314	20996999	881256	6185837
CL5YrA	1	141493	67059	1208777	144473	437509
	2	545962	256357	4957919	319988	2314175
	4	742851	71402	12545919	418830	3699802
CL3YrA	1	105041	84886	947307	168216	476187
	2	576474	260483	5175333	308319	2467169
	4	781387	80047	13159656	433734	3919397
CR5YrA	1	0.701	2.408	7.336	2.877	5.891
	2	0.256	1.196	3.507	1.388	2.593
	4	0.415	0.504	7.601	1.367	2.501
CR3YrA	1	0.749	2.521	6.700	2.625	6.604
	2	0.264	1.234	3.570	1.438	2.713
	4	0.426	0.497	7.815	1.402	2.374
BR5YrA	1	49159	18678	393449	30139	110994
	2	116637	6844	1099276	23678	113990
	4	48934	8538	724920	38547	280090
BR3YrA	1	47390	20667	380672	30057	118094
	2	128381	6844	1210194	26083	129578
	4	54396	8538	824957	44130	307702
LBR5YrA	1	0.171	4.271	5.595	4.479	5.045
	2	0.204	3.835	6.041	4.369	5.053
	4	0.138	3.931	5.860	4.582	5.442
LBR3YrA	1	0.168	4.315	5.581	4.478	5.072
	2	0.207	3.835	6.083	4.416	5.108
	4	0.141	3.931	5.916	4.644	5.482
DPR5YrA	1	0.0870	0.2430	0.8848	0.2546	0.6651
	2	0.107	0.055	0.979	0.132	0.643
	4	0.108	0.191	1.773	0.296	0.682
DPR3YrA	1	0.0937	0.1342	0.8101	0.2790	0.7451
	2	0.0943	-0.0751	0.7833	0.0526	0.5226
	4	0.165	0.000	2.628	0.228	0.680
OPL5YrA	1	2.95	-13.04	12.61	-2.14	4.53
	2	3.71	-29.73	8.05	-9.44	0.66
	4	2.79	-27.26	21.41	1.00	7.75
OPL3YrA	1	3.27	-19.14	5.26	-7.74	4.15
	2	5.47	-44.43	12.76	-14.41	0.70
	4	1.69	-8.28	21.41	1.54	8.80
OPLAYrA	1	1.92	-10.31	5.08	0.57	3.23
	2	2.02	-8.99	13.63	-3.04	0.46
	4	1.58	-9.91	21.41	-0.54	4.82
BetaUnw	1	0.0647	0.0650	0.6350	0.2760	0.4160
	2	0.0843	0.4530	1.2200	0.5170	0.8175
	4	1.10	0.12	19.40	0.48	1.54

Appendix 6: Regression Analysis

Regression Analysis: BetaUnw versus Lev5Yr, Pro5YrA, ...

The regression equation is
BetaUnw = 16.6 - 3.10 Lev5Yr + 1.32 Pro5YrA + 0.0800 Gr5YrA - 2.90 LTA5YrA
- 0.410 CR5YrA + 0.64 LBR5YrA + 0.08 DPR5YrA - 0.0254 OPL5YrA

Predictor	Coef	SE Coef	T	P
Constant	16.609	7.288	2.28	0.032
Lev5Yr	-3.103	3.883	-0.80	0.432
Pro5YrA	1.323	3.940	0.34	0.740
Gr5YrA	0.08002	0.05524	1.45	0.160
LTA5YrA	-2.903	2.527	-1.15	0.262
CR5YrA	-0.4101	0.4575	-0.90	0.379
LBR5YrA	0.635	2.376	0.27	0.791
DPR5YrA	0.079	1.646	0.05	0.962
OPL5YrA	-0.02536	0.05716	-0.44	0.661

S = 3.270 R-Sq = 25.9% R-Sq(adj) = 1.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	89.89	11.24	1.05	0.428
Residual Error	24	256.65	10.69		
Total	32	346.54			

Source	DF	Seq SS
Lev5Yr	1	8.96
Pro5YrA	1	1.97
Gr5YrA	1	7.07
LTA5YrA	1	56.68
CR5YrA	1	12.07
LBR5YrA	1	1.01
DPR5YrA	1	0.02
OPL5YrA	1	2.11

Unusual Observations

Obs	Lev5Yr	BetaUnw	Fit	SE Fit	Residual	St Resid
11	0.335	0.530	0.871	3.055	-0.341	-0.29 X
23	0.021	19.400	6.000	1.735	13.400	4.83R

R denotes an observation with a large standardized residual
X denotes an observation whose X value gives it large influence.

Regression Analysis: BetaUnw versus Lev5Yr, Pro5YrA, ...

The regression equation is
BetaUnw = 17.3 - 2.81 Lev5Yr + 1.16 Pro5YrA + 0.0785 Gr5YrA - 3.00 LTA5YrA
- 0.404 CR5YrA + 0.65 LBR5YrA - 0.00 DPR5YrA - 0.0709 OPLAYrA

Predictor	Coef	SE Coef	T	P
Constant	17.271	7.315	2.36	0.027
Lev5Yr	-2.813	3.876	-0.73	0.475
Pro5YrA	1.158	3.850	0.30	0.766
Gr5YrA	0.07849	0.05445	1.44	0.162
LTA5YrA	-3.002	2.513	-1.19	0.244
CR5YrA	-0.4036	0.4534	-0.89	0.382

LBR5YrA	0.648	2.355	0.28	0.786
DPR5YrA	-0.000	1.601	-0.00	1.000
OPLAYrA	-0.07088	0.09720	-0.73	0.473

S = 3.248 R-Sq = 26.9% R-Sq(adj) = 2.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	93.39	11.67	1.11	0.393
Residual Error	24	253.15	10.55		
Total	32	346.54			

Source	DF	Seq SS
Lev5Yr	1	8.96
Pro5YrA	1	1.97
Gr5YrA	1	7.07
LTA5YrA	1	56.68
CR5YrA	1	12.07
LBR5YrA	1	1.01
DPR5YrA	1	0.02
OPLAYrA	1	5.61

Unusual Observations

Obs	Lev5Yr	BetaUnw	Fit	SE Fit	Residual	St Resid
11	0.335	0.530	0.832	3.022	-0.302	-0.25 X
23	0.021	19.400	6.160	1.744	13.240	4.83R

R denotes an observation with a large standardized residual
X denotes an observation whose X value gives it large influence.

