AN EMPIRICAL INVESTIGATION OF THE INTER-RELATIONSHIPS BETWEEN SYSTEMATIC RISK, FINANCIAL LEVERAGE AND OPERATING LEVERAGE OF INDUSTRIAL COMPANIES LISTED ON THE JOHANNESBURG STOCK EXCHANGE

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ABSTRACT

The Capital Asset Pricing Model (CAPM) postulates that beta is a quantitative measure of a company's undiversifiable risk, the determinants of which are of considerable interest to financial managers and investors alike. Analytical research has shown that beta is a positive function of a company's unlevered or asset beta and its market value debt to equity ratio (i.e. financial leverage). In turn, unlevered beta has been shown to be a positive function of a company's operating leverage, and the trade-off between operating and financial leverage proposed as a means of stabilising beta.

The objective of this research was to empirically determine the nature of the relationships between: beta and financial leverage; beta and operating leverage; and financial and operating leverage. A significant level of positive association was hypothesised between beta and both financial and operating leverage, while a significant negative association was hypothesised between financial leverage and operating leverage.

Prior empirical research has tended to examine the three relationships in isolation and has proved inconclusive with respect to the significance of the associations in each. In the case of the beta/operating leverage and financial leverage/operating leverage relationships prior research has also proved inconclusive with respect to the direction of association. This study has shown that the inconsistencies may be attributable to a failure on the part of prior research to adequately distinguish the different risks inherent in financial leverage and their impact on the inter-relationships.

This study examines the inter-relationships based on a distinction between the default and interest risks of financial leverage, as proposed by the theory of risk assessment of fixed income instruments. Cross sectional and time series estimates of financial and operating leverage are drawn from the balance sheet, income statement and cash flow statement. The hypotheses are tested by means of a cross sectional correlation analysis at both individual

share and portfolio levels, with distinctions drawn between the associations at high and low levels of the independent variables.

The results indicate a marked difference between the associations of the default and interest risk measures of financial leverage, and the balance sheet as opposed to the income statement and cash flow associations. The income statement and cash flow measures did not indicate significant association, except in the beta/ financial leverage relationship where the income statement measure indicated the hypothesised significant positive association.

The balance sheet measures of default risk financial leverage indicated a highly significant positive relationship with beta. These measures explained as much as 14% of the variability in beta at the company level, and 53% at the portfolio level. Companies with higher betas exhibited greater association with default risk than their low beta counterparts. On the other hand, balance sheet measures of interest risk financial leverage did not indicate significant association with beta.

The balance sheet measures of operating leverage did not indicate significant association with beta and exhibited a negative slope coefficient which, while contradicting the hypothesised association, is consistent with the majority of prior empirical findings. On the other hand, the balance sheet measures of operating leverage indicated a highly significant positive association with unlevered (or asset) beta. These measures of leverage were shown to explain as much as 29% of the variability in unlevered beta at the single company level and 72% at the portfolio level.

The balance sheet measures of default risk financial leverage indicated highly significant negative associations with operating leverage. Operating leverage was shown to explain as much as 32% of the variability in default risk financial leverage at the single company level, and 83% at the portfolio level. Companies with higher levels of operating leverage where found to engage in trade-offs more actively than their lower operating leverage counterparts. On the other hand, interest risk measures of financial leverage did not indicate significant association with operating leverage.

The results indicate that the relevant decision variables for financial managers and investors are balance sheet measures of both default risk financial leverage and operating leverage. The distinction between default and interest risks provides a basis for the reconciliation of the findings of prior research. The results suggest that in assessing the impact of changes in operating leverage on beta, companies and investors should look beyond a static *ceteris paribus* framework and consider the impact of the accompanying changes in default risk, which may counteract the impact of operating leverage. Finally, the results indicate that South African Industrial companies do appear to be engaging in trade-offs of operating leverage and default risk and that these trade-offs are likely to be effective in stabilising both total and systematic risk.

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I certify that, except as noted above, this report is my own work and all references are accurately quoted. The acknowledgements are in no way intended as a disclaimer and I accept full responsibility for errors, omissions and the opinions expressed in this report.

Mark Timothy Troughton Signed by candidate

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CHAPTER ONE : INTRODUCTION, SCOPE AND HYPOTHESES

1.1 INTRODUCTION

Over the last fifty years, Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM) have been developed to provide an important theoretical framework for the understanding of share pricing, investor behaviour and risk. According to the CAPM the equilibrium expected return on a share is a function of a risk free rate and a return premium that reflects compensation for the risk inherent in the share.

The crux of the CAPM is that risk is not to be measured in terms of the total variability of a share's returns, but in terms of the co-variability of a share's return with all other shares in the market. The co-movement of the return on a share with the return on the market is termed systematic risk and is measured by beta. Beta is synonymous with systematic risk and is a quantitative measure of a company's riskiness.

Systematic risk, as a market measure of risk, is the result of interactive decisions by investors in the market and is beyond the control of the individual firm or investor. This combined with the complexities of beta measurement has restricted use of beta as a decision variable at company level. The determinants of beta and the extent to which they are controllable are therefore of considerable interest to investors and financial managers alike.

Without analysing the decision processes of investors, the best means of researching the determinants of beta is to identify controllable measures of risk that explain its variability.

This type of research should be guided by a theoretical model linking the firm's investment and production decisions with beta **[Foster (1978)]**. Such a theoretical model is provided by **Hamada (1972,p.45)** and **Rubinstein (1973,p.167)**. Hamada and Rubinstein showed that systematic risk is composed of financial risk and operating risk, the primary determinants of which are financial and operating leverage respectively. Accountants express these measures of leverage in terms of financial ratios which are easily calculated and controllable at the corporate level. Accounting measures of financial and operating leverage are therefore theoretically consistent determinants of beta.

The relationship between operating and financial leverage has been proposed as a means of stabilising beta. According to **Mandelker & Rhee (1984,p.47)** this trade off hypothesis enables companies to offset any movement in systematic risk resulting from a change in operating (financial) leverage by effecting an opposite change to financial (operating) leverage. The validity of the trade-off theory as a means of stabilising systematic risk is therefore dependent upon significant positive association existing between systematic risk and both financial and operating leverage, and results in a significant degree of negative association between operating and financial leverage.

While conceptual support exists for significant inter-relationships between systematic risk, financial leverage and operating leverage, the empirical evidence both locally and internationally has proved more contradictory than conclusive. The Hamada-Rubenstein formulations are based on a dynamic interaction of the three variables, yet prior research has focused on single aspects of the formulations in isolation.

A knowledge of the extent to which, and the way in which, accounting measures of financial and operating leverage are impounded into the measurement of systematic risk of a company and the relationship between these leverage measures is necessary for the following reasons:

i. It would enable company managers to assess the effect of their capital and asset structure decisions on systematic risk.

ii. It would enable investors to predict any future variations in a firm's systematic risk on the basis of accounting figures.

iii. It would indicate whether or not South African companies engage in trade-offs of financial and operating leverage, and thereby provide investors with greater predictive ability with respect to corporate strategy.

iv. It would give an indication of the effectiveness of trade-offs in stabilising systematic risk and therefore the feasibility of trade-offs as wealth maximisation strategies.

v. It would enable accountants to develop and present accounting risk measures of greater usefulness to both managers and investors.

1.2 OBJECTIVES AND RESEARCH QUESTIONS

The objectives of this study are to empirically determine the nature of the relationships between the following variables:

1. Systematic risk and financial leverage.
2. Systematic risk and operating leverage.
3. Financial leverage and operating leverage.

The objectives will be achieved by answering the following research questions in respect of each of the three relationships.

i. Does a significant relationship exist between the variables? (Primary question)

And if so:

ii. To what extent does the independent variable explain the variability in the dependent variable?

iii. Are changes in the independent variable reflected in the dependent variable instantaneously and without bias, i.e. is the association contemporaneous (first order) or lagged?

iv. Is the association a function of the level of leverage (independent variable), i.e. do higher leverage companies exhibit more significant relationships than lower leverage companies, or vice versa ?

v. With respect to financial leverage, is the association significantly different for default risk measures than it is for interest risk measures[1] ?

vi. Does the association change as individual shares are aggregated into portfolios and specific risk is diversified away?

vii. Is the association dependent upon the component of the financial statements from which the variables are drawn, i.e. balance sheet, income statement or cash flow statement?

1.3 THE HYPOTHESES

Each of the primary research questions has a corresponding primary hypothesis. These are:

1(a) A significant degree of positive contemporaneous association exists between beta and default risk measures of financial leverage. Statistically:

$$H_0 : r(FL_{default}, B) \leq 0$$
$$H_1 : r(FL_{default}, B) > 0$$

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1 *This study draws a distinction between the default and interest risks inherent in financial leverage. Default risk is the risk of non repayment of debt while interest risk is the increased variability in firm cash flows caused by the introduction of an interest obligation. The risks are explained in more detail in Section 5.2.4.*

Where:

$r(FL_{default},B)$ = correlation coefficient between default risk measures of financial leverage and beta.

1(b) A significant degree of positive contemporaneous association exists between beta and interest risk measures of financial leverage. Statistically:

$H_0 : r(FL_{interest},B) \leq 0$

$H_1 : r(FL_{interest},B) > 0$

Where:

$r(FL_{interest},B)$ = correlation coefficient between interest risk measures of financial leverage and beta.

2. A significant degree of positive contemporaneous association exists between operating leverage and beta[2]. Statistically:

$H_0 : r(OL,B) \leq 0$

$H_1 : r(OL,B) > 0$

Where:

$r(OL,B)$ = correlation coefficient between operating leverage and beta.

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2 *The association between operating leverage and measures of both levered beta and unlevered beta will be examined. The hypotheses for both relationships are the same. Unlevered beta is discussed in Section 5.3.2.*

3(a) A significant degree of negative association exists between operating leverage and default risk measures of financial leverage. Statistically:

$H_0 : r(OL, FL_{default}) \geq 0$
$H_1 : r(OL, FL_{default}) < 0$

Where:

$r(OL, FL_{default})$ = correlation coefficient between operating leverage and default risk measures of financial leverage.

3(b) No significant association exists between operating leverage and interest risk measures of financial leverage. Statistically:

$H_0 : r(OL, FL_{interest}) > 0$
$H_1 : r(OL, FL_{interest}) = 0$

Where:

$r(OL, FL_{interest})$ = correlation coefficient between operating leverage and interest risk measures of financial leverage.

1.4 SCOPE AND LIMITATIONS

The examination of the inter-relationships between systematic risk, financial leverage and operating leverage results in a broad scope and is possibly the reason why prior research has focused on single aspects of the inter-relationships. The examination of the interaction between all three variables is one of the major contributions of this study and is the reason for the adoption of such a broad scope. Each of the three relationships examined have ancillary issues which, while interesting, do not relate directly to this study. Considering the inherently

broad scope of this study, the discussion of these issues has been restricted as far as possible to retain focus. The issues excluded from the scope of this study include:

i. The examination of the relationship between operating and financial leverage has capital structure research implications. This study examines the relationship to the extent that it is a significant factor in the inter-relationships specified by the **Hamada (1972,p.45)**, **Rubenstein (1973,p.167)** and **Mandelker & Rhee (1984,p.47)** formulations, and not in the context of capital structure research.

   A full review of the massive body of capital structure theory and empirical research is beyond the scope of this report. Theory and empirical research will be examined to the extent that they relate directly to this report, i.e. to the extent that operating leverage surrogates have been examined as possible determinants of capital structure. General capital studies such as **Titi, Sandler & Ward (1995,p.58)** and those relating to the impact of ownership structure such as **Gerson & Barr (1992)** and sections of **Davidson & Rapp (1995,p.90)** will therefore not be reviewed.

ii. While **Retief, Affleck-Graves & Hamman (1986,p.159)** suggest that the riskiness of returns on South African shares is a function of other variables as well as leverage, this study is limited to examining the relationship between beta and financial and operating leverage. Studies relating to accounting betas as measures of systematic risk will therefore not be reviewed.

This study is subject to the following limitations:[3]

i. The expectations based CAPM is used in this study as an ex-post (historical) model.

ii. The market portfolio specified by the CAPM is substituted by proxy indices.

iii. The validity of the assumptions underlying the CAPM and Modigliani-Miller capital structure propositions[4].

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[3] *Limitations will be discussed in greater detail in the appropriate sections later in the report.*

[4] *These assumptions are discussed in Chapter 2, Sections 2.4.2 and 2.5 respectively.*

iv. Financial ratios produced may not be representative of "true" leverage as a result of off-balance sheet financing, non disclosure of costs according to behavioural classification and accounting manipulation of data.

v. The use of financial ratios as a control for size differences across firms depends upon the strict assumption of proportionality between the numerator and denominator. **McDonald & Morris (1984,p.89) and (1985,p.96)** have shown that while the assumption appears reasonable with respect to intra-industry comparisons, there is doubt as to its reasonability with respect to cross industry comparisons. This study assumes strict proportionality and is limited to the extent that an undetected departure from this assumption may significantly impact the results.

vi. The correlation analyses performed are not sufficient to prove a cause and effect relationship and therefore conclusions may be drawn on association but not on causation.

vii. The two variable ordinary least squares (OLS) regression model employed by this study is subject to certain assumptions. While the compliance with the most important of these assumptions will be tested for, a limitation exists to the extent that violations of these assumptions remain undetected.

1.5 ORGANISATION OF THE REPORT

This report is structured to follow a logical research sequence and is divided into three distinct parts. The first part relates to the theory and prior research. The second part relates to the measurement and data collection phase of the study while the third part discusses the empirical testing and results. The report is subsequently concluded. More specifically:

Part One of the report (Theory and Prior Research) consists of Chapters Two and Three. Chapter Two establishes a theoretical basis for measures of operating and financial leverage

and beta, and provides a synthesised theory justifying the inter-relationships between the three variables. Chapter Three reviews prior research that has been published both locally and internationally, and establishes scope for this research.

Part Two of the report (Measurement) consists of Chapters Four and Five. Chapter Four details the sample selection procedures and the measurement of systematic risk, while Chapter Five discusses the measurement of leverage and the formation of portfolios.

Part Three of this report (Testing) consists of Chapters Six to Nine. Chapter Six discusses the empirical testing methodology, incorporating the choice of regression model and the standardised correlation analysis. The specific regression variables, regression results and interpretation of the inter-relationships are examined in chapters seven to nine as follows:

i. Chapter Seven : The relationship between systematic risk and financial leverage.
ii. Chapter Eight : The relationship between systematic risk and operating leverage.
iii. Chapter Nine : The trade-off between financial and operating leverage.

The research is summarised and concluded in Chapter Ten. Implications of the research findings are discussed and future research recommendations on the topic are made.

Part One :

Theory and

Prior Research

CHAPTER TWO : THEORETICAL RESEARCH AND JUSTIFICATION

2.1 INTRODUCTION

The objective of this chapter is to review prior theoretical research relating to the inter-relationships between financial leverage, operating leverage and systematic risk in order to place this study in context and to provide an *a priori* justification for its empirical testing.

Extensive theoretical research has been conducted into the inter-relationships examined by this study. This includes research relating to the underlying variables in the form of the CAPM and capital structure research such as the Modigliani-Miller propositions. The prior research is well documented both in published analytical papers and in finance texts. It is not the intention of this chapter to exhaustively detail such research or their mathematical proofs, but to review their assumptions and conclusions to the extent that they relate directly to this study.

As the concepts of systematic risk, financial leverage and operating leverage relate directly to the risk return trade-off it is necessary to establish the concept of total risk and its interaction with leverage measures through business and financial risks.

This chapter consists of seven sections and is designed to follow a logical theoretical sequence. The first section discusses the concept of leverage. The second section reviews the concept of total risk and its business and financial risk components while section three

outlines market (systematic) risk in the context of the CAPM and the Market Model. The fourth section traces the development of the Modigliani-Miller capital structure propositions. Section five integrates the CAPM and the Modigliani-Miller propositions and establishes the theoretical relationships between systematic risk, financial leverage and operating leverage. The sixth section reviews theoretical research into the trade-off between financial and operating leverage and the chapter is summarised in section seven.

2.2 LEVERAGE

Helfert (1977,p.243) described leverage as the often favourable condition of having a stable element of cost support a wide range of profit levels. Leverage appears both in the operating and financing areas of financial management.

2.2.1 Operating leverage

In the operating enviroment leverage appears where part of the costs of the operation are fixed over a broad range of operating volumes. Profits are boosted or depressed in greater proportion, relative to the changes in volume. **Foster (1984,p.344)** defines operating leverage as the ratio of fixed to variable costs. **McDaniel (1984,p.124)** criticises the traditional definition used by Foster and defines operating leverage as a function of the ratio of fixed cost to contribution margin.

A more rigorous definition is applied by **O'Brein & Vanderheiden (1987,p.45)** who state that "operating leverage refers to the single period magnification of the uncertainty of operating income relative to the uncertainty of sales". According to the authors, the degree of operating leverage (DOL) can be represented by the ratio of the percentage deviation of operating income (X_t) from its expectation [$E(X_t)$] to the percentage deviation of sales revenues (S_t) from its expectation [$E(S_t)$], or:

$$DOL = \{[X_t/E(X_t)]-1\} / \{[S_t/E(S_t)]-1\} \quad (2.1)$$

Where:

DOL = the degree of operating leverage.

X_t = the realised operating earnings (i.e. before interest and taxation) in period t.

S_t = the realised sales in time period t.

$E(.)$ = the expected value of (.).

When the total revenue and total operating cost functions are deterministic, linear and independent of one another (i.e. the classical or traditional model), DOL is constant over all possible values for S_t, and in this case:

$$DOL = [E(S_t) - VC] / [E(S_t) - VC - FC] \quad (2.2)$$

Where:

VC = variable costs.

FC = fixed costs.

All other symbols have been previously defined.

Equation (2.2) indicates that in the classical model, the DOL can be determined as the ratio of the contribution margin at the expected level of sales to the operating income at the expected level of sales. As **O'Brein & Vanderheiden (1987,p.46)** point out, "in the classical model differences in the DOL are due solely to differences in the level of fixed and variable operating costs". **Brigham & Gapenski (1994,p.524)** extend this principle and state that if a high proportion of a firm's total costs are fixed, then the firm is said to have a high degree of operating leverage.

2.2.2 Financial leverage

In the financing enviroment leverage refers to the use of debt financing in the capital structure. When the firm employing the debt financing earns a greater return on its assets than it pays on the debt used to finance the assets, the returns to the ordinary shareholders are magnified by the differential (incremental) return and are said to be "levered up". Conversely, if the return on assets is less than the cost of debt the returns to shareholders are "levered down" by the differential (decremental) return.

Within the O'Brein & Vanderheiden framework discussed in operating leverage, financial leverage is the single period magnification of the uncertainty of operating income after interest relative to the uncertainty of operating income (before interest). The degree of financial leverage (DFL) can therefore be represented by the ratio of the percentage deviation of operating income after interest (P_t) from its expectation [$E(P_t)$] to the percentage deviation of operating income (before interest) (X_t) from its expectation [$E(X_t)$], or:

$$DFL = \{[P_t/E(P_t)]-1\} / \{[X_t/E(X_t)]-1\} \qquad (2.3)$$

Where:

DFL = the degree of financial leverage.

P_t = the realised operating earnings after interest in the period t.

All other symbols have been previously defined.

Under the assumptions of the classical model, the DFL may be written as follows:

$$DFL = [E(St) - VC - FC] / [E(St) - VC - FC - I] \qquad (2.4)$$

Where:

I = Interest expense.

All other symbols have been previously defined.

Equation (2.4) indicates that, for a given level of profitability, the higher the proportion of debt, and therefore interest expense, the greater the degree of financial leverage. For the purpose of financial statement based ratios, the term financial leverage will be used synonymously with the proportion of debt in the capital structure.

Brigham & Gapenski (1994,p.528) point out that the risk of financial leverage is not only to the extent of the fixed interest charge that is introduced by the debt, but even if the debt is assumed to be free of the risk of default, its introduction magnifies or concentrates the business risk on common stockholders. They argue that if a company with a given level of business risk[1] substitutes half of its equity financing with debt financing, the same level of business risk is now distributed over half the equity holders, with a magnifying or "levering" effect.

2.3 TOTAL RISK

This section examines the interaction between business and financial risk from a total risk perspective. For the purposes of this report, the total risk of an asset is defined as the potential deviation between actual and expected outcomes, where the outcomes refer to the magnitude of either accounting earnings or cash flow generated by the asset. Where the asset represents the ordinary shares of a company, total risk may be quantified as the variability (standard deviation or σ) in the return on equity (ROE). ROE is defined as net income to ordinary shareholders (i.e. after interest and taxation) divided by ordinary shareholders' equity.

$$\text{Total risk} = \sigma_{ROE} \tag{2.5}$$

Where:

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1 *The concepts of risk and business risk are discussed in Section 2.3.*

σ_{ROE} = the standard deviation of the ROE.

Hampton (1982,p.13), Brealey & Myers (1991,p.189) and **Brigham & Gapenski (1994,p.520)** divide total risk into business risk and financial risk. Mathematically:

$$\text{Total risk} = \text{Business risk} + \text{Financial risk} \tag{2.6}$$

2.3.1 Business risk

Business risk, in a total risk sense, is the risk of a company's assets if it uses no debt. According to **Brigham & Gapenski (1994,p.521)** it is measured by the uncertainty inherent in the projections of a company's rate of return on assets (ROA) and can be quantified as the standard deviation of the ROA. Mathematically:

$$\text{Business risk} = \sigma_{ROA} \tag{2.7}$$

Where:

σ_{ROA} = the standard deviation of the ROA.

ROA = (Net income to ordinary shareholders + Interest expense)/ Total assets.

Where no debt has been used in the capital structure of the firm, there are no interest payments and the total assets are equal to the equity. The ROA of such a firm will therefore be equal to its ROE as defined in equation (2.5). The business risk in formula (2.7) is therefore equal to the $\sigma_{ROE\ (U)}$, where $_{(U)}$ denotes an unlevered firm, i.e. a firm which does not utilise financial leverage.

Practically, business risk depends on a number of factors. These include: operating leverage, demand variability, sales price variability, input cost variability, ability to adjust output prices for changes in input costs, ability to innovate in terms of new products, and the threat of

substitute products. The financial literature reviewed differed in respect of the components of business risk. The one factor that all the reviewed literature had in common, and which was indicated as being dominant, was operating leverage or DOL [for examples see **Correia, Flynn, Uliana & Wormald (1993,p.85)**, **Brealey & Myers (1991,p.200)** and **Brigham & Gapenski (1994,p.524)**]. Operating leverage is therefore a theoretically consistent component of business risk.

2.3.2 Financial risk

Financial risk is defined by **Hampton (1982,p.183)** as "the chance that an investment will not generate sufficient cash flow either to cover interest payments on money borrowed to finance it, principal repayments on the debt, or to provide profits to the firm." Financial risk is therefore the incremental risk placed on the ordinary shareholders as a result of the decision to use debt finance. **Brigham & Gapenski (1994,p.529)** accordingly define financial risk as the difference between total risk and the business risk of the company had it not used any debt, i.e. had it been unlevered. Mathematically:

$$\text{Financial risk} = \sigma_{ROE} - \sigma_{ROE\,(U)} \qquad (2.8)$$

Where:

$\sigma_{ROE\,(U)}$ = the standard deviation of the ROE had the firm not employed debt.

All other symbols have been previously defined.

According to equation (2.8) the primary component of financial risk is financial leverage. **Brigham & Gapenski (1994,p.529)** concur with this when they state that financial risk is a measure of the risk increasing effects of financial leverage. Financial leverage is therefore a theoretically consistent component of financial risk.

2.4 SYSTEMATIC OR MARKET RISK

2.4.1 Markowitz's Covariance Model

Modern Portfolio Theory (MPT) developed from the work done by **Markowitz (1952,p.77)** on portfolio selection. It is based on the observation that the objective of the rational (or utility maximising) investor is not simply to maximise expected return, but to do so at an acceptable level of risk. Markowitz's portfolio theory assumptions were:

i. Investors view possible future rates of return as a normal probability distribution.
ii. Investors' estimates of risk are proportional to the variability of returns.
iii. Investors' decisions are based on only two parameters of the probability distribution of returns: the expected return and the variance (or standard deviation) of return.
iv. For any risk class, investors prefer a higher to a lower rate of return and conversely, if securities have the same rate of return, they prefer less rather than more risk.

Markowitz showed that for a single share, the expected return is represented by the mean of the expected outcomes and the risk is the standard deviation of those expected outcomes from the expected return. However, in a multi-share portfolio, while the expected return is represented by the weighted average of the constituent share's expected returns, the portfolio standard deviation is not simply the weighted average of the standard deviations of the constituent shares. Rather, the portfolio standard deviation (portfolio risk) is also dependent upon the degree of association between the individual share returns. For a two share portfolio, Markowitz devised the following measures of expected return and risk.

Expected Return:

$$E(R_p) = aE(R_i) + (1-a)E(R_j) \qquad (2.9)$$

Where:

$E(R_p)$ = the expected return on the portfolio.

a = the proportion of total funds invested in share i.

$E(R_i)$ = the expected return on share i.

$E(Rj)$ = the expected return on share j.

Risk:

$$\sigma_p = [a^2 \sigma_i^2 + (1\text{-a})^2 \sigma_j^2 + 2a(1\text{-a})\sigma_{ij}]^{0,5} \qquad (2.10)$$

Where:

σ_p = the standard deviation of the portfolio.

σ_i, σ_j = the standard deviations of shares i and j respectively.

σ_{ij} = the covariance of the returns on shares i and j.

All other symbols have been previously defined.

Markowitz's statistical justification for diversification showed that by holding multi-asset portfolios in which the constituent shares are not perfectly positively correlated, the risk of the portfolio would always be lower than the weighted average of the individual share's standard deviations. **McQueen (1986,p.52)** notes that Markowitz's contribution lay in showing how mathematics could be used to select efficient portfolios from all the potential combinations of shares. An efficient portfolio maximises the expected portfolio return at a given level of risk.

2.4.2 Capital Market Theory and the CAPM

Markowitz's covariance model proved difficult to apply practically as the covariance of each share with every other share in the mean variance space had to be determined. The covariance problems inherent in Markowitz's work led to the development of the CAPM, in the context

of Capital Market Theory (CMT). The CAPM was developed almost simultaneously by **Sharpe (1963,p.292) and (1964,p.440)** and **Treynor (1961,p.1)**[2], while **Mossin (1966,p.782), Lintner (1965,p.35) and (1969,p.398)** and **Black (1972,p.452)** developed it further. The assumptions on which CMT is based are (in addition to those in Section 2.4.1):

i. All investors have the same one period investment horizon.

ii. All investors are price takers and have homogeneous expectations about future rates of return.

iii. There exists a risk free asset such that investors may borrow or lend at the risk free rate.

iv. The quantity of total assets is fixed and all assets are marketable and perfectly divisible.

v. There are no market imperfections such as taxes and transaction costs, and information is costless and simultaneously available to all investors.

vi. There is no inflation or change in interest rates or all such changes are fully anticipated.

vii. Capital markets are in equilibrium.

Utilising the principle of an efficient investment frontier, the following formula was derived:

$$E(R_i) = R_f + B_i[E(R_m) - R_f] \qquad (2.11)$$

Where:

$E(R_i)$ = the expected return on share *i*.

R_f = the risk free rate of return.

B_i = the beta of share *i*, where this = σ_{im}/σ_m^2.

$E(R_m)$ = the expected return on the market portfolio.

All other symbols have been previously defined.

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2 *Unpublished manuscript.*

Equation (2.11) is the deterministic CAPM formulation and plots graphically on a line known as the Security Market Line (SML). The SML depicts the expected return against the covariance of the share's return with the market, i.e. beta (B_i). The expected return of all shares will fall on the SML. Any share not plotting on the SML is either over or under priced and, assuming the markets are efficient, will be restored to the SML (equilibrium) by a price adjustment. The SML is represented in Figure 2.1.

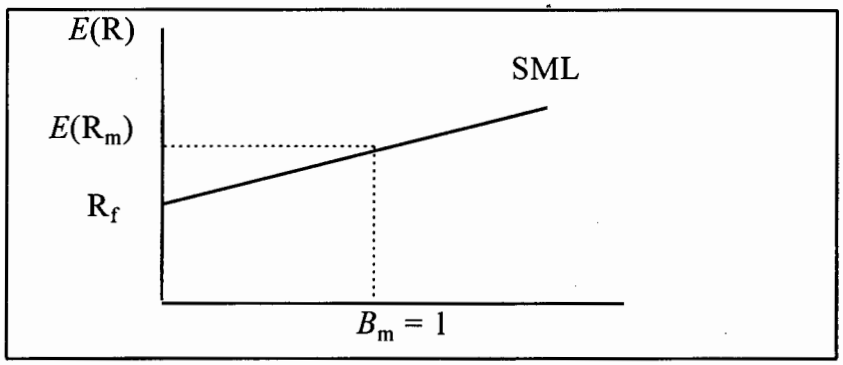

Fig. 2.1: The Security Market Line

The CAPM equation (2.11) divides the uncertainty of a share's return into a "systematic" component, reflecting the share's co-movement with the market wide factor, and an unsystematic or random (stochastic) component reflecting variation in the share's return which is independent of the market wide factor. The unsystematic component, known as unsystematic risk, is specific to each firm and is the risk that can be diversified away in terms of Markowitz's covariance model. The systematic component, known as systematic risk, cannot be diversified away and is therefore the only risk for which investors will receive compensation. It is measured by beta [B_i in equation (2.11)]. Systematic risk and beta are therefore synonymous and are quantitative measures of the riskiness of an asset[3] as seen by the investors.

[3] *Beta is a measure of relative market risk. The actual market risk of share i =* $B_i\sigma_m$.

2.4.3 The Market Model

The Market Model is not supported by any theory [**Ooms, (1987, p.188)**]. The model is predicated on the fact that most shares tend to move up and down together. In mathematical terms, it is expressed simply as a linear equation which measures the degree of co-movement between an individual share and the market. The relevant variation[4] of the model, for the purpose of this report, is the Single Index Model:

Mathematically,

$$R_{i.t} = a_i + B_i R_{m.t} + e_{i.t} \tag{2.12}$$

Where:

$R_{i.t}$	=	the return on share *i* at time *t*.
a_i	=	intercept coefficient (alpha) of the regression line for share *i*.
B_i	=	slope coefficient of the regression line for share *i*.
$R_{m.t}$	=	return on the market portfolio at time *t*.
$e_{i.t}$	=	random error term.

The Market Model as an empirical estimator of beta assumes that the OLS regressions are satisfied. This set of assumptions demands that the errors be randomly distributed about the market line, that they have an expected value of zero, and that the variance of the errors is constant[5].

Bradfield & Bowie (1993,p.7) state that the Market Model and the CAPM are two of the most widely used models in contemporary empirical finance. The Market Model is very similar to a CAPM, but not the same [**Firth (1977, p.93)**]. It is often used instead of the CAPM in empirical testing to estimate betas for use in the SML of the CAPM as it removes

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4 *Other variations include the Multiple Index Model, Diagonal Model and Rosenberg's Multifactor Model.*

5 *The OLS assumptions are detailed in Chapter Six, Section 6.2.1.*

the "noise" created by fluctuations in the risk free rate that appears in the CAPM equation. An implicit assumption in using the Market Model in this manner is that the ex-post (historical) relationship will continue into the future.

The major difference between the two models is that the Market Model permits a return in excess of that attributable purely to the Model Portfolio. This is represented by a_i in equation (2.12). The CAPM states that a_i will always equal zero. On the assumption that a_i = zero in equation (2.12) the market model beta is equivalent to the CAPM beta. This is corroborated by **Affleck-Graves, Money & Carter (1982, p.67)** who state that the Market Model is justified as a basis for estimating beta provided the resulting alphas are not significantly different from zero.

2.4.4 Applicability of the CAPM

Ward (1995,p.100) states that although the theoretical elegance of the CAPM holds strong appeal, the use of a single factor model in measuring the complex return generating process of securities has been questioned. Evidence both overseas and locally has been found which challenges the use of beta as the sole risk/return parameter that explains share behaviour. In the overseas context, **Fama & French (1992,p.208)** found no significant relationship between historical betas and historical share returns.

Locally **Page (1986,p.38)**, **Page (1989,p.78)** and **Biger & Page (1993,p.12)** have shown that Arbitrage Pricing Theory (APT) models with more than one factor are superior to the CAPM in explaining share returns on the JSE. These local studies have not identified the nature of the factors to be considered in the model. **Barr (1990,p.17)** identified four main economic forces on the JSE in the form of: the gold price, short term interest rates, the performance of foreign stock markets and local business confidence. However, these factors are difficult to test empirically.

While the majority of local research appears to support the contention that multi-factor models are superior to the CAPM in predicting returns, the validity of beta does not require that it is

the sole determinant of share risk. The empirical use of beta is justified provided that beta be a major determinant of share risk. **Bradfield, Barr & Affleck-Graves (1988,p.11)** support this contention with their findings that ex-ante (forward looking) estimates of beta are successful in predicting share returns in a univariate context on the JSE. In a review of capital market theory in the South African context, **Bradfield & Barr (1989,p.169)** state that the CAPM has fared well in empirical testing and is suitable for the valuation of shares on the JSE. Using multivariate tests, **Bradfield & Affleck-Graves (1991,p.41)** found that the CAPM is a reasonable model in the South African context. More recently, **Ward (1995,p.111)** found that the CAPM is an acceptable model on the JSE for both mining and industrial shares. The empirical use of beta is therefore justified on the JSE.

2.5 THE MODIGLIANI AND MILLER PROPOSITIONS

In 1958 Franco Modigliani and Merton Miller published their famous article in the *American Economic Review* entitled "The Cost of Capital, Corporation Finance and the Theory of Investment". In a 1979 survey of Financial Management Association members, the article was adjudged to have had the most significant impact on the field of finance of any work ever published.

Modigliani & Miller (1958,p.263) made the following assumptions:

i. Business risk can be measured by σ_{EBIT}, where EBIT is earnings before interest and taxes, and all firms are in the same risk class.
ii. Investors have homogenous expectations.
iii. Capital markets function perfectly.
iv. All debt is risk free.
v. All cash flows are perpetuities. **Brigham & Gapenski (1994,p.532)** point out that this implies that the firm is a non-growth firm with an expectationally constant EBIT, and bonds that are perpetuities.
vi. There are no corporate or individual taxes.

With the use of an arbitrage proof, Modigliani & Miller proved that if two companies differed only with respect to the way they are financed and their total market values, investors would sell shares in the higher valued firm and buy shares in the firm of lower value until the supply and demand resulted in both firms having the same total market value and the restoration of a market equilibrium. The market value of any firm is therefore independent of its capital structure. This is referred to as the 'without-tax' Proposition I and is formulated as follows:

$$V_L = V_U = EBIT / k_{sU} \tag{2.13}$$

Where:

V_L = market value (V) of a levered firm ($_L$).
V_U = market value of an unlevered firm ($_U$).
$EBIT$ = earnings before interest and taxation.
k_{sU} = the cost of equity (k_s) of an unlevered firm ($_U$).

In their second 'without-tax' proposition Modigliani & Miller explained the mechanism behind the conclusion that the weighted average cost of capital (WACC) is independent of the mix of debt and equity securities in the permanent capital structure. Any decrease in the WACC resulting from the use of cheaper debt financing is perfectly extinguished by a resulting increase in the cost of equity. The cost of equity for a levered firm is therefore equal to that of an unlevered firm plus a premium for the use of leverage which is proportional to both the difference between the cost of debt and unlevered equity, and the amount of debt being used. Mathematically, Proposition II is as follows:

$$k_{sL} = k_{sU} + (k_{sU} - k_d)(D/E) \tag{2.14}$$

Where:

k_{sL} = the cost of equity k_s of a levered firm ($_L$).
k_d = the cost of debt ($_d$).
D = market value of the debt.

E = market value of the equity.

All other symbols have been previously defined.

Brealey & Myers (1991,p.400) explain the Modigliani & Miller without-tax propositions in terms of the law of conservation of value, whereby the value of a firm is determined by the stream of cash flows and not by how the stream is split between debt and equity investors.

Using the law of conservation of value, when the assumption of no corporate taxes is dropped the stream of cash flows to the equity holders is increased. The interest expense on the debt is tax deductible and provides a tax shield on income which would not otherwise have been available. The cash flow (or earnings) benefit is equal to the interest expense multiplied by the marginal corporate tax rate. This benefit is discounted back at the before tax cost of debt as an increase in the value of the firm. The increase in the value from debt financing is therefore equal to the market value of debt multiplied by the corporate tax rate (as the market value of debt is equal to the interest expense discounted back at the before tax cost of debt). Mathematically, the 'with-tax' Proposition I is as follows:

$$V_L = V_U + TD \tag{2.15}$$

Where:

T = the marginal corporate tax rate.

All other symbols have been previously defined.

In terms of Proposition II, when corporate tax is introduced, **Modigliani & Miller (1963,p.440)** showed that the increase in the cost of equity as debt is introduced is slower than when corporate taxes were excluded. The risk premium added for financial leverage in the without-tax Proposition II is reduced by the tax deductibility of the interest and the with-tax premium is therefore equal to the after tax portion of the without-tax premium. Mathematically:

$$k_{sL} = k_{sU} + (k_{sU} - k_d)(1-T)(D/E) \tag{2.16}$$

Where:

$(1\text{-}T)$ = the after tax rate at a marginal corporate tax rate of T.

All other symbols have been previously defined.

The implication of the Modigliani & Miller with-tax propositions is that corporate value is maximised at debt levels of 100%. The model has been extended to include personal taxes, risky debt, costs of financial distress, agency costs and signalling theories. This section is not intended as an exhaustive capital structure theory review, but as a development of the models and inter-relationships examined in this research. Accordingly, the extensions will not be reviewed as the models examined by this research are derived directly from a synthesis of the Modigliani & Miller (M-M) propositions and the CAPM.

2.6 A SYNTHESIS OF SYSTEMATIC RISK, M-M AND LEVERAGE

The CAPM and Modigliani & Miller formulations discussed in sections 2.3 and 2.4 were developed independently of each other. **Hamada (1969,p.29) and (1972,p.435)** and **Rubenstein (1973,p.167)** were responsible for synthesising the two models into a coherent framework, both with and without corporate taxation. Firstly, assuming no corporate or individual taxes, they showed that the beta of a levered firm is a function of the beta of the underlying assets in the company (called the asset beta) and a risk premium which is directly proportional to the use of debt. The asset beta is equivalent to the beta that the company would have had, had it not employed debt financing and is therefore synonymously referred to as the unlevered beta. Mathematically:

$$B_E = B_A\,[(D + E)/E] \tag{2.17}$$

Where:

B_E = the equity or share beta.

B_A = the asset or unlevered beta.

All other symbols have been previously defined.

This formula may also be written as:

$$B_E = B_A [1+ (D/E)] \quad (2.18)$$

All symbols have been previously defined.

As corporate taxes are introduced into the model, the risk premium added to equation (2.18) is reduced by the tax deductibility of the interest (i.e. the interest tax shield) and the with-tax premium is therefore equal to the after tax portion of the premium included in equation (2.18). Mathematically:

$$B_E = B_A [1+ (D/E)(1-T)] \quad (2.19)$$

All symbols have been previously defined.

In explaining equation (2.19), **Brigham & Gapenski (1994,p.542)** state that the market risk which is measured by B_E, depends on both the firm's business risk as measured by B_A and its financial risk as measured by $(D/E)(1-T)B_A$. Section 2.2 showed that the major components of business and financial risk where operating and financial leverage respectively, and equation (2.19) therefore establishes a relationship between systematic risk, financial leverage and operating leverage.

This is corroborated by Rubenstein who stated that the business (operating) risk in formula (2.19) reflects the combined effects of the degree of operating leverage, the pure systematic influence of economy-wide events, and the uncertainty associated with the firm's operating efficiency. **Mandelker & Rhee (1984,p.47)** extend Rubenstein's comments to state that the

risk premium reflects the magnification of the operating risk by financial leverage to produce financial risk.

While equation (2.19) specifically includes the debt to equity ratio and therefore financial leverage, the relationship between the asset beta and operating leverage is not as explicit. **Lev (1974,p.632)** showed analytically that both the total risk and the systematic risk (levered) of ordinary shares is positively associated with the degree of operating leverage. **Brealey & Myers (1991,p.200)** provide a considerably more simple proof relating to the asset beta, with the following result:

$$B_A = B_{REV}\ [1 + \{\mathrm{PV}(\textit{fixed cost}) / \mathrm{PV}(\textit{asset})\}] \qquad (2.20)$$

Where:

B_{REV}	=	the beta of the company's revenues
PV(*fixed cost*)	=	the present value (PV) of the company's fixed costs
PV(*asset*)	=	the present value of the company's assets

All other symbols have been previously defined.

Equation (2.20) states that, given the cyclicality of revenues (reflected in B_{REV}), the asset beta is proportional to the ratio of the present value of fixed costs to the present value of the project. According to Brealey & Myers the higher the ratio of fixed costs to project value, and therefore the higher the operating leverage, the higher the asset beta.

The Hamada, Rubenstein and Brealey & Myers equations therefore prove mathematically that systematic risk is a function of both operating and financial leverage and they establish the basis for the inter-relationships between systematic risk, financial leverage and operating leverage which will be examined in the testing phase of this study.

Mandelker & Rhee (1984,p.47) extended the earlier work of Hamada & Rubinstein to explicitly incorporate both risky debt and formulas for the degrees of operating and financial leverage[6]. Firstly, equation (2.19) was adjusted to include risky debt as follows[7]:

$$B_E = B_A [1 + (D/E)(1-T)] - (D/E)(1-T)B_d \qquad (2.21)$$

Where:

B_d = the beta of the company's debt.

All other symbols have been previously defined.

If the debt of the company was riskless the debt beta (B_d) would be equal to zero and equation (2.21) would be equivalent to equation (2.19). Mandelker & Rhee then derived the following formula:

$$B_L = (DOL)(DFL)\, B^0 \qquad (2.22)$$

Where:

B^0 = $\mathrm{Cov}[(P_{t-1} / S_{t-1})(S_t/E_{t-i}), R_{mt}] / \sigma^2(R_{mt})$.

P = earnings after interest and taxes.

S = sales.

R_m = the rate of return on the market portfolio.

t = time operator, i.e at time = t.

All other symbols have been previously defined.

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6 *Studies by Hill and Stone (1980,p.595) and Gahlon & Gentry (1982,p.15) will not be reviewed in this chapter. Hill & Stone developed an accounting analogue of the Hamada & Rubenstein formulas and their risk composition beta is beyond the scope of this research. While Gahlon & Gentry relate beta to both financial and operating risk, it is difficult to investigate the impact of the degrees of operating and financial leverage on beta in their framework as, in the words of Mandelker & Rhee (1984,p.46) "the two types of leverage are introduced by an expansion of the coefficient of variation of earnings after interest and taxes".*

7 *Equation (2.21) was first developed by Conine (1980,p.1033).*

The term P_{t-1}/S_{t-1} represents the net profit margin at time t-1, and S_t/E_{t-i} represents the turnover of the firm's common equity for the period from t-1 to t. According to **Mandelker & Rhee (1984,p.50)** the covariability of the product of these two terms with the market portfolio represents the intrinsic business risk as measured by B^0.

Equation (2.22) shows explicitly that systematic risk is a function of both the degree of operating and financial leverage. The DOL and DFL formulas used by Mandelker & Rhee are identical to those stated in equations (2.1) and (2.3) of this chapter respectively, with two exceptions:

i. The expectational operator of the variables at time t in equations (2.1) and (2.3) is replaced by the realised value of the variable at time t-1 in equation (2.22).

ii. The Mandelker & Rhee model considers taxation and therefore the realised operating earnings after interest (P) in equation (2.3) is stated after taxation in equation (2.22).

Mandelker & Rhee acknowledge the non-linear multiplicative effect of financial leverage on operating risk [as noted by **Hill & Stone (1980,p.595)**] and on the beta of risky corporate debt, but state that both can be avoided in the empirical model by the use of logarithmic transformations. The authors then derived time-series based equations for the empirical measurement of the degrees of operating and financial leverage. These will form the basis of the empirical measurement of DOL and DFL by this study and will be discussed in Chapter Three, Section 3.2.1.9.

2.7 THE TRADE-OFF OF FINANCIAL AND OPERATING LEVERAGE

The "trade-off" between financial and operating leverage has been widely proposed in financial literature as a means of stabilising both systematic and total risk. **Mandelker & Rhee (1984,p.46)** quote **Van Horne (1977,p.784)** as stating that "Operating and financial leverage can be combined in a number of different ways to obtain a desirable amount of risk

of common stock. High operating leverage can be offset with low financial leverage and vice versa."

According to **Mandelker & Rhee (1984,p.47)** the trade-off option allows firms to make asset (capital) structure decisions irrespective of their impact on systematic risk since the resultant change in the degree of operating (financial) leverage can be offset by an adjustment to the degree of financial (operating) leverage. This statement implies that an inverse relationship exists between capital structure and operating leverage. Analytical research has examined both the nature of the relationship between operating and financial leverage and the degree of interaction or independence between the two variables. Significant analytical works will be reviewed in this section in chronological order of publication.

Myers (1974,p.1) and (1977,p.147) showed that investment and financing decisions are linked. He demonstrated that investment decisions, i.e. acceptance or rejection of projects, affected optimal financial structure of a firm and why investment in turn should be affected by leverage. Myers' justification stems from the financing side effects of investment decisions, the consequences of which should be considered in the investment decision, i.e. added to or subtracted from the 'base-case' net present value (NPV) of the investment. For example, a project that prompts the firm to borrow more will increase the present value of the firm, and therefore of the project, by the present value of the interest tax shields on the debt supported by the project.

Hite (1977,p.177) examined the impact of financial leverage on the optimal stock of capital employed by the firm and its capital to labour ratio. Hite found that increased financial leverage would reduce the cost of capital, thereby increasing the optimal stock of capital employed. The conclusions drawn by Hite and those of Myers were based on the assumption of riskless debt, i.e. increased debt neither increases the interest rate paid to bondholders nor gives rise to other costs of financial distress.

Dotan & Ravid (1985,p.501) analysed the interaction between the optimum level of investment and debt financing. The authors constructed a model in which a firm, facing an uncertain price for its product, is required to determine its optimal level of investment and

debt. The amount of investment by the firm set a limit on output, the optimal level of which was determined after price was realised. The model explicitly included risky debt. The analysis showed that optimal levels of investment and debt financing must be determined simultaneously. **Dotan & Ravid's (1985,p.502)** findings supported the trade-off hypothesis and they state that "the analysis provides theoretical support to the common wisdom of negative relationships between financial and operating leverage".

Prezas (1987,p.39) examined the effects of debt on the degrees of operating and financial leverage. Prezas found that in the presence of interactions between investment and financing decisions the degrees of operating and financial leverage are determined simultaneously. He concluded that the value maximising firm cannot change its financial and operating leverage independently of each other. A change in DFL would therefore result in a change in DOL and vice versa. However, according to **Prezas (1987,p.43)** the changes "in general have the same sign" and this implies that the firm moves into a new risk class. He does however state further that the trade-off will be observed "when the debt elasticity of real capital is less (greater) than the debt elasticity of the contribution margin and both elasticity's are less (greater) than one."

A number of authors have analytically examined the relationship between optimal debt levels (ODL) and business risk. While these studies have not explicitly considered operating leverage or the degrees of financial and operating leverage measures, the relationships should be similar to the extent that operating and financial leverage are primary determinants of business and financial risk (as indicated in Section 2.3).

The ODL-business risk studies have not found any conclusive evidence as regards the nature of the relationship. **Castanias (1983,p.1617)** found a predominantly negative relationship between ODL and business risk, lending support to the trade-off theory. **Jaffe & Westerfield (1987)**, on the other hand, found a positive relationship. In a more recent paper **Kale, Noe & Ramirez (1991,p.1693)** found a U-shaped relationship, i.e. negative over lower levels of business risk, flattening out in the mid ranges and positive for higher levels of business risk.

Although neither the operating/financial leverage nor the ODL/business risk analytical studies indicate a consistent trade-off, they do provide some support for the existence of negative relationships and therefore establish a basis for the examination of the relationships empirically. This is corroborated by comments in two recent financial texts, in spite of the analytical findings, that such trade-offs do exist. **Brealey & Myers (1991,p.448)** state that, with or without bankruptcy, distress is more likely for firms with higher business risk and this is why such firms generally borrow less. **Brigham & Gapenski (1994,p.564)** state that firms with higher business risk ought to borrow less than lower risk firms. They argue that firms with lower business risk can borrow more without having the expected costs of distress offset the tax advantages of borrowing.

2.8 SUMMARY

This chapter reviewed prior theoretical research relating to the inter-relationships between systematic risk, financial leverage and operating leverage and consisted of seven sections. The chapter commenced with a discussion of the concepts of operating and financial leverage and the measurement of the degrees of leverage. Operating and financial leverage were shown to be theoretically consistent determinants of total risk as a result of their association with business and financial risks respectively.

In the third section, systematic risk was reviewed in the context of the CAPM and the Market Model beta was established as a quantitative measure of market risk. The review then focused on the capital structure propositions of **Modigliani & Miller (1958,p.263) and (1963,p.440)** and outlined their synthesis with the CAPM as achieved by **Hamada (1969,p.29) and (1972,p.435)** and **Rubenstein (1973,p.167)**. Hamada and Rubenstein showed that systematic risk is a positive function of both asset (or unlevered) beta and financial leverage. The asset beta, in turn, was shown to be a positive function of operating leverage and beta was therefore shown to be positively related to both financial and operating leverage. The chapter then discussed the extension provided by **Mandelker & Rhee (1984,p.47)** to include both risky debt and to explicitly consider measures of the degrees of operating and financial leverage.