Regression Analysis: BetaUnw versus Lev3Yr, Pro3YrA, ...

The regression equation is
BetaUnw = 18.2 - 2.39 Lev3Yr - 25.9 Pro3YrA + 0.0445 Gr3YrA - 2.80 LTA3YrA
+ 0.076 CR3YrA + 0.62 LBR3YrA - 0.15 DPR3YrA - 0.0213 OPL3YrA

Predictor	Coef	SE Coef	T	P
Constant	18.201	8.069	2.26	0.033
Lev3Yr	-2.388	3.252	-0.73	0.470
Pro3YrA	-25.93	21.42	-1.21	0.238
Gr3YrA	0.04453	0.06478	0.69	0.498
LTA3YrA	-2.798	2.519	-1.11	0.278
CR3YrA	0.0759	0.3679	0.21	0.838
LBR3YrA	0.617	2.319	0.27	0.793
DPR3YrA	-0.149	1.222	-0.12	0.904
OPL3YrA	-0.02126	0.05595	-0.38	0.707

S = 3.353 R-Sq = 22.2% R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	76.76	9.60	0.85	0.567
Residual Error	24	269.78	11.24		
Total	32	346.54			

Source	DF	Seq SS
Lev3Yr	1	8.67

Pro3YrA	1	12.94
Gr3YrA	1	10.38
LTA3YrA	1	41.92
CR3YrA	1	0.17
LBR3YrA	1	0.82
DPR3YrA	1	0.23
OPL3YrA	1	1.62

Unusual Observations						
Obs	Lev3Yr	BetaUnw	Fit	SE Fit	Residual	St Resid
23	0.011	19.400	5.162	1.620	14.238	4.85R

R denotes an observation with a large standardized residual

Regression Analysis: BetaUnw versus Lev3Yr, Pro3YrA, ...

The regression equation is
BetaUnw = 18.8 - 1.97 Lev3Yr - 22.4 Pro3YrA + 0.0393 Gr3YrA - 2.93 LTA3YrA
+ 0.080 CR3YrA + 0.59 LBR3YrA - 0.07 DPR3YrA - 0.053 OPLAYrA

Predictor	Coef	SE Coef	T	P
Constant	18.795	8.069	2.33	0.029
Lev3Yr	-1.971	3.251	-0.61	0.550
Pro3YrA	-22.38	20.22	-1.11	0.279
Gr3YrA	0.03926	0.06219	0.63	0.534
LTA3YrA	-2.927	2.518	-1.16	0.256
CR3YrA	0.0804	0.3666	0.22	0.828
LBR3YrA	0.589	2.311	0.25	0.801
DPR3YrA	-0.074	1.231	-0.06	0.952
OPLAYrA	-0.0534	0.1005	-0.53	0.600

S = 3.343 R-Sq = 22.6% R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	78.30	9.79	0.88	0.550
Residual Error	24	268.24	11.18		
Total	32	346.54			

Source	DF	Seq SS
Lev3Yr	1	8.67
Pro3YrA	1	12.94
Gr3YrA	1	10.38
LTA3YrA	1	41.92
CR3YrA	1	0.17
LBR3YrA	1	0.82
DPR3YrA	1	0.23
OPLAYrA	1	3.16

Unusual Observations						
Obs	Lev3Yr	BetaUnw	Fit	SE Fit	Residual	St Resid
23	0.011	19.400	5.240	1.628	14.160	4.85R

R denotes an observation with a large standardized residual

Stepwise Regression: BetaUnw versus Lev5Yr, Pro5YrA, ...

Alpha-to-Enter: 0.15 Alpha-to-Remove: 0.15

Response is BetaUnw on 8 predictors, with N = 33

Step	1
Constant	16.36
LTA5YrA	-2.4
T-Value	-2.38
P-Value	0.024
S	3.07
R-Sq	15.42
R-Sq(adj)	12.69
C-p	-1.6

best alt.	
Variable	LBR5YrA
T-Value	-1.57
P-Value	0.127
Variable	CR5YrA
T-Value	-0.92
P-Value	0.365
Variable	Lev5Yr
T-Value	-0.91
P-Value	0.371
Variable	Pro5YrA
T-Value	0.59
P-Value	0.557

Stepwise Regression: BetaUnw versus Lev3Yr, Pro3YrA, ...

Alpha-to-Enter: 0.15 Alpha-to-Remove: 0.15

Response is BetaUnw on 8 predictors, with N = 33

Step	1
Constant	15.99
LTA3YrA	-2.3
T-Value	-2.28
P-Value	0.029
S	3.09
R-Sq	14.39
R-Sq(adj)	11.63
C-p	-2.6

Best alt.	
Variable	LBR3YrA
T-Value	-1.57
P-Value	0.126
Variable	Lev3Yr
T-Value	-0.89
P-Value	0.379
Variable	CR3YrA
T-Value	-0.88
P-Value	0.383
Variable	Gr3YrA

T-Value	0.88
p-Value	0.388