In the last section of the chapter analytical research into the trade-off between financial and operating leverage was reviewed. This research differed in its specification of the nature of the relationship but provided considerable theoretical support for the existence of a negative relationship between operating and financial leverage.

This chapter has therefore established a theoretical justification for the hypotheses, and empirical testing, of a significant positive association between systematic risk and both financial and operating leverage, and a significant negative association between operating and financial leverage.

CHAPTER THREE : PRIOR EMPIRICAL RESEARCH

3.1 INTRODUCTION

The objective of this chapter is to review prior empirical studies, in the context of the theoretical models established in Chapter Two, to establish the scope for further research and contribution.

The primary hypotheses[1] of this study examine three distinct relationships, viz. systematic risk versus financial leverage; systematic risk versus operating leverage and financial leverage versus operating leverage. Prior research in these areas encompasses not only the wealth of research relating to the association between accounting and market measures of risk but also the significant body of research into the determinants of capital structure. In order to retain focus the most significant published studies in these areas have been chosen for review in this chapter based on direct applicability to this study. While the majority of the studies reviewed have examined several relationships, this review is confined to the examination/ testing of the relationships relevant to this study. All overseas studies were conducted in the USA unless stated otherwise.

This chapter is divided into five sections. The first two sections relate to the relationships between systematic risk and, respectively, financial and operating leverage. The third section focuses on the relationship between financial and operating leverage. The fourth section summarises the review of prior research with the assistance of tables, and the fifth section concludes the chapter.

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1 *See Chapter 1, Section 1.3.*

Where prior studies have examined more than one of the relationships relevant to this research, the studies are reviewed in the section relating to the association between systematic risk and financial leverage. The summary included in the fourth section of the chapter will distinguish the results of these studies between the relevant relationships.

3.2. SYSTEMATIC RISK VERSUS FINANCIAL LEVERAGE

3.2.1 OVERSEAS RESEARCH

3.2.1.1 Beaver, Kettler & Scholes (1970)

Beaver, Kettler & Scholes (1970,p.654) is the seminal study of the relationship between accounting and market risk measures. Annual report data of 307 companies was analysed between 1947 and 1965. The 19-year period was divided into two sub-periods of ten years (1947-1956)[2] and nine years (1957-1965) respectively.

A correlation analysis of the relationship between beta and financial leverage was performed for individual shares and portfolios. Portfolios of five shares each were formed by ranking shares based on financial leverage. Beta was estimated over the full duration of the sub-periods using monthly share returns. Financial leverage was measured by the mean of the ratio of total liabilities to total assets, where the mean was calculated over the full duration of the sub-periods. No adjustments appear to have been made for differing accounting policies or the 'debt' component of preference shares and other hybrid securities.

Correlation coefficients of 0,23 and 0,25 were found for the individual shares in sub-periods one and two respectively, with the corresponding portfolio correlations measuring 0,45 and 0,56. The correlations were all found to be significant beyond the 0.01 level. Beaver et al

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2 *On page 664 of the paper the authors refer to the ten year subperiod as (1947-1965). This period is clearly not ten years and a transposition error appears to have occurred between the 5 and the 6 in 1965. The author of this report has therefore referred to the period as (1947-1956)*

concluded that their evidence supported the contention that financial leverage is impounded in beta and that a high degree of contemporaneous association between the two does exist.

3.2.1.2 Rosenberg & McKibben (1973)

Rosenberg & McKibben (1973,p.325) examined a sample of 578 companies between 1954 and 1966 for association between beta and accounting as well as market variables. The methodology took the form of a stepwise regression, in which 32 accounting and market variables were regressed on beta. Where a variable was found to be insignificant it was rejected from the analysis.

Thirteen variables were found to be significant but only four had the anticipated sign. Beta was estimated using thirteen years of annual share returns. Financial leverage was measured as the five year mean of the ratio of senior securities to total assets. The authors do not provide a definition of "senior securities". **Beaver et al (1970,p.660)** defined senior securities to be securities ranking senior to equity on liquidation (i.e. total balance sheet debt). As a result of the short time lag between the studies and the reference to the Beaver et al article by Rosenberg & McKibben, it is likely that the latter article utilised the same definition of senior securities as Beaver et al. Financial leverage was significant at the 0.05 level and exhibited the expected positive sign.

The authors also examined the relationship between systematic risk and two measures of operating leverage. The first was a thirteen year smoothed measure of fixed charges divided by operating income, which was found to be insignificant at the 0.1 level (the actual level of significance was not reported). The second measure was the ratio of gross plant divided by total assets which exhibited a highly significant relationship at the 0.01 level, but in a negative direction (i.e. the opposite direction to the positive association predicted by theory and hypothesised by the authors).

3.2.1.3 Breen & Lerner (1973)

Breen & Lerner (1973,p.339) divided 1400 companies into twelve groups according to the month in which their 1969 financial year ended. Betas were estimated using two and three years of monthly returns, and were regressed on seven financial variables. Financial leverage, as measured by the book ratio of long-term debt to equity, was not shown to have a consistently significant relationship with beta and exhibited sign reversal. In a footnote to their paper the authors state that they tested a ratio of total debt to equity, but did not report the results as they were similar to those of the long term debt ratio reported on.

3.2.1.4 Melicher & Rush (1974)

Melicher & Rush (1974,p.541) attempted to determine the relationship between eleven financial variables and changes in beta. The sample was restricted to 71 regulated electric utility companies. The study incorporated two sub-periods, 1962-1966 and 1967-1971. Beta was estimated using five years of monthly price relative returns. Financial leverage was measured by the ratio of total debt to total assets. Financial leverage was found to be positively correlated with changes in beta at only the 0.1 level and in only one of the sub-periods.

The authors did not examine operating leverage *per se*, but examined the ratio of net plant to total capital which was found to be significantly positively related to changes in beta at the 0.1 level.

3.2.1.5 Lev & Kunitzky (1974)

Lev & Kunitzky (1974,p.259) examined the association between beta and average as well as smoothed accounting measures of risk. The sample consisted of 260 firms and covered the period between 1949 and 1968.

Beta was estimated using 15 years of continuous monthly returns during the 19 year period covered by the study. The accounting risk measures examined included two financial leverage measures. These were a 15 year average, and a 15 year smoothed, debt to equity ratio. The 15 years chosen for the calculation of the accounting measures were synchronous with those used to estimate the beta of the relevant company. The authors do not provide any details as to the nature of the debt included in the numerator. According to **Brealey & Myers (1991,p.677)** debt to equity ratios usually refer to the long term debt of a company. This report will therefore assume that the measures of debt employed by the study were confined to long term measures.

Neither of the financial leverage measures employed were found to be significantly associated with beta. The association for both was found to be positive, as hypothesised. The authors also examined the ratio of capital expenditures to net plant and equipment. It is submitted that this measure is not a proxy for operating leverage, or for capital intensity, as a result of the denominator. Two companies with different operating leverages and capital intensities, but who engage in the same degree of capital expenditure relative to plant and equipment, would reflect the same ratio. The measure was likely to indicate the replacement policy of fixed assets, or growth, more than it represents the degree of operating leverage or capital intensity.

3.2.1.6 Thompson (1976)

Thompson (1976,p.181) regressed betas of some 290 firms on 43 variables. Data was divided into two nine year sub-periods (1951-1959 and 1960-1968). The study examined both individual shares and portfolios. Thompson concluded that there were three major risk factors inherent in a share beta. These risks stem from the fluctuation in the earnings, dividend and earnings multiple of the individual company.

Thompson tested six definitions of financial leverage (excluding accounting betas). Mean and variance ratios were calculated over the full nine year sub-periods. The beta employed by the study was estimated using nine years of monthly returns. Thompson did not provide a definition for the cash flow measure employed by his study. It is likely that he employed the

simplistic definition of operating income plus depreciation, for two reasons. Firstly, this was the measure employed by financial researchers at the time of the study. Secondly, a non simplistic measure of cash flow raises complicated measurement and methodological issues. Had these issues been addressed by Thompson it is likely that they would have been incorporated into his paper. Thompson's results pertaining to the scope of this study are summarised as follows:

Table 3.1: Thompson's Results

Source	Independent variable	Single Securities 1951-59	Single Securities 1960-68	Portfolios 1960-68
Balance Sheet	Total debt / Total assets (μ)	.02	.24**	.53*
	Total Debt / Total assets (σ^2)	.17**	.02	
Cash Flow	Cash flow / Total Debt (μ)	.00	-.22**	
	Cash flow / Total Debt (σ^2)	.23**	.24**	
Income Statement	Operating Income / Interest (μ)	-.02	-.23**	-.41
	Operating Income / Interest (σ^2)	.27**	.28**	

** Significantly different from zero at the 0.01 level

* Significantly different from zero at the 0.05 level

Table 3.1 indicates that none of Thompson's mean ratios were consistently significant. The cash flow and income statement variance measures were also found to be consistently significant. Thompson does not provide complete results for portfolios. His results indicate that although the explanatory power of financial leverage increases with aggregation, the significance of the relationships is reduced, and in the case of the income statement portfolio the relationship is no longer significant at the 0.05 level. Thompson did not examine operating leverage as a determinant of beta.

3.2.1.7 Belkaoui (1978)

Belkaoui (1978,p.9) performed factor analysis on 15 accounting ratios for 55 Canadian companies between 1971 and 1974. The factor loadings were then used as a criteria for

including the ratio in a multivariate regression on beta. Beta was estimated on four years of bi-weekly share returns. Five ratios were chosen which yielded a multiple correlation coefficient of 0,34. Financial leverage, defined as the four year arithmetic average of long term debt divided by equity, was represented in the multivariate regression equation but individual (partial) significance was found only at the 0.1 level (*t*-value of 1.29). Belkaoui concluded that a significant positive relationship was found between the long term debt to equity ratio and systematic risk.

3.2.1.8 Dhingra (1982)

Dhingra (1982,p.193) regressed the betas of 251 Canadian companies on ten categories of accounting risk measures. Analysis was conducted for the individual share case only as no portfolios were formed. The study was repeated annually over the eight years from 1969-1976. Financial and operating leverage were two of the ten accounting risk categories examined by the author. Two measures of beta were employed. The first was based on one year of weekly returns and the second on monthly returns over a five year period.

In the first part of his study, Dhingra regressed 83 measures of the ten accounting risk categories against the two beta measures. Included in the 83 measures were six operating and eight financial leverage measures. No significance levels or r^2's were reported by the author as few of the relationships were found to be significant and those that were, were not consistent. The results reported by Dhingra related only to the sign of the association of the variables with the betas. He noted that while the association with financial leverage was predominantly positive (as hypothesised), that of operating leverage was predominantly negative (opposite to that hypothesised).

The second part of the study involved a stepwise multiple regression in which Dhingra examined the overall significance of twelve of the original 83 measures. Included in the twelve was one financial leverage measure and two operating leverage measures. The financial leverage measure was that of total debt divided by total assets. The operating

leverage measures consisted of what the author termed the operating leverage ratio (and did not define), and the ratio of net plant to total assets.

For each of the eight years the author ran stepwise regressions for each of the beta measures (i.e. 16 regressions in total). Of these, only six were found to be significant at the 0.05 level. The financial leverage measure and the ratio of net plant to total assets were found to be individually significant at the 0.1 level in only one in the 16 regressions. As a result of the lack of significance the author suggested that the results should be regarded as indicative rather than conclusive.

3.2.1.9 Mandelker & Rhee (1984)

In accordance with their analytical model discussed in Chapter Two[3], Mandelker & Rhee (1984,p.45) empirically tested the role of DOL and DFL in magnifying the intrinsic business risk of ordinary shares. A sample of 255 manufacturing firms was chosen spanning a period of 20 years from 1957-1976. The degrees of operating and financial leverage were empirically measured using the following regressions (respectively):

$$\ln X_{jt} = a_j + c_j \ln S_{jt} + u_{jt} \qquad (3.1)$$

$$\ln P_{jt} = b_j + d_j \ln X_{jt} + e_{jt} \qquad (3.2)$$

Where:

u_{jt} , e_{jt} = disturbance terms.
a_j , b_j = regression intercept coefficients.
c_j = degree of operating leverage (DOL).
d_j = degree of financial leverage (DFL).
X_{jt} = earnings before interest and taxation.
S_{jt} = sales (annual).

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3 *See Chapter 2, Section 2.5.*

P_{jt} = earnings after interest and taxation.

j = firm's 1-255.

t = 1957-1976.

The DOL in equation (3.1) was represented by the percentage change in earnings before interest and tax that resulted from a one percent change in sales. The DFL in equation (3.2) was represented by the percentage change in earnings after interest and tax that resulted from a one percent change in earnings before interest and tax. Systematic risk as measured by beta was estimated by applying the market model to 20 years of monthly share returns.

Simple regressions were run to determine the relationship between beta and each of the leverage measures individually, at both individual and portfolio levels. A bivariate regression was then run to determine the combined effect of DFL and DOL on beta. The authors found that DFL had significant explanatory power with beta. On average DFL explained 25% of systematic risk, with a maximum explanation (r^2) of 33%, at the portfolio level. At the individual share level financial leverage was found to be significantly associated to beta at the 0.01 level.

DOL was found to be significantly related to beta at the 0.01 level for both individual shares and portfolios. DOL explained 10.4% of the variability in beta at the portfolio level no r^2's were presented for either of the leverage measures at the individual company level. The leverage measures were only found to explain 10.8% of the individual company beta when combined in the bivariate regression.

The authors also examined the trade-off between operating and financial leverage by regressing the DFL on the DOL. This relationship was only tested at the portfolio level (where greater significance would be expected due to averaging). Three different portfolio formation procedures were utilised. Shares were ranked on the basis of descending order of DOL, DFL and beta and were allocated to portfolios of five shares based on each of the three rankings .

The portfolio's based on rankings of DOL and DFL yielded a negative relationship significant at the 0.01 level. R^2's were low at 9% and 10,2% respectively. The relationship was

insignificant when portfolios were ranked on beta. Further examination showed that high beta companies engaged in trade-offs more actively than their less risky counterparts.

3.2.2 SOUTH AFRICAN RESEARCH

3.2.2.1 Retief, Affleck-Graves & Hamman (1984) & (1986)

Retief, Affleck-Graves & Hamman (1984a,p.23) performed the first South African study on the relationship between systematic risk and financial leverage. The study formed part of broader research into the relationship between market and accounting risk measures in South Africa in the form of Retief, Affleck-Graves & Hamman (1986,p.154).

The study employed a correlation analysis between beta and eight definitions of financial leverage. Each of the financial leverage measures was individually correlated with the market beta for single shares and portfolios. Portfolios were determined by dividing a beta ranking of companies into equal portfolios consisting of three, and then seven shares. The sample consisted of 63 industrial companies, all having June 30th financial year ends. The analysis covered a ten year period from 01 July 1972 to 30 June 1982.

Price relative returns were calculated on monthly return intervals over a ten year period. These were regressed against corresponding market returns to estimate beta. Portfolio betas were calculated as the arithmetic average of the constituent share's betas.

Eight balance sheet based financial leverage ratios were calculated for each of the companies over the ten year period. The financial leverage measures employed were very similar and were likely to be significantly correlated. The ten values for each of the ratios were then averaged to give the individual company independent variables. Portfolio ratios were calculated as the arithmetic average of the constituent company's average ratios.

All eight leverage definitions were found to be significantly correlated to beta at the 0.025 level. The best results were obtained from the debt ratio[4]. This ratio produced correlation coefficients of 0,50; 0,78; and 0,982 for the individual case, three share portfolio case and seven share portfolio case respectively. Retief et al concluded that there was a high degree of association between financial leverage and systematic risk.

The results of the debt ratio obtained in Retief et al (1984a) were then incorporated into the broader study of Retief et al (1986), together with seven other accounting measures. Both papers formed part of the same study and therefore the methodologies were identical, the only change being the nature of the independent variables other than the debt ratio.

Retief et al (1986) tested a measure of operating leverage for association with beta. The measure employed was fixed assets plus goodwill divided by capital employed (i.e. total assets - current liabilities). Operating leverage was not found to be significantly associated with beta at the 0.05 level. While significance at the individual company level was found at the 0.099 level, this decreased to the 0.208 and 0.393 levels for the three and seven share portfolios respectively.

Ten out of the 63 companies included in Retief et al's sample, i.e. 16%, were represented by companies listed in the Industrial Holding sector of the JSE. These companies are typically highly diversified and are effectively portfolios within themselves. The inclusion of these companies in the individual company analysis may have subjected the correlation analysis to an aggregation bias.

3.2.2.2 Recent cash flow based research

Recent research by **Wessels, Smith & Gewers (1993,p.101)** and **Loxton, Hamman, & Smit (1994,p.137)** has examined the association between systematic risk and cash flow information. The cash flow definitions employed by these studies are not proxies for either

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4 $\frac{\text{Total Assets - Equity}}{\text{Total Assets}}$

operating or financial leverage, and make no reference to interest, debt, assets or cost behaviour. These studies will therefore not be reviewed by this report[5].

3.3 SYSTEMATIC RISK VERSUS OPERATING LEVERAGE

3.3.1 Lev (1974)

Lev (1974,p.627) established an analytic relationship between operating leverage and systematic risk[6] and tested it empirically. Lev's sample consisted of 122 firms drawn from the electric utility, steel manufacturing, and oil producing sectors of the NYSE. These were split into three sub-samples based on sector classification. Operating leverage was defined as the ratio of fixed to variable operating costs and was measured using the following regression equation:

$$TC_{jt} = a_j + v_j Q_{jt} + u_{jt} \qquad (3.3)$$

Where :

TC = total operating costs.

Q = physical output (e.g. Kilowatt-hours), or volume of sales where output was unavailable.

v = the slope coefficient representing the firm's average variable cost per unit of output.

u = regression residual.

j = firm from 1-122.

t = year from 1957 to 1968.

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5 *The cash flow measures utilised by these studies are discussed in Chapter Five, Section 5.2.5.*

6 *Lev's analytical findings are discussed in Chapter 2, Section 2.5.*

The average variable cost estimate (v_{jt}) was used by Lev as a measure of operating leverage. Beta was estimated using the market model on monthly price relative returns calculated over the ten year period between 1958 and 1967.

Operating leverage was regressed on beta for each of the three sub-samples. No portfolios were formed. Lev found that operating leverage was significantly associated with beta at the 0.05 level for both the electric utility and steel manufacturing sub-samples, but not for the oil producers. Lev (1974,p.636) concluded that "the explanatory power of the variable cost component was modest".

3.4 OPERATING VERSUS FINANCIAL LEVERAGE (CAPITAL STRUCTURE STUDIES)

There has been a wealth of empirical testing of potential determinants of capital structure. In testing an attribute's relation to capital structure, prior research has typically found a proxy for the attribute and examined the relationship between the proxy and financial leverage. This has resulted in the testing of operating leverage proxies under the guise of different attributes and with differing hypotheses. A meaningful review of prior research requires a review of studies that have considered operating leverage both explicitly and implicitly.

The scope of this review is therefore limited to proxies that approximate operating leverage, irrespective of the name afforded the attribute by the researcher. A distinction is drawn between operating leverage and business risk. While operating leverage has been shown to be a major determinant of business risk [7] it is not the only determinant and in order to retain focus business risk proxies are not reviewed.

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[7] *See Chapter 2, Section 2.3.1.*

3.4.1 OVERSEAS RESEARCH

3.4.1.1 Ferri & Jones (1979)

Ferri & Jones (1979,p.631) investigated the relationship between financial structure and operating leverage as well as a number of other variables. The authors employed the Howard-Harris clustering algorithm to test the effect of industry class whereby the algorithm was used to assign firms to leverage classes based on financial leverage characteristics. The sample consisted of 233 firms which were split into two five year time periods (1969-1974 and 1971-1976). Multivariate discriminant analysis was used to test the relationships across the various leverage classes in each of the two periods.

Financial leverage was defined as the book value ratio of total debt to total assets. Two measures of operating leverage were employed. These were the ratio of fixed to total assets, and the percentage change in operating income as a proportion of the percentage change in sales. Ferri & Jones hypothesised a negative relationship between financial and operating leverage.

The authors found a consistently negative relationship between financial leverage and the ratio of fixed to total assets which was significant at the 0.10 level in the first period and the 0.05 level in the second period. Evidence was found of positive relationships between leverage and industry class but these were not statistically significant.

3.4.1.2 Marsh (1982)

Marsh (1982,p.121) used logit and probit analysis to examine a sample of UK listed firms that made debt or equity issues from 1959-1974. The objective of the paper was to determine the factors which explained the choice between issuing debt or equity. As the study only considered issues of debt or equity, the proxy for financial leverage was effectively the ratio of issued debt to issued equity.

Marsh tested a multivariate model in which the choice between issuing debt or equity was modelled as a function of a number of attributes one of which was what Marsh referred to as "the proportion of assets". This was measured by the ratio of fixed to total assets. This ratio has been used extensively as an operating leverage surrogate on the basis that the greater the proportion of assets which are fixed, the greater the proportion of fixed costs is likely to be.

In sharp contrast to the hypothesis and findings of **Ferri & Jones (1979,p.631)**, Marsh hypothesised a positive relationship between financial leverage and the ratio of fixed to total assets. Marsh ascribes his positive hypothesis to the 'assets in place' hypothesis of **Myers (1977,p.147)**[8].

The ratio of fixed assets to total assets was found to be consistently positively related to the choice of issuing debt as opposed to equity at the 0.05 level. Marsh's (1982,p.137) most significant finding, however, was that companies that have recently experienced "unusually large" share price increases are more likely to issue equity. While Marsh's conclusions regarding the timing of equity issues were very significant, and have been supported in subsequent research, his findings regarding the determinants of overall capital structure are limited[9]. The reasons for this are as follows:

i. Marsh's "issue study" sample was limited to those companies who issued debt or equity in capital markets. This excludes from the sample all financing decisions which resulted in the use of internally generated equity (cash), bank /institutional loans and all current liabilities. The forms of finance excluded from the sample are likely to have represented the majority of financing utilised by firms during the study period. This is supported by **Myers' (1986a,p.149)** comment on the American market: "For all non-financial corporations over the decade 1973-1982, internally generated cash covered, on average, 62% of capital expenditures, including investment in inventory and other current assets. Net stock issues were never more than 6%."

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8 *According to the hypothesis, firms with greater proportions of tangible assets can support greater debt levels.*

9 *Marsh's study has been reviewed in this chapter as it has been cited in previous research as evidence of the determinants of capital structure.*

This is exacerbated in that Marsh's sample does not consider all issues of debt or equity. Only cash issues are considered and this excludes non-cash issues such as scrips, conversion issues, exchange issues and securities issued as consideration for acquisitions. Furthermore, only "simple" cash issues of debt and equity are considered. This excludes all issues of preferred, convertible and other forms of hybrid securities. It is submitted that issue studies such as that conducted by Marsh[10] consider only a very small and selective portion of the financing decision.

ii. Marsh (1982,p.138) concedes that his significance levels should be interpreted with caution as he tested a number of proxies for each attribute and included proxies in his final multivariate model based on significance rather than on accuracy of specification of the underlying attribute .

3.4.1.3 Bradley, Jarrel & Kim (1984)

Bradley, Jarrel & Kim (1984,p.857) presented a single period model of capital structure with two classes of securities in the form of equity and debt. The authors ran simulations of the model based on comparative statics and identified three determinants of capital structure including non debt tax shields (NDTS). The relevance of the study to operating leverage is in the possible association of the NDTS proxy with operating leverage. The proxy used for the NDTS was the sum of annual depreciation and investment tax credits[11] divided by annual earnings before interest, depreciation and taxes (for 1961-1982). The NDTS would be expected to be positively correlated to operating leverage as depreciation is likely to represent a significant, if not the most significant, component of fixed costs.

The authors used an OLS regression model to empirically test the relationship between financial leverage and proxies for the three attributes mentioned above. Ratios for the sample of 821 firms were calculated over the period 1962-1981. Financial leverage was measured by

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10 *This applies to similar studies conducted by,amongst others, Baxter & Cragg(1970,p.225), Martin & Scott(1974,p.71) and Taub (1975,p.410).*

11 *These are similar in nature to South African tax rebates, i.e. they reduce tax payable as opposed to being a deduction from taxable income .*

the mean ratio of book value long term debt to the sum of market value equity and book value long term debt.

The authors hypothesised negative relationships between financial leverage and all of the proxies. By using dummy variables in an analysis of variance a significant industry effect was found. The NDTS proxy was found to be positively associated with financial leverage at the 0.01 level.

3.4.1.4 Long & Malitz (1986)

Long & Malitz (1986,p.156) tested the relationship between financial leverage and what they referred to as "asset structure". In the same manner as Marsh (1982,p.121), the authors used the Myers' (1977,p.147) assets in place hypothesis to propose a positive relationship between financial leverage and asset structure.

The definition of financial leverage was the ratio of long term debt to "long term funded capital". Long term funded capital was defined as the book values of long term debt plus equity, plus capitalised intangibles in the form of research and development (R&D) and advertising expenditure. The authors capitalised all R&D and advertising expenditure and amortised these over five and three years respectively.

The paper utilised four proxy ratios for asset structure, all of which were denominated by long term funded capital. The two proxies which are likely to have been associated with operating leverage, and are therefore of interest to this study, utilised numerators of capital expenditures and net plant (presumably cost of plant less accumulated depreciation). All ratios were calculated as three year averages over the period 1981-1983.

The sample (the size of which was not reported) was stratified according to industry classification. Industry ratios were calculated as the mean of the ratios of constituent firms. The industries were ranked into quartiles based on financial leverage, and the top five and bottom five industries were examined for trends.

No r^2's nor significance levels were calculated for either the firms or industries in respect of individual proxies. The results of the individual proxies were based on descriptive statistics and trends only, and were examined at industry level only. The authors acknowledged that their results were suggestive rather than conclusive. Long & Malitz suggested that the net plant ratio was positively related to financial leverage and that the capital expenditure ratio was not at all related although their results indicated an inconsistent but dominantly negative association.

3.4.1.5 Friend & Lang (1988)

Friend & Lang (1988,p.271) attempted to test whether capital structure decisions are motivated by manager self interest. The hypothesis was that the greater the shareholding of management the greater the undiversified risk they held, and therefore the greater the incentive to management to reduce the possibility of bankruptcy via financial leverage. Financial leverage was measured by the ratio of total debt minus trade creditors and accruals to total assets. In effect the numerator measures interest bearing debt, but without any adjustment for hybrid securities such as redeemable preference shares, convertibles etc.

The study spanned the period from 1979 to 1983. A sample of 984 firms was divided into four sub-samples based on criteria relating to manager interest in the firms. For each of the sub-samples regressions were run between leverage and proxies for, amongst other items, asset structure. The results were compared across the sub-samples to evaluate the manager self interest hypothesis. No hypotheses were stated for the capital structure determinants.

The proxy used for asset structure was that of fixed assets divided by total assets. It is difficult to evaluate the significance of the full results as the authors only give what they call a "representative sample". Based on this sample, the asset structure measure was found to be positively related to leverage. Significance was found at the 0.05 level but was not consistent.

3.4.1.6 Barton & Gordon (1988)

Barton & Gordon (1988,p.623) examined the effects of both strategy differences and financial variables on capital structure. A sample of 304 firms was drawn from the Fortune 500 for the years 1970-1974. The firms were divided into four groups based on a strategy classification. Multiple regression was employed to test the relationships between leverage and the financial variables across the four groups.

The authors tested the relationship between financial leverage and what they referred to as capital intensivity. The proxy used for capital intensivity was the ratio of average net fixed assets to total book assets. Leverage was measured in an unorthodox manner as the ratio of equity to capital employed. This is effectively the ratio of (capital employed-long term debt) / capital employed. The ratio has excluded all current liabilities and would be negatively correlated to traditional financial leverage measures of long term debt.

Barton & Gordon hypothesised a positive relationship between their financial leverage definition and capital intensivity. The authors stated that capital intensivity was likely to be closely related to operating leverage and cited **Ferri & Jones (1979,p.641)** as evidence of a negative relationship with the more traditional leverage measures. Capital intensivity was not found to have a statistically significant relationship to financial leverage and the direction of the association was not consistent.

3.4.1.7 Titman & Wessels (1988)

Titman & Wessels (1988,p.1) used a factor analytic approach known as linear structural modelling (LISREL) to examine the relationship between capital structure and a number of attributes for 469 manufacturing companies. The authors used six definitions of leverage which consisted of three different numerators (viz. Long term, short term, and convertible debt) and both a market and a book value of equity as denominators for each of the numerators.

The attributes examined which were of particular interest to this report were those relating to asset structure and non debt tax shields (NDTS). The proxies with the highest factor loadings in these categories were, respectively, the ratio of inventory plus gross plant to total assets, and the depreciation charge divided by total assets. The proxies were measured as three year averages over differing periods between 1974 and 1982.

Titman & Wessels found a distinct difference between their results based on long and short term debt as opposed to those based on convertible debt. The convertible debt exhibited inconsistent relationships, none of which were significant. The rest of the review of this paper will therefore relate to the findings of long and short term debt leverage measures.

The authors hypothesised a positive relationship between financial leverage and asset structure and although the relationship was found to be statistically insignificant, three of the four regressions indicated negative relationships. The NDTS (i.e depreciation divided by total assets) was also not statistically significant but indicated a consistent negative association. The results were consistent across the different maturity and valuation bases of debt for the two proxies with the exception that small firms tended to use more short-term debt than large firms.

3.4.1.8 Bennett & Donnelly (1993)

Bennett & Donnelly (1993,p.43) examined the cross sectional variation in the capital structures of non financial UK companies from 1981 to 1984 using proxy variables for five attributes including both asset structure and non-debt tax shields.

The authors employed six financial leverage proxies. Three different measures of debt were used in the numerator, viz. total debt, long-term debt and short-term debt. For each measure of debt two denominator measures of the value of the firm were employed. The first denominator was a 'market' value measure of total assets and was represented by the sum of the market value of equity and the book value of total debt. The second denominator was a

book value measure consisting of total assets minus current liabilities. All financial leverage ratios were calculated as four year averages.

The asset structure and NDTS proxies were measured by, respectively: plant and machinery divided by total assets minus current liabilities (i.e. capital employed); and the comprehensive deferred tax liability divided by capital employed.

A positive relationship was hypothesised between asset structure and financial leverage and a negative relationship was hypothesised between NDTS and financial leverage. These hypotheses seem inconsistent. The authors propose a positive relationship for the ratio of plant and machinery to capital employed but a negative relationship for the ratio of the deferred tax liability to capital employed. Plant and machinery is likely to be the major, and in some cases the sole, contributor to the deferred tax liability and is therefore likely to be very strongly positively related to it. This was confirmed by the findings of the study which indicated a strong positive correlation between the proxies ($\rho = 0.254$).

The results were found to be dependent on the maturity of the leverage definition employed. Total debt was positively correlated with asset structure at the 0.05 level and negatively correlated with NDTS at the 0.05 level, but the explanatory power of both proxies was low. In relation to long term debt, asset structure was not found to be significant and was inconsistent with respect to sign, while the NDTS remained negatively associated at the 0.05 level. The findings with respect to short term debt were similar to those with respect to total debt, with both asset structure (positively) and NDTS (negatively) significant at the 0.05 level.

The Bennett & Donnelly study is subject to the following shortcomings:

i. The positive association between asset structure and NDTS proxies was stronger than either proxy exhibited with financial leverage. The findings of weaker associations with financial leverage in opposite directions indicates that the correlations with financial leverage may be spurious.

ii. The choice of the denominator for both the asset structure and NDTS proxies. The denominator chosen for the asset structure and NDTS proxies was total assets less current liabilities. In terms of the accounting balance sheet this gives 'capital employed'. This introduces a financing bias into ratios that are intended to focus on assets. In terms of the Bennett & Donnelly definition two companies with the same asset structure (i.e. proportion of fixed to current or total assets) but who utilise different proportions of short term debt will have different asset structure ratios. Research[12] has shown that current liabilities are the single biggest source of debt. Any variations in the usage of current liabilities would therefore result in a significant financing bias in the asset based proxies. This bias is likely to have had a more pronounced effect on the relationships with the short term debt measures.

3.4.3 SOUTH AFRICAN RESEARCH

Prior to the start of this study no empirical South African research had been published relating to the determinants of capital structure. During the late stages of this study two South African studies in the form of **Jordaan, Hamman & Smit (1994,p.21)** and **Davidson & Rapp (1995,p.90)** were published. The current study was conducted completely independently of these studies, and its methodology and scope for research were established without any knowledge of the "prior" studies.

While such overlapping studies are often regarded as *sub judice*, Jordaan et al and Davidson & Rapp have been reviewed by this study. The strength of the conclusions drawn by this study will be enhanced by the ability of such conclusions to reconcile and explain perceived inconsistencies in prior research.

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12 *See: Bowman (1980,p.245) and Mulford (1984,p.899)*

3.4.3.1 Jordaan, Hamman & Smit (1994)

Jordaan, Hamman & Smit (1994,p.21) conducted what they referred to as a study of an exploratory nature[13] to identify potential determinants of South African capital structures. The authors tested the association between capital structure and four attributes, including operating leverage. The sample size cannot be determined from the article. The authors started with 109 companies and then excluded an unknown number of companies based on data availability and pyramid /subsidiary company relationships.

Data was collected for the sample for the period between 1970 and 1990. Ratios were found to be non stationary over the period and the study was divided into two sub-periods. The first data period was an older and considerably more averaged period from 1970-1985, and the second was a more contemporaneous period from 1986-1990.

The sample was divided into industry classifications based on the JSE sector in which the shares were listed. No analysis was reported of the individual company sample. The only results reported were those which examined capital structure determinants intra-industry. Nineteen industry sectors were identified.

Six financial leverage ratios were tested, four of which were balance sheet based definitions that used total assets as a denominator and had the following numerators: total debt; long term debt; interest bearing debt; and short term debt. The fifth ratio was total debt divided by capital employed and the sixth was the interest cover ratio (earnings before interest and taxation divided by interest expense). Debt consisted of book debt only and no adjustments were made for preference shares, convertibles, or other hybrid instruments.

The authors did not hypothesise the direction of the relationship between financial and operating leverage. Two proxies for operating leverage were employed by the study in the form of the ratio of fixed assets divided by total assets and the change in operating income divided by the change in sales. Intra-industry stepwise regressions were performed to examine the relationships. No tests were conducted to check the validity of the OLS

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13 *Translated from the Afrikaans "verkennende aard" page 24.*

assumptions and no adjustments were made for outliers. The authors justify this on the basis of the study being only exploratory in nature.

Interpretation of the results and comparison to other studies is difficult for two reasons. Firstly, no results are reported for the individual company sample as a whole, as is customary in such research. The results are reported based on the number of industries where the proxy was found to be significantly associated with capital structure, with distinctions drawn between the number of positive and negative associations found. Secondly, significant association was determined at the 0.1 level only. No r^2's, t-statistics, regression coefficients, or differentiation of significance levels were provided. This is not intended as a criticism.

No significant association was detected for the income statement measures of either financial or operating leverage and any significance present was found in the balance sheet relationships. The only consistently strong association exhibited by the balance sheet operating leverage measure was in respect of the short term financial leverage measure, which was found to be negative. This negative association was found to become positive in respect of the long term financial leverage measure, although the relationship was only significant in the first of the two sub-periods. Interestingly, while no significant association was evident with the total financial leverage measure (i.e. total debt/total assets), a negative association was dominant.

3.4.3.2 Davidson & Rapp (1995,p.90)

Davidson & Rapp (1995,p.93) concluded, in the context of the JSE, that "Unfortunately, MMII (i.e. with taxes) is not empirically valid." The Davidson & Rapp study is not directly related to the scope of this study as they do not examine operating leverage. However, their study will be reviewed as the MM (with taxes) model forms a significant part of the **Hamada (1969,p.435)** and **Mandelker & Rhee (1984, p.51)** formulations which are tested empirically by this study.

Using a sample consisting of the 70 largest Industrial companies as defined by the *Finance Week 200*, the authors draw their conclusion based on the following evidence:

i. They regress the market value debt/ equity (D/E) ratio (where debt is not defined) on measures of the return on the share (ROS), the return on assets (ROA) and the return on equity (ROE), where the ROA and ROE are accounting determined, but not defined. The ROS and ROA are significantly negatively correlated to the D/E ratio at the 0.05 and 0.001 levels respectively. The ROE, on the other hand, is significantly positively correlated at the 0.1 level.

ii. Realising that they have not adjusted for risk, the authors do so by regressing "financial risk" on the same return measures. Financial risk is defined as the difference between the unlevered beta and the levered beta, as determined by formula (2.19). The betas are measured over three years of monthly returns using the JSE All Share Index and no apparent adjustments for thin trading. The ROS and ROA were found to be significantly negatively correlated at the 0.01 and 0.001 levels respectively, while the ROE was insignificantly positively correlated.

With due respect to the authors, the strong conclusions drawn are inappropriate for the following reasons:

i. The MM with tax model implies that, for a given level of business risk, the expected return on equity is positively correlated to the D/E ratio, provided that the expected return on assets is greater than the after tax cost of debt. The model does not imply an historically positive relationship between the D/E ratio and returns. It merely implies that the difference between the ROE and the ROA (i.e. ROE-ROA) will be proportional to the D/E ratio, with a positive relationship when the ROA is greater than the after tax cost of debt and a negative relationship when the ROA is less than the after tax cost of debt[14].

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14 *Even if this difference between ROE and ROA had been tested and found to be negatively associated with the D/E ratio, it would not necessarily invalidate MMII, particularly when the summary statistics of Davidson & Rapp are considered. Their mean ROA was 16.2%, with a standard deviation of 9.6%. If the returns were normally distributed, approximately 16% of the sample companies had ROA's of less than 6.6%. When compared with an after tax risk free rate of return of approximately 9% (18% * 50% (tax rate)) prevailing at the time of the study, it is likely that a considerable portion of the sample exhibited negative leverage.*

ii. The sample used by the authors is significantly biased in favour of large firms and cannot be regarded as representative of the JSE. Unfortunately, the risk profile of these companies cannot be determined. While the mean beta is 0.76 (standard deviation 0.42), the low beta value may be indicative of too few data points in the beta regressions (a maximum of 36) and the lack of adjustments for thin trading[15].

3.5 SUMMARY

While the review has shown that the majority of prior studies have employed similar methodologies in the form of simple and multiple regression analyses, the measurement of the regression variables and results have differed substantially. In the capital structure research similar operating leverage proxies have been tested as indicators of different attributes, under diametrically opposed hypotheses and against different maturities of debt financing. In an attempt to break through the differing attributes and hypotheses and to facilitate comparison and the drawing of conclusions, prior research has been summarised in table format in descending date order. The column titles and their respective meanings are as follows:

i. **Study**: The author/s of the study, where studies are included in descending date order.

ii. **Beta: price relative returns**: (dependent variable) The number of years and interval over which price relative returns were calculated to estimate beta.

iii. **Financial / Operating leverage proxy**: (independent variable) The proxy used by the study to measure financial/operating leverage.

iv. **Proxy average**: The number of year's worth of data required to measure the leverage proxy (independent variable).

v. **Consist. Sign**: (Consistent sign) Indicates whether or not the direction of the association was consistent.

vi. **Dominant sign**: Indicates the dominant direction of association.

vii. **Signif at 0.05**: (Significant at the 0.05 level) Indicates whether the relationship was found to be significant at the 0.05 level in the majority of the regressions performed.

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15 *The methodological issues relating to the measurement of systematic risk will be discussed in Chapter 4, Section 4.4.3.*

3.5.1 Systematic risk versus financial leverage

Table 3.2: Beta vs. Financial Leverage

Study	Beta - price relative returns	Financial leverage proxy	Proxy average	Consist. sign	Dominant sign	Signif. at 0.05
		Balance Sheet				
		Total debt				
etief et	10 years, monthly	TLia / TAss	10 years	Yes	Positive	**Yes**
hingra	5 years, monthly	TLia / TAss	No	No	Positive	No
hompson	9 years, monthly	TLia / TAss (μ)	9 years	Yes	Positive	**Yes**
hompson	9 years, monthly	TLia / TAss (σ^2)	9 years	Yes	Positive	No
lel&Rus	Change in 4 yr, monthly	TLia / TAss	4 years	Yes	Positive	No
os&Mck	13 years, annually	TLia / TAss	5 years	Yes	Positive	**Yes**
eaver et	9 years, monthly	TLia / TAss	9 years	Yes	Positive	**Yes**
		Long -term debt				
elkaoui	4 years, bi-weekly	LTLia / Equity	4 years	Yes	Positive	No
ev&Kun	15 years, monthly	LTLia / Equity	15 years	Yes	Positive	No
re&Lern	3 years, monthly	LTLia / Equity	No	No	Positive	No
		Income Statement				
lan&Rhe	20 years, monthly	Time series, eq. (3.2)	20 years	Yes	Positive	**Yes**
hompson	9 years, monthly	OpInc / Interest (μ)	9 years	Yes	Negative	No
hompson	9 years, monthly	OpInc / Interest (σ^2)	9 years	Yes	Negative	**Yes**
		Cash Flow				
hompson	9 years, monthly	Cash / TLia (μ)	9 years	No	Negative	No
hompson	9 years, monthly	Cash / TLia (σ^2)	9 years	Yes	Negative	**Yes**

udies: Retief et = Retief et al (1986), Dhingra = Dhingra (1982), Belkaoui = Belkaoui (1978), Thompson = Thompson (1976), Lev&Kun = Lev & Kunitzky 74), Mel&Rus = Melicher & Rush (1974), Bre&Lern = Breen & Lerner (1973), Ros&Mck = Rosenberg & McKibben (1973), Beaver et = Beaver et al (1970), n&Rhe = Mandelker & Rhee (1984). **Abbreviations**: TLia = Total Liabilities, LTLia = Long Term Liabilities, TAss = Total Assets, OpInc = Operating Income fore Interest and Taxation), Interest = Interest expense, Cash = Operating Income plus Depreciation.

The following observations can be drawn from prior research based on financial leverage:

i. The focus of prior research has been on balance sheet measures of financial leverage. The balance sheet measures indicate consistency with respect to the direction of the relationship with beta, but conflict with respect to the significance thereof. While it may be concluded that prior research has shown that the direction of the association is consistent with theory, it cannot be concluded that the significant association predicted by theory has been established.

ii. No distinction has been drawn between the differing natures of balance sheet financial leverage that have been tested, i.e. total and long term debt. Prior research has simply referred to financial leverage, irrespective of the measure employed and has failed to recognise the different natures/risks inherent in financial leverage and their possible effect on the relationship with systematic risk. Table 3.3 indicates that the different measures have exhibited markedly different associations with beta. While four of the six total leverage measures were found to be significant, none of the long term leverage measures indicated significant association with beta. These differences and their reconciliation provide considerable scope for research.

iii: The income statement and cash flow measures of financial leverage have also exhibited a consistent direction of association but conflicting significance. Only one study, **Thompson (1976,p.173)**, has examined cross sectional income statement and cash flow measures of financial leverage. The simplistic cash flow measures employed by Thompson are more representative of income statement measures than they are of cash flow measures, and in effect the relationship between beta and cash flow measures of financial leverage remains untested.

3.5.2 Systematic risk versus operating leverage

Table 3.3: Beta vs. Operating Leverage

Study	Beta - price relative returns	Operating leverage proxy	Proxy average	Consist. sign	Dominant sign	Signif. at 0.05
		Balance Sheet				
etief et	10 years, monthly	FAss+Gwill /TAss-CLia	10 years	Yes	Positive	No
hingra	5 years, monthly	Operating leverage ratio	No	No	Negative ≠	No
hingra	5 years, monthly	NPlant / TAss	No	No	Negative ≠	No
el&Rus	Change in 4 yr, monthly	NPlant / TotCap	4 years	Yes	Positive	No
os&Mck	13 years, annually	GPlant / TAss	No	Yes	Negative ≠	**Yes**
		Income Statement				
an&Rhe	20 years, monthly	Time series, eq. (3.1)	20 years	No	Positive	**Yes**
ev	10 years, monthly	Time series, eq. (3.3)	10 years	Yes	Positive	**Yes**
os&Mck	13 years, annually	FixCharge / OpInc	5 years	N/a	N/a	No

dy: Lev = Lev (1974). **Abbreviations**: FAss = Fixed Assets, Gwill = Goodwill, CLia = Current Liabilities, NPlant = Net Plant, GPlant = Gross Plant, TotCap = al Capital, FixCharge = Fixed Charges, ≠ = direction of relationship is opposite from that hypothesised by authors. Other studies and abbreviations are as viously defined.

The following observations can be drawn from prior research based on operating leverage:

i. There is no consensus regarding the direction of the relationship between operating leverage and beta. While the two overseas time-series studies exhibited a theoretically consistent significant positive relationship, none of the cross sectional measures of leverage have done so. The only cross sectional operating leverage measure to exhibit significance did so in a negative direction and the majority of the cross sectional measures have indicated a negative association. This dominant negative association is anomalous and its explanation affords considerable scope for further research.

ii. None of the studies reviewed examined the association between operating leverage and the asset or unlevered beta. Chapter Two showed that the theoretical association between beta and operating leverage is as a result of operating leverage's association

with the unlevered beta. The examination of this relationship may provide useful insights into the relationship between the levered beta and operating leverage.

iii. As with financial leverage, prior research has concentrated on balance sheet measures of operating leverage. The majority of income statement measures have been time-series based, and no study has examined cash flow measures of operating leverage. There is considerable scope for the examination of cross sectional income statement and cash flow measures of operating leverage.

iv. An observation which applies to the relationships between systematic risk and operating as well as financial leverage is that relating to the extent of averaging. All of the studies which indicated significance between beta and either operating or financial leverage utilised beta estimates based on share returns calculated over between nine and thirteen years. Overseas, and local research in the form of **Boshoff (1983,p.31)**, has shown that the average period over which beta estimates are stable is three years. The studies which have exhibited significance have therefore used a beta estimate that is an average over at least three stationary periods. Such a measurement is a highly averaged beta estimate.

Furthermore, these studies also used highly averaged operating or financial leverage measures. None of the studies that utilised leverage measures based on current financial statement (i.e. one year's worth of) information found significance. In determining the portfolio associations, the average ratios and the average betas of the individual companies were further averaged over the portfolios. While it may be argued that the averaging reduces measurement error, it is submitted that the extent of the averaging in the studies concerned is likely to significantly overstate any association between beta and measures of leverage[16].

3.5.3 Financial leverage versus operating leverage

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16 *Beaver et al (1970,p.670) show statistically that as the degree of aggregation increases, the significance of the relationship is likely to increase.*

Table 3.4: Financial Leverage vs. Operating Leverage

Study	Financial leverage proxy	Operating leverage proxy	Proxy average	Consist. sign	Dominant sign	Signif. at 0.05
	1: Total debt					
rdaan et	TLia / TAss	FAss / TAss	5 & 15 yrs	Yes	Negative	N/a
en&Don	TLia / Mequity+TLia	NPlant / TAss-CLia	4 years	Yes	Positive	**Yes◎**
en&Don	TLia / Mequity+TLia	DefTaxLia / TAss-CLia	4 years	Yes	Negative	**Yes◎**
err&Jone	TLia / TAass	FAss / TAss	5 years	Yes	Negative	**Yes**
	2: Long term debt					
rdaan et	LTLia / TAss	FAss / TAss	5 & 15 yrs	Yes	Positive	N/a
en&Don	LTLia / Mequity+TLia	NPlant / TAss-CLia	4 years	No	Positive	No◎
en&Don	LTLia / Mequity+TLia	DefTaxLia / TAss-CLia	4 years	Yes	Negative	No◎
it&Wess	LTLia / Equity	Dep / TAss	3 years	Yes	Negative	No
it&Wess	LTLia / Equity	Inv+Gplant / TAss	3 years	No	Negative	No
ar&Gord	Equity / CapEmp	FAss / TAss	5 years	No	Negative□	No
ri&Lang	IBD / TAss	FAss / TAss	5 years	Yes	Positive	**Yes**
on&Mali	LTLia / LTCap+IAss	CapExp / LTCap+IAss	3 years	No	Negative	N/a
on&Mali	LTLia / LTCap+IAss	Nplant / LTCap+IAss	3 years	Yes	Positive	N/a
radley et	LTLia /LTLia+Mequity	Dep+TaxCr /OpInc+Dep	20 years	Yes	Positive	**Yes**
larsh	LTLia	FAss / TAss	N/a	Yes	Positive	**Yes**
	3: Short term debt					
rdaan et	CLia / TAss	FAss / TAss	5 & 15 yrs	Yes	Negative	N/a
en&Don	CLia / Mequity+TLia	NPlant / TAss-CLia	4 years	Yes	Positive	**Yes◎**
en&Don	CLia / Mequity+TLia	DefTaxLia / TAss-CLia	4 years	Yes	Negative	**Yes◎**
it&Wess	LTLia / Equity	Dep / TAss	3 years	Yes	Negative	No
it&Wess	LTLia / Equity	Inv+Gplant / TAss	3 years	Yes	Negative	No
	4. Time Series					
lan&Rhe	Time Series eq. (3.3)	Time Series eq. (3.2)	N/a	Yes	Negative	**Yes**

dies: Jordaan et = Jordaan et al (1994), Ben&Don = Bennett & Donnelly (1993), Ferr&Jone = Ferri & Jones (1979), Tit&Wess = Titman & Wessels (1988), &Gord = Barton & Gordon (1988), Fri&Lang = Friend & Lang (1988), Lon&Mal = Long & Malitz (1986), Bradley et = Bradley, Jarrel & Kim (1984), Marsh = rsh (1982). **Abbreviations**: Mequity = Market Value of Equity, DefTaxLia = Deferred Tax Liability, LTLia = Long Term Liability, Dep = Depreciation, Inv = entory, CapEmp = Capital Employed, IBD = Interest bearing Debt, LTCap = Long Term Capital, IAss = Intangible Assets, TaxCr = Tax Credits. Other studies abbreviations are as previously defined. ◎ = This study was shown to be subject to a short term financing bias and potential spurious correlation. □ = This ffectively positive as the financial leverage proxy is inversely related to financial leverage

The following observations can be drawn from prior research based on capital structure:

i. Prior research has focused on the examination of long term measures of capital structure rather than total or short term debt measures and has tended to disregard the distinction between the measures when drawing conclusions. While prior research has not produced unanimous results with respect to the relationship between long term financial leverage and operating leverage surrogates, the majority of studies have indicated a positive association with little statistical significance.

ii. In sharp contrast to the long term financial leverage measures, the studies that have examined total and short term measures have indicated dominant negative relationships and the only study to find positive relationships for either total or short term measures was shown to include a short term financing bias. This observation challenges the consensus in recent research that a positive association exists between financial leverage and operating leverage (or asset structure). This consensus is evidenced in a *Journal of Finance* article by **Harris & Raviv (1991,p.334)** when they say "studies generally agree that leverage increases with fixed assets".

iii. By disregarding the differences between financial leverage measures and the effect these differences may have on the relationship to operating leverage, prior research has not recognised that operating leverage (asset structure) may reflect a positive association with long term leverage despite having a negative correlation with overall capital structure

A positive relationship between long term debt and asset structure may exist solely as a result of firms matching the maturity of their finance to that of their assets, regardless of overall capital structure. By excluding short term finance the results based on long term finance cannot be generalised to overall capital structure unless the proportions of long and short term finance are both highly positively correlated with the asset structure employed.

A rationale proposed for the use of long term debt is that it represents the permanent capital structure of the firm. This is highly questionable. In an analysis of firm financing **Bowman (1980,p.245)** and **Mulford (1984,p.899)** found that current liabilities were the single largest source of finance and in the case of the former, comprised 50% of the total debt plus preference shares. Exclusion of short term debt therefore results in the omission of a significant, if not the major, part of the corporate financing decision, as well as one of the riskiest from the firms perspective. This is confirmed by **Titman & Wessels (1988,p.14)** who state that firms that utilise greater proportions of short term debt are more susceptible to temporary economic downturns.

iv. Prior research has taken a narrow view of the relationship between financial and operating leverage. The trade-off based theory of **Mandelker & Rhee (1984,p.47)** focused on one times series, income statement based measure of both financial and operating leverage. Capital structure on the other hand has taken a balance sheet view of the relationship. To enable meaningful conclusions to be drawn the relationship should be examined over different proxies drawn from the balance sheet, income statement and cash flow statement using both cross sectional and time series measures.

3.5.4 Common observations

The following observations apply to the prior research in each of the three relationships:

i. There is a dearth of published South African research into the inter-relationships examined by this study. There has been one published study relating to the association between systematic risk and leverage measures in the form of **Retief, Affleck-Graves & Hamman (1984a, p.23) & (1986,p.154)** and one capital structure study in the form of **Jordaan, Hamman & Smit (1994,p.21)**.

ii. No adjustment was made by prior research for differing accounting policies between firms and the impact this has on the financial statement information that forms the basis of proxies.

ii. The majority of previous studies utilised the OLS regression model to determine the statistical significance of the associations. Application of this regression model relies on strict assumptions regarding the stationarity of the relationship tested, and more importantly the nature of the regression residuals. As **Titman & Wessels (1988,p.14)** point out "their (the results) statistical significance should be interpreted cautiously. The reported *t*-statistics are based on the assumptions of independent, identical, and normally distributed error terms - assumptions that are surely violated by our data". None of the studies reviewed either tested or adjusted for compliance with these assumptions. In the presence of any violation of these assumptions the reported significance levels may be severely mis-stated.

3.6 CONCLUSION

This chapter has reviewed and summarised prior research into the inter-relationships between systematic risk, financial leverage and operating leverage. It has shown that prior research has tended to take a narrow, balance sheet view of the relationships which has indicated varying significance levels and conflicting directions of association. Further research should broaden the scope to examine the interactions between as many consistent proxies for the variables as possible. It should ensure that the financial information that comprises the proxies is comparable and that the regressions on these proxies are consistent with the assumptions of the employed regression model to ensure meaningful results.

The chapter has shown that prior research has not adequately distinguished between the risks inherent in different financial leverage definitions and has tended to examine each of the three relationships in isolation. To be of value, future research should build on the finding in this chapter that different financial leverage measures exhibit different associations with both systematic risk and operating leverage, and examine this in a dynamic framework that allows for interaction between the three variables rather than three distinctly static associations. This chapter has not only indicated that significant scope exists for further research, but has also proposed the direction that further research should take.

Part Two :

Measurement

ii. All companies that underwent financial year end changes between 31 December 1979 and 31 December 1989 were excluded. A change in financial year end results in published financial information that spans a period which is usually considerably shorter or longer than one calendar year. This would bias any cash flow or earnings figures used in the calculation of ratios.

iii. Companies registered and controlled overseas. These companies are subject to different taxation to South African companies. Their dividends are declared in foreign currency and were subject to non-resident shareholders taxation (NRST) during the period of the study. Overseas companies may also have been subject to inflated transfer prices to circumvent exchange control regulations. These factors were likely to give rise to a bias in the calculation of price relative returns and cash flows.

iv. Companies listed in the Industrial Holding section of the Johannesburg Stock Exchange. Such companies are usually highly diversified and are effectively portfolios in themselves. This study distinguishes between individual share and portfolio effects. Non exclusion of these companies would have resulted in an aggregation bias in the individual share relationship.

v. Companies for which complete share price data for the three financial years ended 1989 was not available from the University of Stellenbosch Business School (USB) Database.

vi. Companies for which complete financial statement information for the ten financial years ended 1989 was not available from the Bureau of Financial Analysis (BFA) Financial Database in Pretoria.

vii. For the remaining companies, companies with a subsidiary[1] in the sample. The holding companies were rejected to prevent duplication in the sample. This procedure was followed by **Retief, Affleck-Graves and Hamman (1984a,p.27)**.

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1 *For the purposes of this report a company is defined as a subsidiary of an investor company if the investor controls greater than 50% of the ordinary shares of the investee company.*

In selecting their company sample **Retief et al (1984a,p.27)** required all companies to have the same financial year end. The authors argue that earnings are subject to seasonal effects and as a result interest costs and cash flows measured over different intervals are subject to different economic factors. This selection procedure would have severely restricted the size of the company sample and has not been applied by this study for the following reasons:

i. Companies with similar year end's are not necessarily subject to the same seasonal effects. Seasonal variations in the interest costs and cash flows of a company are a function of the company's operating cycle rather than its financial year end. Companies with similar year end's will not necessarily have the same operating cycle and therefore be subject to the same seasonal effects. Although companies with similar year end's will be subjected to the same general economic factors (for example interest rate movements), these economic factors will effect companies at different stages of their operating cycle differently.

ii. If companies with similar year end's do have the same operating cycle then exclusion of all companies with dissimilar financial year ends would result in a sample biased in favour of a particular operating cycle. This would restrict any extrapolation of the findings of this study to firms with different operating cycles.

4.3 COMPANY SAMPLE SELECTION : RESULTS

The application of the sample selection criteria outlined in section 4.2 resulted in the selection of 76 industrial companies. The companies are listed alphabetically in Appendix 1, together with the section of the JSE in which they were listed and the month in which their financial year ended. The final sample of 76 companies is after the elimination of companies found to have betas which were statistically insignificantly different from zero[2].

An analysis of the sample by sector is presented in Table 4.1. Companies from the Engineering and Building and Construction sectors dominated the sample. Together these

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2 *The significance tests performed on the betas are detailed in section 4.4.*

sectors constituted 30% of the sample. Fishing and Printing and Publishing sectors, on the other hand, were not well represented.

Table 4.1: Company Sample by Sector

Sector	Sample size
Beverages, Hotels, and Leisure	3
Building and Construction	11
Chemical and Oil	3
Clothing, Footwear & Textiles	7
Electronics	3
Engineering	12
Fishing	1
Food	6
Furniture and Household	2
Motor	5
Paper and Packaging	3
Pharmaceutical and Medical	2
Printing and Publishing	1
Retail and Wholesale	8
Steel and Allied	2
Sugar	2
Tobacco & Match	2
Transport	3
Total	76

4.4 MEASUREMENT OF SYSTEMATIC RISK: METHODOLOGY

The validity of the Market Model as a means of estimating beta was established in Chapter Two[3]. The empirical methodology of this study employed this model to estimate betas. Beta was therefore established as the slope coefficient resulting from a time series regression of ex-

[3] *See Chapter 2, Section 2.4.3.*

post share and market returns. All systematic risk related data was obtained from the USB Financial Databank. The empirical form of the regression equation[4] is:

$$R_{i.t} = a_i + B_i R_{m.t} + e_{i.t} \tag{4.1}$$

All symbols have been previously defined.

4.4.1 The Ex-Post Share Return ($R_{i.t}$)

Ex-post share returns were determined using the following price relative returns formula:

$$R_{i.t} = \frac{P_{i.t} - P_{i.t-1} + Div_{i.t} + ED_{i.t}}{P_{i.t-1}} \tag{4.2}$$

Where:

$P_{i.t}$ = closing price of share i at the end of period t.

$P_{i.t-1}$ = closing price of share i at the beginning of period t

$Div_{i.t}$ = dividend of share i in period t where period t contained the last day to register (LDR)

$Ed_{i.t}$ = equivalent dividend of share i at the end of period t where the ex rights and ex dividend date (LDR), as well as the effective date of share splits, share consolidations and reductions of capital, was contained in period t.

The method of calculating the equivalent dividend is stated in section 4.4.3.2.

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4 *Equation (4.1) is equivalent to equation (2.12) and has been restated for the convenience of the reader.*

4.4.2 The Ex-post Market Return ($R_{m.t}$)

The ex-post market return consisted of a price relative return and a dividend yield on the market portfolio, calculated as follows:

$$R_{m.t} = \frac{PI_{m.t} - PI_{m.t-1}}{PI_{m.t-1}} + \frac{DI_{m.t} * n}{100 * 365} \qquad (4.3)$$

Where:

$PI_{m.t}$ = market price index value at end of period t.

$PI_{m.t-1}$ = market price index value at the beginning of period t.

$DI_{m.t}$ = dividend index for the market portfolio at the end of period t (expressed in percentage terms).

n = number of days between the end of period t and the end of period $t-1$.

The share price and dividend indices utilised by this study are stated in Section 4.4.3.3.

4.4.3 Market Model Issues

The application of the Market Model involves a number of contentious issues. The nature of some of these issues and the methodological solutions employed are dealt with in this section.

4.4.3.1 Measurement of the price relative

Affleck-Graves, Money & Carter (1982,p.65) argued that the use of the logarithm of the price relative is preferable to the traditional definition of return method employed in this study. The logarithmic model, as an additive model, is theoretically superior to the traditional, non additive, alternative. However, they concluded that, empirically, returns are

of such a low order that the traditional return is almost equal to the log return, especially when short intervals are used. **Fama, Fisher, Jensen & Roll (1969,p.4)** confirmed this on return intervals of up to one month. The traditional form employed is therefore justified.

4.4.3.2 Equivalent dividends

When a company changes its capital structure during the interval over which a return is calculated, the existing shareholder experiences either an increase or reduction in shareholding during the interval. The return on the investors holding is incorrect if measured purely as the difference between prices at the beginning and end of the interval plus any dividend payable.

To reflect the correct price relative return in the presence of capital structure changes, it is necessary that an adjustment be made to the price relative return formula defined in equation (4.2). The method employed in this study is that developed by **de Villiers (1980,p.61)** and **(1988,p.26)** and **du Plessis (1984,p.67)**. The method requires that an 'equivalent dividend' be calculated and incorporated into the price relative return formula.

Gewers (1993,p.32) provided an extension to de Villiers' model. Gewers argued that in the rare situation that more than one capital structure change occurs in a company within a return period[5] the calculation of the return during that return period using the de Villiers model may be in error. Gewers presented adjusted formulas to calculate the equivalent dividend in the event of simultaneous or near simultaneous capital structure changes. This study has incorporated the extension to the de Villiers model that was proposed by Gewers.

This study considered five major types of capital structure changes in the form of capitalisation issues, rights issues, share splits, share consolidations and reductions of share capital. Two types of simultaneous capital structure changes were also considered. These were the simultaneous split and consolidation of shares and the simultaneous issue of scrip dividends and consolidation of shares. The implications of these changes in capital structure

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5 *two weeks in this study - see Section 4.4.3.5*

together with the equivalent dividend formula used in the event that such a change arose, are set out in Appendix 2.

4.4.3.3 Market Indices

The deterministic Market Model formulation [equation (4.1)] requires that the price relative returns be regressed against the returns yielded by the market portfolio. **Firer (1993,p.25)** states:

> "It should, at this juncture, be acknowledged that it is not possible to apply the CAPM in its purest form, because in order to obtain an estimate for beta, the stock's return should theoretically be regressed against an index representing all risky assets in the world. No such index exists and so a "true" beta cannot be obtained."

The lack of existence of a market portfolio requires that an available portfolio be used as a proxy. **Roll (1977,p.157)** argues that the tests of the CAPM flow from the ex-ante efficiency of the market portfolio, and the fact that such a portfolio cannot be observed is a major shortcoming of the model. Furthermore, he states that even a minor departure from the market will vitiate the tests. By using a proxy index, the estimated beta will measure the proxy index related risk rather than the market related risk. If the portfolio is unrepresentative of the market portfolio, total risk will not be split into the correct market and specific risk proportions. This proxy beta that is estimated may be significantly different from the "true" beta.

The problem is further compounded on the JSE where a two factor influence was noted by **Gilbertson and Goldberg (1981,p.42)**. The study found that the mining and industrial sectors of the JSE each comprise a significant portion of the total market capitalisation, and are often influenced by different factors. The authors conclude that any market model analysis should take the mining and industrial factors into account.

Bradfield & Barr (1989,p.173) compare the use of the JSE Actuaries Overall Index as the market proxy to the use of an equally weighted index, in the context of thin trading adjustments. The JSE Actuaries' Overall Index is an index comprised of almost exclusively well traded securities having relatively large market capitalisation proportions. The equally weighted index used by the authors, on the other hand, includes all thinly traded securities as well, all being given the same weight. The equally weighted index is therefore subject to thin trading to a greater extent than the Overall Index. The authors conclude that when used in conjunction with an adjustment for thin trading (and the Cohen et al procedure in particular) the equally weighted index results in an improved beta estimate.

Bowie & Bradfield (1993,p.13) find evidence of a mild segmentation of the JSE into mining and industrial sectors. The authors argue that if segmentation between the mining and industrial sectors on the JSE is evident, shares are likely to be priced to compensate investors for bearing the risk of the mining and industrial market proxies separately. The estimation of beta should therefore take into account this segmentation by using different market proxies in the mining and industrial sectors.

Bowie & Bradfield cite evidence from **Venter, Bradfield & Bowie (1992,p.1)** which indicates that the mean squared errors in forecasting the return on a portfolio are considerably lower for industrial and mining shares when the appropriate major sector indices are used to estimate beta than when the Overall Index is used.

In a more recent study **Ward (1995,p.110)** uses the graphical method of correspondence analysis to show that the JSE consists of three distinct segments of securities which can be broadly classified as: precious metals and minerals; other metals and minerals; and financials and industrials. Ward found that the CAPM corresponded to the major dimension of risk in his full data set. He observed that when the CAPM was constructed using the financial and industrial indices as market proxies it did not represent the major dimension of risk in these sectors. Ward concluded that the All Share Index should be used in measuring the betas of Industrial companies rather than the Industrial Index.

The JSE Actuaries' Overall Index is broader, and possibly more representative of the market portfolio, than the JSE Actuaries Industrial Index. However, despite the findings of **Ward (1995,p.110)**, the majority of prior South African research suggests that using an overall index on a sample consisting only of industrial shares would subject the industrial betas to the market segmentation. This would understate the Industrial betas (as mining shares tend to have greater risk) and therefore the JSE Actuaries' Industrial Index was used. The JSE Actuaries Dividend Index was utilised to determine the dividend yield on the market portfolio. Any failure on the part of these indices to consider the major risk dimensions in the Industrial sector represents a shortcoming of this study.

4.4.3.4 Thinly Traded Shares

The estimation of the market model parameters is subject to a bias resulting from so called 'thin trading'. **Strebel (1977,p.15)** noted this as a problem on the JSE. Most shares trade at discrete, stochastic (random) intervals in time, with prices recorded only at points of actual trading. For thinly traded shares, contemporaneous market movements are often not reflected in the recorded price [**Barr & Bradfield (1988,p.288)**]. This effect is magnified when the share is not traded during an interval and the last price of the previous interval is carried forward to the end of the interval, resulting in a zero return. **Affleck-Graves, Money & Carter (1982,p.65)** termed these returns "false zeros" as they do not represent market expectations about a particular share at that point in time.

Thin trading creates two series of prices, one being the observed or recorded prices, and the other an unknown and more volatile series of "true" prices based on market expectations. **Scholes & Williams (1977,p.310)** and **Dimson (1979,p.198)** found that shares trading very frequently or infrequently on average have Ordinary Least Squares (OLS) estimators asymptotically biased upward for alphas and downwards for betas. On the other hand, shares with more average trading frequencies have OLS estimators of alpha and beta that are asymptotically biased in the opposite direction. In the South African context, **Bradfield (1990,p.22)** documented evidence of the significant bias in beta estimates resulting from thin trading on the JSE.

Many methods have been proposed to overcome the limitations of conventional OLS estimation of beta. Most noteworthy of these are Scholes & Williams' unbiased estimator method, Dimson's Aggregated coefficients method, the 'trade-to-trade' method advocated by **Dimson & Marsh (1983,p753)**, and the Dimson-Cohen procedure proposed by **Cohen, Hawawini, Maier, Schwartz & Whitcomb (1983,p.276)**. These methods are statistically based and very detailed. It is not the intention of this report to detail each method. Rather, the report will present a justification for the use of the trade-to-trade method which was employed.

Bradfield & Barr (1989,p.169) tested the effectiveness of the **Cohen et al (1983,p.276)** thin trading estimators in counteracting the bias on the JSE. The authors conclude that the Cohen et al procedures, on average, yielded less biased estimators of beta than the traditional ordinary least squares procedure.

Bowie & Bradfield (1993,p.13) extended the Bradfield & Barr (1989) study by examining the efficiency of the trade-to-trade method. Bowie & Bradfield performed a simulation study in which they generated returns for the simulated shares, using the market model, into which they introduced thin trading. Betas were then estimated using the Cohen et al procedures, the OLS method, and the trade-to-trade method. The estimated betas were compared with the known betas and evaluated on the basis of unbiasedness and efficiency. The authors concluded that (p118):

> "The trade-to-trade technique is found to be superior on both counts and is recommended as the appropriate technique for beta estimation on the JSE."

The trade-to-trade method only considers prices where actual trading occurred and volume was present. If a share was not traded on the last day of the interval, the returns were calculated up to the last day of the interval when the shares were traded. The return for the next interval was then calculated from this day. In the event that a share was not traded at all during a particular interval, the interval was excluded from the return calculations. Market returns were calculated over the equivalent periods. Referring to the trade-to-trade method, **Boshoff (1983a,p.31)** concluded that:

"This effectively eliminated the problem of thinly traded shares and caused the analysis to cover efficient prices only. "

4.4.3.5 The return interval and estimation period

The return interval refers to the time period between successive return measures, or t - (t-1) in equations (4.2) and (4.3). The estimation period refers to the total number of years for which the share returns are regressed against the market returns in estimating beta.

Boshoff (1983a,p.29) found that different length return intervals generated different betas, but more importantly, that share ranking on beta yielded different results for different length return intervals. This is the so-called 'intervalling effect' noted by **Hawawini (1983,p.73)**. Betas of shares with a smaller market capitalisation than average will decrease as the return interval is shortened, whereas betas of securities with a larger than average market capitalisation, will increase.

Hawawini (1983,p.74) argues that the intervalling effect is essentially a problem of thin trading, and that "recognised" adjustments for this trading will correct the interval bias. It is submitted that the trade-to-trade method, as a 'recognised' adjustment for thin trading, will correct the interval bias. Short return intervals may therefore be used in this study without subjecting beta estimates to short interval bias.

Boshoff (1983a, p.30) found that the longer the estimation period, the more unstable the beta estimate. **Carter (1983)** found that the majority of the shares he examined did not have stable betas, whereas **Bowie & Bradfield (1992b,p.1)** observed that there are no more significant changes in beta than could be attributed to chance.

Non stationarity of beta introduces a trade-off into the beta estimation decision between the return interval and the estimation period. The longer the return interval, the longer the

estimation period must be to obtain sufficient data pairs to make the estimate statistically significant. However, the longer the estimate period, the more unstable the beta estimate.

The more unstable the beta estimate is, the less representative it will be of the 'true' beta at the end of the estimation period. The estimated beta is more representative of the average beta over the estimation period. While an 'average' beta may be sufficient to establish a relationship between beta and leverage, it will not be sufficient to prove whether such a relationship is contemporaneous or lagged. It was therefore necessary that the beta estimate obtained be as representative as possible of the true beta on the last day of the estimation period.

Retief, Affleck-Graves & Hamman (1986,p.154) state that convention suggests the use of five years of monthly data to yield a reasonable estimate of beta. This implies that sixty data pairs should be obtained for the estimation procedures. This view is corroborated by **Bowie & Bradfield (1993,p.17)**.

Chow tests of beta stationarity performed by **Boshoff (1983a,p.30)** found that the average period over which beta estimates were stable was three years. It is submitted that the conventional five year beta is too unstationary an estimate on which to base the determination of whether the inter-relationships to be examined are contemporaneous or lagged. Only 60% of the observations used in estimating such a beta would be contained in the three year stationary period leading up to the estimation date.

In a study of beta measurement techniques in the South African context, **de Villiers (1980,p.42)** advocated working with a bi-weekly (fortnightly) return interval, incorporating the trade to trade method. This methodology was also advocated by **du Plessis (1984,p.75)** and used by **Ooms (1986,p.38)** and **Ooms, Archer & Smit (1987,p.187)**. A beta estimate based on a bi-weekly return interval over a three year estimation period would include 100% of its observations in the three year stationary period immediately prior to the estimation date. Such a beta estimate would be made from a possible 78[6] observations rather than the conventional 60 observations.

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6 *26 bi-weekly intervals per year multiplied by three years*

The stationarity of the suggested three year bi-weekly beta would result in a better specification of the nature of the beta-leverage relationship than the "conventional" beta. The three year bi-weekly beta employed by this study was estimated over a period of three financial years ending in 1989 (i.e. from the first day of the financial year ending in 1987 to the last day of the financial year ending in 1989). Beta estimates were tested for significant differences from zero at the 0.05 level using Student's *t*-test. Companies with betas that were insignificantly different from zero were eliminated from the sample.

4.4.3.6 Serial independence and constant variance of error terms

Two primary assumptions of the Market Model are that the error terms in the regression equation (4.1) are independent of each other (i.e. serially independent) and have constant variance (i.e. homoscedastic)[7]. **Affleck-Graves & Money (1975,p.387)** found that the assumption of serial independence (i.e. lack of autocorrelation) holds for JSE securities. **Affleck-Graves (1977,p.6.15)** concluded that 'apparent' heteroscedasticity (non constant variance) occurred in approximately 30% of the securities sampled. He argues that this is not true heteroscedasticity, but the result of a poor fitting model. No tests for compliance with these assumptions were conducted by this study in respect of the Market Model.

4.4.3.7 Non Normality of returns

An important assumption inherent in the OLS Market Model is that the regression residuals, or error terms, are normally distributed. **Gilbertson & Roux (1977,p.26)** found that the distribution of share returns on the JSE exhibits strong leptokurtic characteristics. This distribution is strongly peaked with long tails. They suggest that this implies non random behaviour and therefore a decline in the efficiency of the OLS estimators. In a more recent study, **Bowie & Bradfield (1992a,p.1)** confirm that the returns on JSE securities are not normally distributed.

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7 *These assumptions are discussed in more detail in Chapter 6, Section.6.2 in relation to the correlation analysis.*

Ooms et al (1987,p.187) quote **Raes (1981,p.13)** as showing that although the OLS estimates are inefficient, as long as the distribution is symmetrical, OLS provides estimates which are unbiased and consistent. **Affleck-Graves & McDonald (1989,p.892)** point out that the presence of departures from normality in the distributions of the underlying regression variables (i.e. the returns in this case) does not create problems in itself. They do, however, add that it suggests that the distributions of the regression residuals be carefully examined before making distributional assumptions.

None of the local or overseas literature reviewed made any adjustment for non normality of returns, and no adjustment was made in this empirical research methodology. The extent to which undetected heteroscedasticity, autocorrelation and departures from normality may be present in the Market Model residuals is a limitation of this study.

4.5 SYSTEMATIC RISK MEASUREMENT: RESULTS

The application of the Market Model to the 76 sample companies resulted in the regression parameters listed in Appendix 3. Companies have been listed in descending order of beta. The companies and beta estimates listed are stated after eliminating companies with betas which were found to be insignificantly different from zero at the 0.05 level in terms of Student's *t*-test.

Alpha regression estimates were also tested at the 0.05 level using Student's *t*-test. None of the alpha's estimated were found to be significantly different from zero and therefore the Market Model estimates of beta were justified. [**Affleck-Graves, Money & Carter (1982,p.67)**]. Summary statistics for the beta estimates are contained in Table 4.2.

Table 4.2: Beta Characteristics

Mean	Median	Std.Dev.	Var.	Min.Val	Max.Val	Range	Skew.	Kurt.
0.849	0.834	0.248	0.062	0.261	1.480	1.219	0.261	0.087

Std. Dev = Standard Deviation; Min. Val = Minimum Value; Max. Val = Maximum Value; Skew = Skewness Coefficient; Kurt. = Kurtosis Coefficient.

Comments:

i. The mean value of 0.849, when compared to the market average beta of 1.00, indicates shares that are less risky than the Industrial Section, on average. This phenomenon has been observed by prior researchers. The sample used by **Retief (1984,p.95)** had an average beta of 0.799, which he argued was reasonably representative of the population. More recently, **Wessels, Smith & Gewers (1993,p.101)** had an average sample beta of 0.821.

Affleck-Graves (1977,p.6.21) noted that South African betas were consistently below 1.00 on average, and attributed this to a poor fit of the CAPM on the JSE. He argues that the OLS model fits a more horizontal line to the data, regardless of the true beta, when the fit is poor. This implies a downward bias in beta estimates. **Bradfield (1990,p.22)**, on the other hand, argues that this is a result of thin trading. In view of the "low beta phenomenon" on the JSE the sample appears to be representative of the Industrial section.

ii. The beta sample appears to be approximately normally distributed based on the skewness and kurtosis coefficients[8].

4.6 SUMMARY

This chapter consists of four sections and represents the first of two parts in the measurement phase of this study.

The first two sections of the chapter detailed the company sample selection criteria and results. The sample was limited to the Industrial Section of the JSE and the biggest limitation on sample size was the availability of financial statement information for the ten years ended

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8 *The application of the skewness and kurtosis coefficients as indicators of normality is discussed in Chapter 6, Section 6.2.1.3.*

1989. Seventy six companies, representing 19 sectors, satisfied the selection criteria. The Engineering and the Building and Construction sectors were particularly well represented and together constituted 30% of the sample.

The third and fourth sections detailed, respectively, the empirical procedures employed in the estimation of systematic risk and the results of the procedures. Systematic risk, as measured by beta, was estimated by applying the Market Model to three years of fortnightly share returns. Share returns were adjusted to include equivalent dividends and the market portfolio was proxied by the JSE Actuaries Industrial Index. The trade-to-trade method was employed to counteract the effects of thin trading. The betas of the sample companies were found to be representative of the Industrial Section with, on average, lower betas than their Industrial counterparts.

The company sample and betas will be used in the next section of the measurement phase of this study (Chapter Five) to estimate leverage and unlevered or asset beta as well as to form portfolios.

CHAPTER FIVE : MEASUREMENT OF LEVERAGE AND FORMATION OF PORTFOLIOS

5.1 INTRODUCTION

The objective of this chapter is to detail the methodology and results of the measurement of leverage (financial and operating) and to outline the portfolio formation procedures. As the validity of the results of this study are dependent upon the methodology employed, each step is justified. The chapter is divided into six sections. Sections one and two, respectively, deal with the methodology and the results relating to the cross sectional measurement of leverage. Sections three and four detail the methodology and results relating to the time series measurement of leverage. The fifth section details the portfolio formation procedures and the chapter is concluded with a summary in section six.

5.2 CROSS SECTIONAL MEASUREMENT : METHODOLOGY

Retief (1984,p.14) argues that in any study of the associations between market and accounting variables, the choice of accounting variables must be justified, and based on a theoretical foundation. The Hamada-Rubenstein and **Brealey & Myers (1991,p.200)** formulations[1] provide the theoretical basis for this research. These formulations are stated in market value terms. Financial leverage in these formulations is represented in market value balance sheet terms, i.e. the market value of debt relative to the market value of equity. Operating leverage, on the other hand, is stated in market value terms which incorporate both income

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1 *See equations (2.17) to (2.19) in Chapter Two, Section 2.6.*

statement/cash flow and balance sheet items, i.e. the ratio of the present value of fixed costs to the present value of the project.

In testing the formulations empirically it is difficult to obtain market values for debt and therefore also for assets (as the market value of assets equals the market value of debt plus the market value of equity). This is confirmed by **Bowman (1980,p.253)** who stated that his research effort entailed hundreds of hours to develop estimates of market debt values for 92 firms. **Bowman (1980,p.253)** and **Rees (1995,p.249)** indicate that there are two acceptable proxies:

i. To use the book value of debt and the market value of equity, or

ii. To use book values for both debt and equity.

The majority of prior research has utilised the book values of both debt and equity despite Bowman's preference for the market value of equity (i.e. alternative i.). The empirical testing has employed the book (accounting) values of both debt and equity for the following reasons:

i. It would provide the highest level of comparability with prior research.

ii. The sample period utilised by this study incorporates the October 1987 stock market crash, and subsequent revival. This is likely to introduce an instability in the market equity values that is not present in the book values. Furthermore, firms with different year end's during the sample period would be subject to considerably different market factors and this would reduce comparability.

iii. The problem of thin trading on the JSE[2] results in a deviation between the reported market equity value and the 'true' market equity value. This reduces the reliability of market equity values.

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2 *This is discussed in Chapter 4, Section 4.4.3.4.*

In selecting accounting measures of leverage for use in this study, five principal criteria were identified. These were:

i. All aspects of the financial statements should be represented.
ii. The leverage measures should be based on comparable financial statement information.
iii. The debt and equity components of preference shares and debentures should be distinguished.
iv. The leverage measures should distinguish the different risks inherent in financial leverage (i.e. default and interest risks).
v. A meaningful measure of cash flow should be utilised.

These criteria and their methodological solutions are discussed in the following section.

5.2.1 Representation of all aspects of financial statements

Although the theoretical formulations underlying this study incorporate both balance sheet and income statement/cash flow items, prior research has focused on balance sheet measures of leverage[3]. Although not expressly stated, this is probably due to their relative stationarity. Income statement and cash flow measures are significantly more sensitive to aberrations in trading results and therefore less attractive empirically. However, investors performing fundamental analysis are likely to consider all aspects of annual reports. Consequently, this study measures leverage relative to the income and cash flow statements as well as the balance sheet.

5.2.2 Comparability of financial statements

South African generally accepted accounting practice (GAAP) affords companies a large degree of choice with respect to accounting policies. The use of different accounting policies

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3 *See Chapter 3, Sections 3.5.1 to 3.5.3.*

by companies results in significant differences in their financial statements. These differences compromise the comparability of financial statement based ratios and would therefore impact on the inter-relationships examined by this study. This lack of comparability is further exacerbated by the findings of **Zmijewski & Hagerman (1981,p.146)** that management chooses a portfolio of accounting methods rather than examining each policy in isolation. Companies who differ with respect to accounting treatments are therefore likely to do so in respect of their entire portfolio of accounting policies.

The comparability of financial statements has not been addressed by prior South African or overseas research in this area. In order to overcome the lack of comparability, the accounting policies with the greatest potential impact were identified and standardised as far as possible. Three policies were identified. The policies and the methodological solutions provided by this study are outlined in the following section.

5.2.2.1 Goodwill and other intangibles

Goodwill is the excess of the aggregate amount of the cost of shares in subsidiaries over the fair net asset value of such shares at the date of acquisition. Other intangibles represent other non-physical assets such as patents, trademarks etc. The sum of these assets often represents a significant proportion of total assets.

Accounting policies with respect to these items vary widely. The three most popular policies are: the carrying of the assets at cost in the balance sheet; the amortisation of the cost of the asset as an expense over a period of time and the write-off of the asset in full on acquisition. To ensure comparability, any goodwill and other intangibles present in the balance sheets of companies in the sample was written off against distributable reserves.

Total assets are therefore stated net of goodwill and other intangibles. An adjusted total assets figure was also calculated, incorporating these items, to examine their effect on the tested relationships.

5.2.2.2 Deferred taxation[4]

Companies have a choice[5] of two accounting policies with respect to deferred taxation:

i. The comprehensive basis which considers the taxation effect of the cumulative timing differences between accounting and taxable income.

ii. The partial basis which considers the taxation liability that is likely to crystallise (i.e. settled in cash) in the foreseeable future.

A major reason for the adoption of the partial basis as an alternative was that the comprehensive basis results in very large, ever increasing deferred taxation balances which are often not settled in cash. This occurs when reversing differences[6] are overshadowed by larger originating differences, particularly in periods of high inflation and regular asset replacement. The partial basis is therefore likely to result in significantly lower balance sheet deferred taxation balances.

To ensure comparability[7], any deferred taxation balances included in the balance sheets of companies in the sample, and the associated deferred taxation in the income statements, were reversed against distributable reserves. Liabilities are therefore stated net of deferred taxation.

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4 *A discussion of deferred taxation theory is beyond the scope of this report. This report assumes that the reader is familiar with the principles of deferred taxation, and focuses on the effect of different deferred taxation treatments on the comparability of financial statements.*

5 *GAAP Statement AC 102 specifies certain criteria for the use of the partial basis. These will not be discussed but are unlikely to preclude the majority of listed companies from adopting the policy.*

6 *Reversing differences occur when accounting income is less than taxable income, and originating differences occur when accounting income is greater than taxable income (assuming no permanent differences).*

7 *While AC 102, which permits the use of the partial basis, was issued in July 1989, many companies adopted the partial basis on the authority of the preceding exposure draft (ED72) which was issued in early 1988. Some companies (most notably Barlow Rand Ltd) had even adopted the partial basis prior to the issue of the exposure draft.*

5.2.2.3 Capitalisation of finance leases

Capitalisation of finance leases involves recognition of the substance of the lease contract rather than the legal form. Entering into a finance lease is equivalent to the purchase of the leased asset with the simultaneous receipt of a loan to finance the purchase. In terms of the financial statements, it requires the recording of the leased asset at cost and the corresponding loan as a lease liability on the balance sheet.

The revised GAAP statement AC 105 requires that all companies capitalise finance leases. However, this revision was only effective from financial years starting on or after 01 April 1989. It was therefore not applicable to the financial statements utilised in this study. The applicable statement is the 'old' AC 105 which offered companies the option of capitalisation or non-capitalisation.

A policy of non-capitalisation afforded companies the right not to reflect lease liabilities as liabilities in the balance sheet. This resulted in a form of so called 'off balance sheet finance'. In a comparison of accounting treatments between countries, **Choi & Bavishi (1983,p.65)** found that the predominant accounting policy for finance leases in South Africa was that of non-capitalisation.

As the amount of uncapitalised finance leases was not required to be disclosed by the old AC105, the only option to ensure comparability was to eliminate all leased assets and the corresponding liabilities from companies that had capitalised finance leases. However, in the majority of financial statements where leases were capitalised, current and long term portions of lease liabilities were not separately distinguishable from other liabilities. It was therefore not possible to process any adjustment to ensure comparability with respect to finance leases. This is a limitation of the study.

5.2.3 Distinction between debt and equity components of financing instruments

Foster (1986,p.76) states that the calculation of financial ratios requires that many classification and definitional issues be addressed and that these are particularly difficult when computing capital structure ratios.

Traditionally, preference shares have been regarded as equity instruments and debentures as debt instruments. However, proliferation in financial markets has resulted in numerous types of hybrid instruments which display certain debt and certain equity characteristics. As preference shares and debentures form a significant portion of the capital employed of many companies, it was necessary to separately identify debt and equity components to prevent any mis-statement of financial leverage.

The significant impact of the classification of hybrid instruments was corroborated by **Urbancic's (1980,p.19)** investigation of the effect that different classification rules for redeemable preference shares had on the debt to equity ratio. The debt to equity ratio (defined as total liabilities to shareholders equity) was found to increase by 23.4%, on average, when redeemable preference shares were regarded as a liability rather than equity.

The approach taken by this study was to define an equity instrument. Any financing instrument not meeting the equity definition was regarded as a debt instrument. An instrument exhibiting any one of the following three criteria was regarded as equity:

i. Non-redeemable.
ii. Convertible into ordinary shares.
iii. Participating in profits.

For the purpose of standardising financial statements and ratio definitions, the debt components of preference shares and debentures will be referred to as 'debt in preference shares' and 'debt in debentures' respectively.

5.2.4 Distinction between the default and interest risks in financial leverage

Beaver (1966,p.91) showed that the risk inherent in the debt levels adopted by a firm is to the extent that this debt introduces increased repayment obligations. The increased repayment obligations increased the risk that the repayment obligations would not be met and would lead to ultimate bankruptcy of a firm. Beaver saw the risk in increased leverage as default risk.

Modigliani & Miller (1958,p.263) showed that as debt is introduced, i.e. financial leverage is increased, the earnings' stream of the ordinary shareholders becomes more volatile. Increased volatility of the earnings' stream implies a greater possibility that the actual earnings will deviate from the expected earnings and therefore increased risk. The increased volatility in earnings' streams is caused by the introduction of increased interest charges associated with increased debt. Modigliani and Miller saw the risk in increased leverage as an interest risk and their model of capital structure was later updated to include the risk of financial distress (a form of default risk).

More recently, **Rees (1995,p.99)** discusses the dual nature of debt without explicitly referring to the different nature of the risks. He states :

> " The more fixed interest capital the firm has, the higher is the risk of its capital, both equity and debt. However, the return on capital is also expected to be higher. There is a caveat to these comments and that is that if the gearing of the firm becomes unusually high the risk of financial failure is increased and the cost of failure (multiplied by the probability of failure) will affect the value of the firm."

Beaver, Modigliani-Miller and Rees approach financial leverage from the firm's perspective and although not stated explicitly, they refer to two risks inherent in financial leverage in the form of default risk and interest risk. The concepts of default and interest risk are not unique to this study, and were developed by **Hickman (1958,p.1)** and **Altman (1989,p.909)**, among others, in relation to the risk assessment of fixed-income instruments (from the perspective of the investor). This is corroborated by **Altman (1989,p.909)** when he states:

" In addition to default risk, investors also consider the effects of two other major dimensions of investing in fixed-interest investments, i.e. interest rate risk and liquidity risk. The interaction among the three dimensions of risk has raised the analytic content of fixed income assessment to an increasingly sophisticated level. The analysis of default risk, however, has been the area of most concern and empirical measurement over the years."

Prior research has failed to adequately distinguish between different debt maturities[8] and the different risks they represent. When summarised on the basis of maturity, the consistency amongst the findings of prior research increased considerably. This study does not distinguish on the basis of maturity, but on the basis of the underlying risks inherent in debt. This study argues that the differences in the results for different maturities of debt are caused by the differing risks inherent in these maturities rather than the size of the maturity itself.

While fixed income theory states that there are three risks inherent in financial leverage, this study focuses on default and interest risk. Liquidity risk encompasses the entire working capital policy of the firm and not just the debt component of working capital (i.e. current liabilities) which is of interest in the inter-relationships examined by this study. Liquidity risk has been excluded from the scope of this report to retain focus.

Default risk and interest risk are not mutually exclusive. Interest risk is a subset of default risk as all interest bearing debt has default risk. The intention in specifying different financial leverage definitions for these risks is not to separate the risks out (which is not possible from a financial statement perspective), but to obtain definitions based predominantly on one or the other.

For the purposes of this study interest risk debt was defined as all debt giving rise to interest charges, i.e. interest bearing debt. Two categories of default risk were defined. The first category (class one) was total default risk. This was defined as the total claims outstanding, including outside shareholders, and is represented by total liabilities. A significant portion of

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8 *See Chapter Three Section 3.5.1 to 3.5.3.*

total default risk debt also has interest risk. In an attempt to reduce the impact of interest risk on the total default risk measurement, the second category (class two) of default risk was limited to debt which has default risk only (i.e. non interest bearing debt). The specific balance sheet components of these items are:

INTEREST BEARING DEBT	Debt in preference shares + debt in debentures + long term loans + overdraft + short term interest bearing loans.
TOTAL LIABILITIES	Debt in preference shares + debt in debentures + outside shareholders' interest + long term loans + current liabilities.
NON INTEREST BEARING DEBT	Total Liabilities - interest bearing debt.

The items included in total liabilities but excluded from interest bearing debt are: outside shareholders interest, trade creditors, provision for taxation and provision for dividend. To the extent that current liabilities, and trade creditors in particular, form the major component of non interest bearing debt, the class two measures of default risk may include an element of liquidity risk. The inability of this study to distinguish perfectly between the default, interest and liquidity risks is a limitation.

The definitions of interest bearing and non interest bearing debt only consider explicit interest costs. Trade creditors would have an opportunity financing cost to the extent that opting for credit terms resulted in the creditor foregoing an early settlement or cash discount. This opportunity financing cost is not considered by the definitions.

The definitions of total liabilities and interest bearing debt do not include off balance sheet financing such as unconsolidated financial subsidiaries and factoring of accounts receivable. The use of off balance sheet financing is pervasive and this may cause leverage, as defined, to understate 'actual' leverage. As **Greene (1980,p.59)** points out:

" The basic drives of man are few: to get enough food, to find shelter, and to keep debt off the balance sheet. "

5.2.5 Use of a meaningful cash flow measure

Finance theory postulates that the value of an asset, and therefore a financial instrument, is the present value of the cash flows that are expected to be derived from it. This implies that cash flow, and its variability, are the relevant factors in buy and sell (beta) decisions and risk stabilisation strategies. It was therefore crucial that this study employed meaningful measures of cash flow.

The majority of South African as well as overseas research has focused on the definition of cash flow as: Earnings after taxation plus depreciation and amortisations. This is not a meaningful cash flow measure. It is simply an accounting measure of operating profit before considering historical investment costs.

Foster (1986,p.79) states that many studies have approximated cash flow from operations as net income plus depreciation and amortisations, and that while the simplicity of the approximations is appealing, there is a drawback as a result of excluding significant items that affect cash flow.

In an empirical study, **Bowen, Burgstahler, and Daley (1984,p.1)** concluded that such a simplistic cash flow measure is highly correlated with the original net income series. The authors found that when more refined adjustments were made to derive cash flow the resultant series was considerably less correlated with the net income series. They state that this is consistent with the refined measures capturing a different aspect of the firm's financial attributes other than net income.

Recent South African research by **Wessels, Smith & Gewers (1993,p.101)** and **Loxton, Hamman & Smit (1994,p.137)** examined the association between systematic risk and 'refined' measures of cash flow. These studies did not specifically examine measures of

financial or operating leverage. However, as the measurement of cash flow based leverage proxies forms a significant part of this report, and the testing of such proxies one of its more significant contributions, the cash flow definitions employed by the studies will be considered.

Both studies used measures of cash flow based on those suggested by **Drtina & Largay (1985,p.315)**. Drtina and Largay approached the cash flow from the accounting perspective. In accordance with accounting pronouncements (internationally and locally), Drtina and Largay suggested that a distinction be made between cash flows from operating, investing and financing activities and their article focuses on the accounting definition of operating cash flow.

By limiting their cash flow variables to the operating section the Wessels et al and Loxton et al studies ignored the cash flow required to maintain operations. Although this cash flow is required to be included in the investment section of the cash flow statement from an accounting perspective (and was therefore not discussed by Drtina & Largay), it should be regarded as part of operating cash flow for decision making purposes.

The exclusion of the (investment) cash flow to maintain operations results in a significant upward bias in the cash flow of capital intensive companies. A significant portion of a capital intensive company's cash flow is expended on its investment to maintain operations. It is therefore crucial that a deduction for such cash flow be made.

It is often difficult to obtain the necessary information to calculate this cash flow. In the absence of inflation, and assuming a program of regular asset replacement, this cash flow is well approximated by the annual depreciation charge. In the presence of the South African double digit inflation rate it is necessary to supplement the depreciation charge with the difference between historical and 'real' depreciation[9].

For labour intensive companies the major cash expenditure is likely to be wages, which are effectively deducted by both studies in arriving at their cash flow measures. By deducting

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9 *An appropriate means of arriving at this cash flow is discussed later in this section.*

neither accounting depreciation nor any additional depreciation, the cash flow measures employed by the studies have therefore deducted the major outflows for labour intensive (and likely low operating leverage) companies, but not for capital intensive (and likely high operating leverage) companies. This upward bias in the cash flow of capital intensive companies is likely to have distorted any relationship with beta.

Considerable effort was spent by this researcher in obtaining the best possible measure of cash flow. A structured framework for the calculation of "refined" cash flow information is provided by South African GAAP statement AC 118.

AC 118 requires companies to produce a cash flow statement in a specified format for inclusion in the annual financial statements. This statement was only effective for financial years starting on or after 01 October 1988. Cash flow statements were therefore available for September to December year end's in 1989 only. This was inadequate for the purposes of this study. Consequently, cash flow statements had to be reconstructed for each of the companies in the sample for the financial years ending 1987, 1988 and 1989.

The reconstructed cash flow statements were prepared in accordance with AC 118. The document divides the cash flow statement into operating (including interest, taxation, and dividends), investment and financing sections. The investment section is in turn divided into the investment cash flow to maintain operations and that to expand operations. To overcome the weaknesses of the **Wessels et al (1993,p.101)** and **Loxton et al (1994,p.137)** studies, the relevant measures for this study were the operating cash flow (before dividends) and the investment cash flow to maintain operations.

The only departure from AC 118 related to investment cash flow to maintain operations. This effectively represents the net cash investment in fixed assets to maintain operations. The following difficulties were encountered:

i. The calculation of the net cash investment requires knowledge of the proceeds on disposal of fixed assets. Insufficient information was disclosed in the annual reports of the sample companies to calculate the proceeds on disposal.

ii. Even if the net cash investment in fixed assets could have be calculated, it would have been impossible to make the important distinction between the portion relating to maintenance of operations and that to expand operations.

A surrogate was therefore required for the investment cash flow to maintain operations. The surrogate used was an inflation adjusted depreciation charge for fixed assets other than land and buildings (hereafter: other fixed assets). Investment in land and buildings usually represents an expansion of operations and was therefore excluded. The inflation adjustment of a historical cost requires the use of an appropriate index. The index used was the index for machinery non-electrical, which was calculated and published by the Central Statistical Services of the Department of Constitutional Development and Planning.

The surrogate was calculated as follows:

i. The age of the historical depreciation charge was calculated in months. This was calculated by dividing the accumulated depreciation balance at year end by the depreciation charge for the year.

ii. The average purchase date of the fixed assets was determined by subtracting the 'age' in months from the financial year end of the company.

iii. The percentage increase in the machinery index, from the average purchase date until the appropriate year end, was calculated.

iv. The percentage increase in the index was applied to the historical depreciation charge to determine the adjustment for inflation.

v. The inflation adjustment to depreciation was then added to the historical depreciation charge resulting in the inflation adjusted depreciation charge. This would approximate the net cash investment to maintain operations in a company with regular fixed asset replacement.

Mathematically:

$$IAD = D * \left(1 + \frac{I_t - I_{t-a}}{I_{t-a}}\right) \qquad (5.1)$$

Where:

IAD	=	Inflation adjusted depreciation.
D	=	Historical depreciation.
I_t	=	Index value at the financial year end.
I_{t-a}	=	Index value at the average purchase date.

Two distinct measures of cash flow were employed. These were:

i. Operating cash flow before interest, taxation and inflation adjusted depreciation (referred to as CASH1).

ii. Operating cash flow before interest and taxation (i.e. after deducting inflation adjusted depreciation, and referred to as CASH2).

5.2.6 Data collection

All leverage data used in this study, including the surrogate cash flow data outlined in Section 5.2.5, was obtained from the BFA (Bureau of Financial Analysis) database in Pretoria. Where the BFA data was found to be incomplete, the data set was updated from the individual company annual reports. Sixty of the data points received from the BFA were randomly chosen and agreed to company annual reports to verify the accuracy of the data. All 60 data points tested were found to be accurate and established a basis for using the remaining data.

5.2.7 Standardised financial statements

To facilitate the measurement of leverage, balance sheets and income statements were reclassified and standardised according to the formats shown in Appendices 4 and 5 respectively. Cash flow statements were then reconstructed according to the standardised format shown in Appendix 6.

The standardised financial statements were incorporated into 15 financial statement definitions. Table 5.1 details the definitions, the standardised information contained within them and their abbreviations for the purposes of ratio calculation.

Table 5.1: Financial Statement Definitions

Abbreviation	Definition	Financial Statement Components
Balance Sheet:		
TLIA	Total liabilities	Outside shareholder's interest + debt in preference shares + debt in debentures + long term borrowings + current liabilities.
ATLIA°	Adjusted total liabilities	Total liabilities - outside shareholders interest.
IBD	Interest bearing debt	Debt in preference shares + debt in debentures + long term borrowings + short term borrowings + overdraft.
NIBD	Non interest bearing debt	Total liabilities - interest bearing debt
ANIBD°	Adjusted non interest bearing debt	Adjusted total liabilities - interest bearing debt
FASS	Fixed assets	Total fixed assets.
TASS	Total assets	Total fixed assets + investments + current assets.
ATASS•	Adjusted total assets	Total assets + goodwill + other intangibles.
OASS	Operating assets	Total assets - investments - short term advances.
EQUITY	Ordinary shareholders equity	Total assets - total liabilities
Income Statement:		
DEPR	Historical depreciation	Depreciation expense.
EBIT	Earnings before interest and taxation	Trading profit - depreciation expense + investment income.
INT	Interest expense	Interest expense.
Cash Flow Statement:		
CASH 1	Operating cash flow one	Operating cash flow before interest, taxation and investment to maintain operations
CASH 2	Operating cash flow two	Operating cash flow one - investment to maintain operations

° The adjusted debt definitions were examined to determine the effect of outside shareholder's interest.
• The adjusted asset definition was examined to determine the effect of goodwill and intangibles.

5.2.8 Ratio calculation

In the final phase of leverage measurement the standardised financial statement definitions were incorporated into the 23 leverage ratios shown in Table 5.2.

Table 5.2: Leverage Ratios

Risk	Balance Sheet	Income Statement	Cash Flow
Default risk class one (Financial leverage)	TLIA / TASS ATLIA / TASS TLIA / EQUITY TLIA / ATASS	EBIT / TLIA	CASH 2 / TLIA
Default risk class two (Financial leverage)	NIBD / TASS ANIBD / TASS NIBD / EQUITY	EBIT / NIBD	CASH2 / NIBD
Interest risk (Financial leverage)	IBD / TASS IBD / EQUITY IBD / ATASS	EBIT / IBD EBIT / INT	CASH2 / IBD CASH 2 / INT
Operating Leverage	FASS / TASS FASS / ATASS FASS / OASS	(EBIT+DEPR) / EBIT	CASH 1 / CASH 2

The balance sheet financial leverage definitions included in Table 5.2 have been measured relative to both assets and equity. This has been done in attempt to avoid spurious correlation being induced into the regressions where financial and operating leverage ratios are regressed on each other and both have assets as the denominator. According to **Kuh & Meyer (1965,p.412)** correlation can be induced by deflating (i.e. denominating) both dependent and independent variables by the same common variable.

The rationale for the use of the balance sheet operating leverage definitions[10] in Table 5.2 is that, for a given level of sales, the higher the proportion of fixed to total (or operating) assets, the higher the proportion of fixed costs and therefore the greater the level of operating leverage. Capital intensive companies with a high proportion of fixed assets tend to have a greater proportion of fixed costs in their cost structures than do labour intensive companies whose primary balance sheet assets are usually accounts receivable and inventory. The FASS/TASS ratio has been the most popular ratio with prior researchers investigating the association between operating leverage and both systematic risk and financial leverage[11].

The income statement and cash flow measures of operating leverage have been calculated to approximate the DOL. The traditional formula for the DOL[12] is effectively the ratio of net profit before fixed costs to net profit after fixed costs. The DOL can be measured in cash flow terms by substituting operating cash flow for net profit. As detailed information regarding cost behaviour is unavailable in South African financial statements surrogates need to be found to approximate fixed costs. The income statement measure [(EBIT+DEPR)/EBIT] has used the historical cost depreciation charge to approximate fixed costs, while the cash flow measure (CASH1/CASH2) has used the investment cash flow to maintain operations. Any significant deviation between these measures and the 'true' DOL represents a limitation of this study.

5.3 MEASUREMENT OF CROSS SECTIONAL LEVERAGE: RESULTS

The reconstruction of financial statements and calculation of ratios were initially performed on Lotus 1-2-3 (version 3.0), and following a leave of absence were imported into MSExcel (version 5.0c) for Windows due to its enhanced statistical and graphics capabilities. Twenty three leverage ratios were calculated for each of the 76 sample companies for the financial years ended 1987, 1988 and 1989. An average of each ratio was calculated for each company

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10 *This report does not provide detailed explanations of the fundamentals of financial ratio analysis nor does it justify each ratio examined. The reader is assumed to be familiar with the rudiments of financial analysis.*

11 *See Chapter 3, Sections 3.5.2 and 3.5.3.*

12 *See Chapter 2, equation (2.2).*

as the mean of the 1987, 1988 and 1989 ratios. In total, 6992 ratios were calculated, excluding portfolios.

The 1989, 1988 and average ratios are presented in Appendices 7, 8 and 9 respectively. The 1987 ratios were only used to calculate the average ratios and were not used in testing. These ratios will therefore not be reported. Table 5.3 shows sample characteristics of the average ratios. The income statement, cash flow and equity denominated balance sheet ratios have been shaded.

Table 5.3: Average Ratio Characteristics

Ratio	Mean	Std.Dev	Min.Val	Max.Val	Range	Skew.	Kurt.
TLIA / TASS	0.534	0.171	0.066	1.014	0.948	0.076	0.495
ATLIA / TASS	0.4815	0.166	0.066	0.786	0.720	-0.356	-0.227
TLIA / ATASS	0.526	0.163	0.066	0.868	0.802	-0.146	-0.009
TLIA / EQUITY	3.562	16.863	0.072	147.611	147.539	8.536*	73.782*
NIBD / TASS	0.362	0.164	0.047	0.804	0.757	0.564*	-0.023
ANIBD / TASS	0.309	0.155	0.002	0.714	0.712	0.452	0.068
NIBD / EQUITY	2.206	9.598	0.050	83.844	83.794	8.433*	72.493*
IBD / TASS	0.172	0.109	0.015	0.427	0.412	0.537*	-0.483
IBD / ATASS	0.169	0.107	0.015	0.427	0.412	0.559*	-0.371
IBD / EQUITY	1.356	7.295	0.022	63.766	63.744	8.575*	74.257*
FASS / TASS	0.333	0.173	0.001	0.813	0.812	0.496	-0.179
FASS / ATASS	0.328	0.171	0.001	0.813	0.812	0.505*	-0.103
FASS / OASS	0.368	0.192	0.003	0.917	0.914	0.732*	0.468
EBIT / TLIA	0.375	0.272	-0.009	1.817	1.826	2.322	9.758
CASH2 / TLIA	0.281	0.229	0.003	1.482	1.479	2.336	9.277
EBIT / NIBD	17.328	67.258	0.431	570.17	569.74	7.700	62.991
CASH2 / NIBD	0.424	0.329	0.006	2.142	2.136	2.129	8.751
EBIT / IBD	4.467	12.340	0.112	97.334	97.222	6.218	44.203
EBIT / INT	34.329	134.49	0.568	1139.8	1139.2	7.700	62.992
CASH2 / IBD	4.0658	11.039	-0.017	68.432	68.449	4.826	24.486
CASH2 / INT	31.396	141.85	-1.314	1221.5	1222.9	8.117	68.486
(EBIT+DEP)/ EBIT	1.257	0.227	0.907	2.339	1.432	2.537	8.322
CASH1 / CASH2	1.401	1.216	-4.889	7.777	12.666	0.390	19.45

Std. Dev = Standard Deviation; Min. Val = Minimum Value; Max. Val = Maximum Value; Skew = Skewness Coefficient; Kurt. = Kurtosis Coefficient * = Balance sheet coefficient that exhibits a departure from normality.

Comments:

i. With the exception of the equity denominated ratios, the balance sheet measures are relatively stable and are not subject to extraordinary deviations. The minimum values indicate that there are some companies in the sample with very low values of both debt and fixed assets. The non equity-denominated ratios with total liability numerators are approximately normally distributed based on the skewness and kurtosis coefficients[13]. The remainder of the non equity-denominated balance sheet ratios exhibit departures from normality. These departures from normality are relatively small and all indicate positive skewness, which is consistent with the findings of **Muil, Hamman & Smit (1992,p.26)**.

ii. The balance sheet ratios with equity as a denominator indicate the existence of extreme values, particularly in the upper region. On average the standard deviations are in excess of five times the mean value. The existence of extreme values is further reflected in the significant departures from normality indicated by the very high levels of positive skewness and kurtosis.

iii. The income statement and cash flow ratios are very volatile. In many instances the standard deviation is three times the mean value. The ratios exhibit both very high and very low values, but the more extreme values occur in the upper region. This is corroborated by the positive skewness and kurtosis coefficients and is consistent with the findings of prior research into the distributions of ratios as summarised by **Ezzamel & Mar-Molinero (1990,p.26)**.

In contrast to the balance sheet ratios, none of the income statement or cash flow ratios are normally distributed, based on the skewness and kurtosis coefficients. As expected, the ratios with the more extreme values are those exhibiting the highest skewness and kurtosis coefficients.

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13 *The application of the skewness and kurtosis coefficients as indicators of normality is discussed in Chapter 6, Section 6.2.1.3.*

iv. The minimum values for income statement ratios and cash flow ratios with the same numerator and positive denominators are found to have different signs e.g. EBIT/ TLIA and EBIT/ IBD. This is possible due to the average being calculated as the mean of the constituent ratios i.e. in some cases the negative ratios in individual years are averaged out. This would not have been the case if the averages had been arithmetically calculated.

5.3.1 Treatment of outliers

The extreme income statement, cash flow and equity denominated balance sheet values were likely to significantly impact the regression results and required further examination as to whether or not they constituted "outliers". **Barnett & Lewis (1978, p.4)** define an outlier as:

> "an observation which appears to be inconsistent with the remainder of that set of data. The phrase 'appears to be inconsistent' is crucial. It is a matter of subjective judgement on the part of the observer whether or not he picks out some observation for scrutiny."

The subjectivity inherent in the outlier decision increases the opportunity for "data mining" where observations are excluded based on their impact on the regression results. This adapting the sample to the results type of research is assisted by the powerful interactive regression capabilities of some of the modern statistical packages. This view is supported by **Lovell's (1983,p.1)** article on data mining in *The Review of Economics and Statistics* where he states that the efficiency with which data miners go about their work has increased significantly as a result of technological advances.

A number of methods have been proposed in statistical and financial literature for the identification and treatment of outliers. It is not the intention of this report to provide a detailed discussion of all such methods, rather it is to justify the method adopted by this research. The objectives in this regard were twofold:

i. To reduce the significant impact that extreme observations had on the results.

ii. To reduce the subjectivity in the outlier decision, and therefore the potential for data mining, as far as possible.

To achieve the second objective it was considered necessary to standardise the treatment as far as possible, and to report the unadjusted results as well as the adjusted results. This would also facilitate an analysis of the impact of the extreme observations on the tested relationship. However, this would lengthen this report considerably and would result in significant repetition where the adjusted and unadjusted results indicated similar findings. The unadjusted results will therefore only be presented when they are found to differ significantly from the adjusted results.

Scatter plots were examined for the existence of extreme observations which would significantly impact the results. A descriptive analysis was then conducted whereby the four highest and lowest observations were analysed. A pattern was immediately evident. Where extreme observations were present, these were limited to the one or two highest and lowest observations, the elimination of which would reduce the outlier impact and bring the distribution of the ratios significantly closer to normality. The listings of the financial ratios in Appendices 7, 8 and 9 include the two highest and two lowest observations for each of the ratios.

The deletion of extreme observations is referred to as "trimming" in statistical literature. This procedure is one of the outlier procedures suggested by **Foster (1986,p.101)**. Trimming has been widely used in statistical research into the normality of, and adjustments to achieve normality in, financial ratios. Examples of this would include **Frecka & Hopwood (1983,p.120), Ezzamel & Mar-Molinero (1990,p.24)** and more recently in the South African context **Jordaan, Smit & Hamman (1994,p.67)**.

Frecka & Hopwood deleted trimmed observations that resulted in violations of skewness or kurtosis tests, while Ezzamel & Mar-Molinero used a mixture of judgement and a threshold of three standard deviations from the mean to trim observations. Jordaan, Smit & Hamman

trimmed observations that were beyond three standard deviations from the mean, but exercised no judgement.

The risk of data mining is greatest where judgement is exercised with respect to the inclusion or exclusion of individual observations. The only judgement exercised by this report in this regard was in identifying that all the income statement, cash flow and equity denominated balance sheet ratios had extreme observations. If the existence of extreme observations was determined according to the Frecka & Hopwood and Jordaan et al studies, the same conclusion would have been reached. While the exercise of judgement may result in the argument that the ratio of (EBIT+DEPR)/EBIT does not include extreme observations, it was decided to treat all income statement, cash flow and equity denominated balance sheet ratios similarly.

The standardised trimming procedure then involved trimming the top and bottom two observations from the sample, to give 72 observations. These adjusted samples will be referred to as the trimmed samples. A correlation matrix (correlogram) of the adjusted leverage variables has not been presented as the correlations between systematic risk, financial leverage and operating leverage form the basis of the empirical testing methodology.

5.3.2 Estimates of unlevered beta

Once betas had been estimated, the standardised financial statements had been prepared and ratios calculated, the unlevered (or asset) betas were calculated.

The unlevering of the beta estimates involved the application of the **Hamada (1969,p.30)** and **(1972,p.435)** and **Rubinstein (1973,p.167)** formulation[14] to the beta estimates. As explained in Section 5.2, the empirical application of this formulation utilised book values of debt and equity. The levered betas calculated in Chapter Four were therefore multiplied by the ratio of EQUITY/(TLIA+EQUITY) as defined by the standardised financial statements and calculated

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14 *See equation (2.17) in Section 2.6.*

at the company's financial year ended 1989. This unlevering formulation was applied by **Mohr (1985,p.575)**[15].

This formulation was used to unlever beta in preference to the formulation including taxation and risky debt[16]. Risky debt was excluded because this requires the measurement of the debt beta. **Butler, Mohr & Simonds (1991,p.890)** state that it is impractical to estimate CAPM betas for the debt of each firm. They cite **Alexander (1980,p.1063)** and others as saying that the estimation of bond betas is beset with problems of untraded issues, non normality of returns, and non stationarity of estimated betas. Taxation was excluded as a result of the significant variability in the effective tax rates amongst the firms (including many firms with zero tax rates and some with negative tax rates), the problems caused by differing deferred taxation policies and the fluctuating standard tax rate during the period under review.

One company in the sample, Winbel Ltd., was found to have a negative equity at its 1989 financial year end and a resulting negative unlevered beta. The company was eliminated from the unlevered beta sample to avoid any distortion in the relationships caused by the negative unlevered beta. The unlevered betas are included together with the levered betas in Appendix 3. Summary statistics for the unlevered betas are contained in Table 5.4.

Table 5.4: Unlevered Beta Characteristics

Mean	Median	Std.Dev.	Var.	Min.Val	Max.Val	Range	Skew.	Kurt.
0.396	0.393	0.146	0.021	0.098	0.748	0.649	0.124	-0.590

Std. Dev = Standard Deviation; Min. Val = Minimum Value; Max. Val = Maximum Value; Skew = Skewness Coefficient; Kurt. = Kurtosis Coefficient.

Comments:

i. The mean value of 0.396 may appear low when compared to the mean of the levered beta of 0.849. However, the unlevering formulation of EQUITY/(TLIA+EQUITY) is equivalent to the ratio of EQUITY/TASS, which is equivalent to 1-(TLIA/TASS).

15 *Mohr (1985,p.575) used the market value of equity rather than the book value as used by this study.*

16 *This formulation would have been based on Chapter 2, equation (2.21).*

Table 5.3 showed that the mean of the TLIA/TASS ratio was 0.534 and therefore 1-0.534 = 0.466 will approximate the mean of the unlevering factor. This reasonability test indicates an approximate unlevered beta of 0.395 (0.466*0.849), which approximates the calculated mean of 0.396. The difference between levered and unlevered betas indicates a relatively high level of financial risk in the sample companies.

ii. The unlevered beta sample appears to be approximately normally distributed based on the skewness and kurtosis coefficients[17].

5.4 MEASUREMENT OF TIME SERIES LEVERAGE: METHODOLOGY

The leverage measures obtained in Section 5.3 are all static cross sectional measures. In order to fully examine the inter-relationships between systematic risk, financial leverage and operating leverage it is necessary to consider time series measures of operating and financial leverage. The time series measures of DOL and DFL used by **Mandelker and Rhee (1984,p.50)** were employed by this study.

The time series measures calculate the rate of change of the dependent variable with respect to changes in the independent variable. These measures are therefore more closely aligned with the principle of the degree of leverage, which is elasticity based, than the cross sectional ratios. These time series measures are estimates and are not without their own empirical problems. As **O'Brein & Vanderheiden (1987,p.48)** point out in respect of the empirical DOL formula used by Mandelker & Rhee:

> " we feel that their technique may be picking up growth, where the rates of growth for sales and operating earnings were roughly equal."

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17 *The application of the skewness and kurtosis coefficients as indicators of normality is discussed in Chapter 6, Section 6.2.1.3.*

No prior South African research has considered time series measures of leverage. The inclusion of time series measurements would also facilitate comparison with **Mandelker & Rhee (1984,p.50)**. Both a 10 year and a 20 year time series estimate were made for each of the degrees of operating and financial leverage as follows[18]:

$$\text{Ln}\, X_{jt} = a_j + c_j \,\text{Ln}\, S_{jt} + u_{jt} \tag{5.2}$$

$$\text{Ln}\, P_{jt} = b_j + d_j \,\text{Ln}\, X_{jt} + e_{jt} \tag{5.3}$$

Where:

X_{jt} = earnings before interest and taxation.

S_{jt} = Rand value of sales (turnover).

P_{jt} = earnings after interest, before taxation.

a_j, b_j = the regression intercept coefficients.

c_j = degree of operating leverage (DOL).

d_j = degree of financial leverage (DFL).

u_{jt}, e_{jt} = disturbance terms.

j = company.

t = 1970-1989 and 1980-1989.

5.5 MEASUREMENT OF TIMES SERIES LEVERAGE: RESULTS

The application of equations (5.2) and (5.3) resulted in the 20-year and 10-year time series measures included in Appendices 10 and 11 respectively[19]. Problems were encountered with respect to the non availability of data and the existence of negative values.

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18 *Equations (5.2) and (5.3) are equivalent to equations (3.1) and (3.2) respectively, and have been repeated in this section for the convenience of the reader.*

19 *The appendices exclude companies that were rejected on the basis of non availability of data or insignificant regression slope coefficients, as discussed in Sections 5.5.1 and 5.5.3.2 respectively.*

5.5.1 Non availability of data

Complete data for all sample companies was not available. The majority of the missing data related to sales (turnover) figures, particularly with respect to the 20-year sample. Examination of a sample of individual company annual reports indicated that this was not the result of an incomplete database. The reason for the lack of data was that, up until an amendment to the Fourth Schedule of the Companies Act promulgated in 1993, South African companies were not required to disclose turnover where this would be misleading or harmful to their business.

All companies for which a complete set of data was not available were eliminated from the time series analysis. This resulted in considerably reduced sample sizes of 24 and 58 companies for the 20-year and 10-year samples respectively.

5.5.2 Negative values

Equations (5.2) and (5.3) require that the natural logarithms of the dependent and independent variables be calculated. This was not possible where the dependent or independent variables were found to be negative. Where this occurred the following regressions were run to estimate the degrees of operating and financial leverage:

$$X_{jt} = \phi_1 + \phi_2 S_{jt} + \delta_{jt} \tag{5.4}$$

$$P_{jt} = \psi_1 + \psi_2 X_{jt} + \zeta_{jt} \tag{5.5}$$

Where:

ϕ_1, ψ_1 = regression intercept coefficients.

ϕ_2, ψ_2 = regression slope coefficients.

δ_{jt}, ζ_{jt} = stochastic error terms.

All other terms have been previously defined.

After ϕ_2 and $\psi_2$were estimated, the DOL was approximated by ϕ_2 ($\mu S_j/\mu X_j$) and DFL was approximated by ψ_2 ($\mu X_j/\mu P_j$) where μS_j , μX_j and μP_j denote the 20-year and 10-year average values of S_j , X_j and P_j respectively. This procedure was performed by **Mandelker & Rhee (1984,p.51)**.

5.5.3 Testing of the time series regressions

The time series regressions were all tested for the following:

i. Significance at the 0.05 level using Student's *t*-test.
ii. Autocorrelation at the 0.05 level using Durbin -Watson's *d*-statistic..
iii. Stationarity at the 0.05 level using the Chow test.

The t , d , and Chow F statistic's are reported in Appendices 10 and 11 together with the time series measures of leverage.

5.5.3.1 Student's *t*-test

The t-test examined the null hypothesis of no significant difference from zero in respect of the regression slope coefficients. Where the null hypothesis could not be rejected, companies were rejected from the time series sample. All of the 20-year regressions were found to be significant but 10 companies were rejected from the 10-year sample leaving a remaining sample of 48 companies.

5.5.3.2 Durbin-Watson *d*-test

The application of the OLS regression model to equations (5.2) to (5.5) is dependent upon a number of assumptions underlying the model. These assumptions are discussed in detail in

Chapter Six, Section 6.2.1. The only OLS regression assumption that was tested in respect of the time series leverage measures was that of autocorrelation which according to **Gujarati (1988,p.358)** is particularly prevalent in time series data. **Mandelker & Rhee (1984,p.51)** did not test for compliance with any of the OLS regression assumptions. The extent to which any violation of the OLS assumptions has gone undetected and unadjusted and resulted in either a significant bias in the regression slope coefficients or the *t*-test, is a limitation of this study.

As suggested by **Gujarati (1988,p.375)**, the Durbin-Watson *d*-statistic was used to test for the presence of autocorrelation. The MSExcel package (version 5.0c) used by this researcher does not calculate the *d*-statistic. The calculation of the statistic was therefore programmed by the researcher according to the guidelines given in **Gujarati (1988,p.375)** and tested against the example given on page 378 of Gujarati. Appendices 10 and 11 have highlighted (via shading) the *d*-statistics where the null hypothesis of no significant autocorrelation was rejected at the 0.05 level according to the tables produced in **Gujarati (1988,p.686)**. Autocorrelation was found to be present in the majority of the 20-year sample regressions but very few of the 10-year sample regressions.

5.5.3.3 The Chow *F*-test

The regressions run in equations (5.2) to (5.5) are dependent upon the restrictive assumption of stationarity of the regression slope coefficient i.e. the degree of leverage in the case of equations (5.2) and (5.3). The Chow stationarity test as proposed by **Gujarati (1988,p.444)** and used by **Mandelker & Rhee (1984,p.52)** was used to test this assumption

The **Chow (1960,p.591)** test for stationarity is essentially a method for testing for differences between two regressions. It can be used to test for the stationarity of a regression coefficient (in this case the slope coefficient) by splitting the original regression equation into two sub regressions and testing for differences in the slope coefficient between the two.

MSExcel (version 5.0c) does not produce the Chow F-ratio and the test was therefore programmed by this researcher in MSVisual Basic programming language. The accuracy of the programmed routine was checked against an example on page 444 in **Gujarati (1988)**. The test involved the following steps:

i. The residual sum of squares (RSS_1) from the original (i.e. full) regression was determined, with degrees of freedom equal to the number of observations (n_1) minus two.

ii. The full regression was split into two equal sub-period regressions. The 20-year time series leverage regression was split into two 10-year sub regressions covering the time periods 1970-1979 and 1980-1989. The 10-year time series leverage regression was similarly split into two 5-year sub regressions covering the time periods 1980-1984 and 1985-1989. The RSS of these sub regressions (RSS_2 and RSS_3 respectively) were obtained, with corresponding degrees of freedom of n_2 minus two and n_3 minus two.

iii. The RSS of the subsidiary regressions were added together to give RSS_4, i.e. $RSS_4 = RSS_2 + RSS_3$. The difference between the sum of the sub regression RSS and the full sample RSS was determined as RSS_5, i.e. $RSS_5 = RSS_1 - RSS_4$.

iv. The F-test was applied as follows:

$$F = \frac{RSS_5 / 2}{RSS_4 / (n_1 - 4)} \qquad (5.6)$$

All symbols have been previously defined.

The significance probability value of the F-statistic was determined by a pre-installed macro in MSExcel. If the computed F exceeded the critical F, then the hypothesis that the two regressions were the same was rejected.

The null hypothesis of no significant change in the slope coefficient over the regression interval was rejected for 80% of the 20-year sample. When considered together with the small sample size and the high degree of autocorrelation that was found in the sample, it was decided to exclude the 20-year sample from the correlation analysis.

Only three of the remaining 48 companies in the 10 year sample were found to have non stationary coefficients. **Mandelker & Rhee (1984,p.52)** retained companies found to have non stationary coefficients as part of the time series sample to avoid reduction in the sample size. They argue that any measurement error present in these coefficients is likely to be considerably reduced as the sample companies are aggregated into portfolios. It is submitted that the non stationary coefficients could significantly bias the single company relationship and should be excluded. The companies (Edward L. Bateman Ltd., Haggie Ltd. and Waltons Stationery Company Ltd.) were eliminated from the sample leaving a final 10-year sample of 45 companies.

The characteristics of the 10-year time series measures of leverage are discussed in Table 5.5.

Table 5.5: 10-Year Time Series Leverage Characteristics

Ratio	Mean	Std.Dev	Min.Val	Max.Val	Range	Skew.	Kurt.
DOL	0.948	0.226	0.599	1.630	1.031	0.862	0.475
DFL	0.914	0.200	0.394	1.443	1.049	-0.468	1.049

Std. Dev = Standard Deviation; Min. Val = Minimum Value; Max. Val = Maximum Value; Skew = Skewness Coefficient; Kurt. = Kurtosis Coefficient.

Comments:

i. The leverage measures were found to have similar minimum and maximum values and means, with the financial leverage measure reporting lower values. The mean values are very similar to those found by **Mandelker & Rhee (1984,p.52)** which were 0.944 and 0.980 for DOL and DFL respectively. No extreme values were found in either measure. Both measures reported slight departures from the normal distribution with the operating leverage measure departing on the basis of positive skewness and the financial leverage measure on the basis of positive kurtosis.

5.6 PORTFOLIO FORMATION

5.6.1 Portfolio formation: Methodology

The inter-relationships between financial leverage, operating leverage and beta were examined at an individual share level and at a portfolio level. Portfolio relationships were examined for two reasons:

i. Any measurement error present in variables would be reduced by aggregation into portfolios.

ii. To examine the nature of the associations when specific risk is diversified away.

The choice of the portfolio size involved a trade-off. Portfolios had to be large enough to benefit from aggregation and diversification, but small enough to result in as many portfolios, and therefore regression data points, as possible. With a cross sectional leverage sample of 76 companies, the optimum portfolio combination was considered to be 15 portfolios of five shares each, i.e. 75 shares in total.

With only 45 companies in the time series sample it was decided that, in addition to the nine portfolios of five shares each, 14 portfolios of three shares each would also be produced to increase the number of regression data points. These have been termed the five share and three share portfolios respectively.

In respect of each single share relationship examined, two portfolio relationships were examined. The two separate portfolios were formed by the ranking in descending order of the regression independent variable (leverage) and beta. Where the regression dependent variable was unlevered beta, the beta portfolios were substituted with portfolios based on rankings of unlevered beta.

Theil (1971,p.445) shows that a selection bias exists when grouping and cross-sectional regressions are performed in the same study period. To correct the bias, portfolios should be

formed by ranking on an instrumental variable which is highly correlated with the independent variable but which can be observed independently of it. No such variable could be found for either financial or operating leverage, and any selection bias present in the portfolio formation is a limitation of this study

5.6.2 Portfolio formation: Results

Betas and leverage ratios were determined for each portfolio as the mean of the constituent company values. The portfolio formation procedures were performed on MSExcel (version 5.0c) by means of a "macro" written by the author in MSVisual Basic programming language. In excess of 240 different portfolios were formed and the portfolio variables have therefore not been included in the Appendices.

5.7 SUMMARY

This chapter is the second and final chapter in the measurement section (Part 2) of this report, and consisted of five sections. The first two sections detailed, respectively, the methodology and results of the cross sectional measurement of financial and operating leverage. Balance sheet and income statement information for the sample of seventy six companies was adjusted for different accounting policies as well as for the debt and equity components of financing instruments (mainly preference shares and debentures). Cash flow statements were constructed according to GAAP statement AC118 for each of the companies over the sample period, incorporating an inflation adjusted depreciation charge as a surrogate for the investment cash flow to maintain operations.

Fifteen financial definitions were extracted from the standardised financial statements and incorporated into 23 ratios encompassing balance sheet, income statement and cash flow measures of financial and operating leverage. An important distinction was drawn between the default and interest risks inherent in financial leverage. Two categories of default risk were identified in the form of total debt and non interest bearing debt.

The third and fourth sections of the chapter detailed the methodology and the results of the measurement of time series leverage. Two time series leverage measures (10-year and 20-year) were obtained in accordance with the empirical formulae developed by **Mandelker & Rhee (1984,p.51)**. The measures were tested for statistical significance, auto-correlation and stationarity. 90 % of the 20-year sample exhibited either significant autocorrelation or a lack of stationarity and were consequently excluded from the study. A final sample of 45 companies yielded acceptable 10-year time series measures of financial and operating leverage.

The last section of the chapter discussed the portfolio formation procedures and results. Portfolios were formed by ranking on both beta and the leverage measure which constituted the regression independent variable, with portfolio variables calculated as the arithmetic average of the constituent companies. The individual share and portfolio leverage measures obtained in this chapter will be used in the testing section (Part 3) which follows.

Part Three :

Testing

CHAPTER SIX : THE EMPIRICAL TESTING METHODOLOGY

6.1 INTRODUCTION

This is the first chapter in the Testing section (Part 3) of this report. The objective of this chapter is to detail the standardised procedures which will be used in the remainder of the testing section (Chapters Seven to Nine) to empirically test the inter-relationships between systematic risk, financial leverage and operating leverage. The chapter consists of three sections, the first of which details the OLS regression model employed by this study and the procedures utilised to detect violations of its assumptions. The second section discusses the standardised correlation analysis and the chapter is summarised in the third section.

6.2 THE OLS REGRESSION MODEL

The empirical testing methodology took the form of a correlation analysis. Cross sectional regressions were performed between the dependent and independent variable for each of the relationships examined. The significance probability level of the resulting regression coefficients were calculated using Student's *t*-test and interpreted using a significance threshold of the 0.05 level. In the bi-variate context of this study the *t*-test is equal to an *F*-test and it tests whether or not the regression slope coefficient is significantly different from zero.

assumptions which were most likely to have a significant impact on the reported significance levels be identified, and tested for.

OLS assumptions i. and ii. have not been examined by this study. Assumption i. is satisfied in the model presented in equation (6.1) as a result of the inclusión of the regression intercept term. In relation to Assumption ii., **Gujarati (1988,p.358)** states that the problem of autocorrelation is usually more common in time series data than cross sectional data. Autocorrelation was therefore not tested. In the cross sectional context of the correlation analysis, assumptions iii. to vi. were considered most likely to affect the reported significance levels with particular attention being paid to the assumption of homoscedasticity. The tests performed to examine the compliance with these assumptions were as follows:

6.2.1.1 Homoscedasticity

Cassidy (1981,p.204) states that the problem of heteroscedasticity, or non-constant variance of the error term, is "particularly endemic" to cross section models. The **Goldfeld-Quandt (1972,p.93)** test, as recommended by Cassidy and **Gujarati (1988,p.333)**, was used to test for the presence of heteroscedasticity. The test is based on the premise that the variance of the error terms is correlated with the independent variable and it involved the following procedures:

i. Observations (number = n) were ranked in descending order of the independent variable.

ii. The central ($n/4$) observations were omitted, leaving an upper and lower set of observations (number = m) equal to $[n-(n/4)]/2$ each.

iii. OLS regressions were then fitted to the m upper and lower observations, and their respective residual sum of squares (RSS) were calculated as RSS_1 and RSS_2. These RSS have degrees of freedom equal to m-2.

iv. The Goldfeld-Quandt F-statistic was then calculated as RSS_1 / RSS_2. This F-statistic has an F-distribution with m-2 numerator and denominator degrees of freedom.

v. The significance probability of the F-statistic, and its inverse, were then determined by a pre-written Macro in MSExcel version 5.0c. Where the significance probability of either the calculated F-statistic or its inverse was less than 0.05, heteroscedasticity was present.

In the presence of heteroscedasticity the regression estimates are still unbiased but are inefficient, not having the least variance of all unbiased estimators. This results in the reliability of the standard errors being reduced and a reduction in the accuracy of the t-test employed. It was therefore necessary to attempt to correct for heteroscedasticity where it could affect the significance, or lack thereof, of the tested relationship.

Where a regression with a significance probability of less than or equal to 0.40 was found to be heteroscedastic, a log transformation was attempted. Where the significance probability was in excess of 0.40 it was considered unlikely that the heteroscedasticity was causing a mis-statement of a relationship which was significant at the 0.05 level, and no transformation was attempted.

The log transformation for heteroscedasticity, as recommended by **Gujarati (1988,p.340)**, involves taking the natural logarithm of the dependent and independent variables, and re-running the regression. The transformation compresses the scales in which the variables are being measured and this reduces the magnitude of the difference between the variances of the error terms in the untransformed regression. Mathematically, the transformation is represented as:

$$\ln Y_i = B_1 + B_2 \ln X_i + u_i \qquad (6.2)$$

All symbols have been previously defined

The log transformation could not be applied to zero or negative observations and these observations were therefore eliminated for the purpose of the transformation. Where the transformation successfully eliminated heteroscedasticity, the significance tests were performed on the transformed regression.

6.2.1.2 Independence of the error term

According to **Gujarati (1988,p.57)** this assumption is automatically fulfilled where the independent variable is non random and assumption i. (i.e. a zero population error term) holds. He notes further that this assumption is of concern in simultaneous equation models.

To test for compliance with this assumption, the regression error terms were regressed on the independent variable, and the resulting correlation coefficients tested for significance at the 0.05 level using Student's *t*-test. None of the regressions performed violated this assumption, and the lowest significance probability level was 0.98 indicating a high level of compliance with the assumption.

6.2.1.3 Normally distributed error terms

The validity of this assumption does not affect the regression estimates, but is required to enable accurate hypothesis testing and therefore reporting of significance probability levels. It is stressed that this assumption requires normality in the distribution of the error term, and not in the dependent and independent variable observations[3].

The tests employed to detect departures from normality were the examination of calculated skewness and kurtosis coefficients. These descriptive statistics were used by **Muil, Hamman & Smit (1992,p.20)** and **Jordaan, Smit & Hamman (1994,p.71)** to detect departures from normality in the distributions of financial ratios on the JSE. **Affleck-Graves & McDonald**

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3 *See comments by Affleck-Graves & McDonald (1989,p.893) in Chapter 4, Section 4.4.3.7.*

(1989,p.893) state that the earliest statistical tests for departures from normality were based on sample skewness and sample kurtosis and that simulation studies indicate that these sample tests are reasonably powerful, especially in cases where the direction of the deviation from normality is known.

The skewness coefficient examines whether the distribution of data departs from the bell-shaped curve of the normal distribution in either the upper or lower parts of the distribution. According to **Foster (1986,p.106)** a benchmark for suspecting positive skewness is a coefficient of greater than +0.5, and for negative skewness a coefficient of less than -0.5.

Foster (1986,p.106) states that a common test for normality involves comparing the sample distribution in the tails with the theoretical normal distribution. He states further that the kurtosis coefficient is used in this comparison to determine whether the distribution is more or less fat-tailed than would be expected from the normal distribution. Normality is violated when the kurtosis coefficient is less than -1 or greater than +1.

Affleck-Graves & McDonald (1989,p.893) state that the exact distribution of sample skewness and kurtosis statistics is difficult to obtain, and therefore that approximations to probability integrals must be used. The application of the absolute values of 0.5 and 1.0 for the skewness and kurtosis coefficients is therefore relatively simplistic. Where the regression error terms were found to violate the normality assumption (either in terms of skewness or kurtosis), this has been reported. No adjustments were made to transform data which violated the assumption of normality.

6.2.1.4 Linearity of the relationship

No formal statistical test was conducted to ensure that the linear specification was complied with. Regression observations were plotted and visually examined for significant departures from linearity, none of which were detected.

6.2.1.5 Limitations

Any departure from the OLS assumptions reduces the ability to draw conclusions based on significance levels. Where any of the assumptions were found to be violated and were not able to be corrected, caution has been exercised in the interpretation of the results. The specification analysis employed by this study does not purport to test, or correct, for all possible violations of the OLS assumptions. Considering the lack of any specification analysis in the reviewed prior research, the procedures employed, and those relating to the assumption of homoscedasticity in particular, represent a small step towards robust conclusions and establishing the appropriateness of OLS assumptions in this field of research. To the extent that any OLS violations remain undetected, or uncorrected, this study is limited.

6.3 THE CORRELATION ANALYSIS

A standardised correlation analysis was performed. In respect of each of the relationships tested, the following procedures were performed for individual shares, leverage portfolios and beta portfolios:

i. In regard to the cross sectional measures of leverage, the dependent variable calculated at the financial year ended 1989 (or in the case of beta, over the three financial years ended 1989) was regressed against the independent variable calculated:

   a. At the financial year ended 1989 (the first order relationship).
   b. At the financial year ended 1988 (the lagged relationship).
   c. As the three year mean of the financial years ended 1989, 1988 and 1987 (the average relationship).

ii. In respect of the time series measures of leverage, the degree of leverage calculated over the ten financial years ended 1989 was regressed on the dependent variable calculated at the financial year ended 1989.

iii. In respect of each of the regressions performed in Steps i. and ii. the following were performed:

a. The observations (number = n) were ranked in descending order of the independent variable.

b. The middle $n/4$ observations were deleted, leaving an upper and lower set of m observations equal to $[n-(n / 4)] / 2$ each.

c. Separate regressions were then run on both the upper and lower sets of observations and were tested for significance at the 0.05 level using Student's t-test.

The regressions detailed in Steps i. and ii. have been referred to as the "total" regressions and those referred to in Step iii. as the "upper" and "lower" regressions. The purpose of performing Step iii. was twofold. Firstly, the comparison between the regressions performed on the upper and lower data points indicates whether there is a difference in the relationships for high and low values of the independent variable[4]. Secondly, the RSS calculated from the upper and lower regressions were used to calculate the F-statistic used in the Goldfeld-Quandt test for heteroscedasticity in the full sample regression.

6.3.1 Significance levels and the drawing of conclusions

A significance probability level of 0.05 implies a 5% probability that the null hypothesis of no significant difference from zero is incorrectly rejected. This is termed a false rejection or a Type I error. In other words, of every twenty relationships found to be "significant" at this level, one is likely not to be significant. The possibility for error also applies to the converse, i.e. where there is a failure to reject the hypothesis when it is false (termed a Type II error).

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4 *This was necessary to answer research question iv. as identified in Chapter 1, Section 1.2.*

The standardised results' tables to be presented in Chapters Seven to Nine to contain 27 regressions in respect of each relationship examined. As a result of the probability for error, and Type I error in particular, conclusions regarding the significance of the association of relationships will not be drawn on the basis of one or two significant regressions in a table, but on the evidence of a pattern or consistency in the significance. The standardised results' tables are discussed in Chapter Seven, Section 7.2.2.

6.3.2 Software and programming

The correlation and specification analyses were all performed in MSExcel version 5.0c. MSExcel has pre-written "macro's" for the performance of OLS regression with a variety of output options including residuals, scatterplots etc. The package is a spreadsheeting package and not a fully fledged statistical package. It has particularly strong graphics capabilities and a user friendly programming language in the form of MSVisual Basic. The standardisation of financial statements and calculation of ratios were performed in MSExcel and this enabled the correlation analysis, specification analysis and portfolio formation procedures to be combined into one programming module and eliminated the need for importing and exporting data.

MSExcel does not calculate the Goldfeld-Quandt F-statistic. The procedures for calculating this statistic, as outlined in Section 4.6.1.1, were programmed by this researcher. The sub-routine containing these procedures was then incorporated into an MSVisual Basic module together with the portfolio formation procedure outlined in Section 5.6 and customised pre-written MSExcel macro's for the necessary regression output.

The programmed Goldfeld-Quandt test was checked against examples contained in **Gujarati (1988, p.335)** and **Cassidy (1981, p.214)**. To further ensure the accuracy of the programmed routines, five percent of all output was randomly chosen and the procedures were reperformed manually.

6.4 SUMMARY

This chapter has detailed the empirical testing methodology applied by this report. The two variable OLS model has been employed with the resulting regression slope coefficients examined for significant difference from zero at the 0.05 level, using Student's *t*-test. The regression error terms have been examined for compliance with the following OLS assumptions: homoscedasticity using the Goldfeld-Quandt test; normality using skewness and kurtosis coefficients; independence from the independent variable by applying Student's *t*-test to the regression slope coefficient between the two; and linearity by visual examination of regression scatterplots.

The OLS model has been incorporated into a standardised correlation analysis which tests for contemporaneous (first order), lagged, and averaged associations for the full regression sample as well as for the upper (higher) and lower values of the independent variable. This correlation analysis was applied to individual share as well as beta and leverage portfolio relationships. The necessary routines were programmed by the author in MSVisual Basic and executed in MSExcel.

The correlation analysis detailed in this chapter has been applied in the remainder of the testing section of this report in respect of the following relationships:

i. Systematic risk and financial leverage (Chapter Seven).
ii. Systematic risk and operating leverage (Chapter Eight).
iii. Financial leverage and operating leverage (Chapter Nine).

CHAPTER SEVEN : THE RELATIONSHIP BETWEEN SYSTEMATIC RISK AND FINANCIAL LEVERAGE

7.1 INTRODUCTION

This chapter examines the relationship between systematic risk and financial leverage and consists of five sections. The first section specifies the regression variables and discusses the format of the standardised results' tables. Sections Two and Three present the results of the regressions between systematic risk (beta) and, respectively, cross sectional measures of default risk and interest risk financial leverage. Section Four details the results of the regressions between beta and time series measures of financial leverage. The results are summarised in section five.

7.2 CORRELATION ANALYSIS

7.2.1 Regression variables

The standardised correlation analysis was employed to examine the associations between beta and financial leverage and beta by performing regressions on the variables stated in Table 7.1.

Table 7.1: Beta vs. Financial Leverage: Regression Variables

Fin. Lev. Measure	Fin. Stat. Component	Independent Var.	Dependent Var.
Default Risk (Class One)	Balance Sheet	TLIA / TASS	BETA
		ATLIA / TASS	BETA
		TLIA / ATASS	BETA
	Income Statement	EBIT / TLIA	BETA
	Cash Flow	CASH2 / TLIA	BETA
Default Risk (Class Two)	Balance Sheet	NIBD / TASS	BETA
		ANIBD / TASS	BETA
	Income Statement	EBIT / NIBD	BETA
	Cash Flow	CASH2 / NIBD	BETA
Interest Risk	Balance Sheet	IBD / TASS	BETA
		IBD / ATASS	BETA
	Income Statement	EBIT / IBD	BETA
		EBIT / INT	BETA
	Cash Flow	CASH2 / IBD	BETA
		CASH2 / INT	BETA
Time Series	Income Statement	DFL [per eq. (5.3)]	BETA

Fin. Lev. = Financial Leverage; Fin. Stat = Financial Statement; Var = Variable.

In total 420[1] regressions were performed to test the relationship between beta and financial leverage.

The hypothesised direction of association between beta and financial leverage is positive. The balance sheet based regressions appearing in Table 7.1 are all expected to have positive association as the financial leverage ratios examined are positively associated with financial leverage. However, the income statement and cash flow based regressions are all expected to exhibit negative association as the financial leverage ratios examined are negatively

1 *This is calculated as [15(cross sectional measures of leverage) * 3 (single share, beta portfolio and leverage portfolio) * 3 (first order, lagged and average) * 3 (full sample, upper and lower observations)] + [1(time series measure of leverage) * 5 (one single share regression + two leverage portfolio regresions + two beta portfolio regressions) * 3 (total, upper and lower observations)]. This excludes regressions performed in respect of logarithmic transformations.*

associated with financial leverage. The time series regressions are expected to exhibit positive association as the time series measure is positively associated with financial leverage.

7.2.2 Standardised results' tables

7.2.2.1 Columns

The results of each of the examined relationships are presented in standardised tables. The tables consist of three distinct sections of columns.

i. The first section is the "total" section and details the regression output relating to the total (i.e. full sample) regression. The columns contained in the total section are explained Table 7.2.

Table 7.2: Total Section Column Components

Column Title	Meaning
r	Pearson product moment correlation coefficient.
t value	Student's *t*-test value.
df	Degrees of freedom.
prob	Significance probability, where the probability is that of obtaining a larger absolute value of *t* from data sampled independently from a bi-variate normal distribution with zero correlation.

ii. The second section relates to the "upper" and "lower" regressions in which the significance probabilities (as defined in Table 7.2) are separately examined in respect of the higher and lower values of the independent variable.

iii. The third section is the "residuals" section and relates to the specification analysis performed on the residuals (error terms) resulting from the total regression. The assumption is that the OLS conditions are satisfied and where a violation of one of

the conditions exists, this is indicated by a "NO" in the relevant column. The columns contained in the residuals' section are explained in Table 7.3.

Table 7.3: Residuals' Section Column Components

Column Title	Meaning
homo	Residuals are homoscedastic unless otherwise indicated. °
normal	Residuals are approximately normally distributed unless otherwise indicated.
indep	Regression residuals are uncorrelated with the independent variable unless otherwise indicated.

° = Where "log (x)" appears in the homo column it indicates that heteroscedasticity was present in the untransformed relationships, which was eliminated by means of the logarithmic transformation discussed in equation (6.2). The x figure in parentheses represents the t- value of the untransformed regression.

7.2.2.2 Rows

The rows in the tables distinguish the nature of the relationship examined. The components are detailed in Table 7.4.

Table 7.4: Row Components

Row Title	Meaning
Single co	The regressions performed on the single company sample.
Portfolio-B	The regressions performed on the portfolio sample formed by ranking on beta (or unlevered beta where it is the dependent variable).
Portfolio-L	The regressions performed on the portfolio sample formed by ranking on the independent variable (leverage).

To assist in the interpretation of results, the significance probability levels of regressions that are significant at the 0.05 level have been highlighted by the use of shading and bold type. Where regression variables have been trimmed as a result of outliers, the full sample results

will be discussed only when found to differ significantly from the trimmed sample[2]. In the majority of instances the full sample results were found to be similar to the trimmed sample in respect of the level of association, but less well specified in terms of the OLS assumptions.

Scatterplots were prepared for each of the total regressions to examine outliers and to test for linearity. Over 400 total regressions were performed in this research and it was considered excessive to include all of the scatterplots in this report. Instead, a plot of the first single company average regression in each of the results' tables is presented in Appendix 12. The single company average relationships were chosen as they incorporate all the data used by the study. The numbering of the graphs in the Appendix corresponds to the numbering of the table containing the regression, i.e. the first single company average regression contained in Table 7.5 will appear as graph 12.5.

7.3. RESULTS OF THE REGRESSIONS BETWEEN BETA AND DEFAULT RISK FINANCIAL LEVERAGE

7.3.1 BETA VERSUS DEFAULT RISK FINANCIAL LEVERAGE (CLASS ONE)

7.3.1.1 Balance sheet measures

Table 7.5 presents the results of the regressions performed between beta and balance sheet measures of default risk financial leverage (class one).

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2 *The reasoning for this was discussed in Chapter 5, Section 5.3.1.*

Table 7.5: Beta vs. Balance Sheet Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL1									
Single Co									
first order	0.373	3.463	74	0.001	0.179	0.992			
lagged	0.263	2.341	74	0.022	0.261	0.421	log(3.3)		
average	0.285	2.558	74	0.013	0.294	0.389	log(3.4)		
Portfolio-B									
first order	0.729	3.844	13	0.002	0.012	0.854			
lagged	0.676	3.311	13	0.006	0.019	0.695			
average	0.702	3.559	13	0.003	0.034	0.511			
Portfolio-L									
first order	0.634	2.953	13	0.011	0.268	0.770		NO	
lagged	0.676	3.310	13	0.006	0.126	0.994			
average	0.626	2.896	13	0.013	0.494	0.714			
BFL2									
Single co									
first order	0.272	2.433	74	0.017	0.533	0.156	log(2.9)		
lagged	0.275	2.460	74	0.016	0.077	0.083			
average	0.287	2.576	74	0.012	0.299	0.046			
Portfolio-B									
first order	0.658	3.152	13	0.008	0.005	0.966			
lagged	0.586	2.604	13	0.022	0.012	0.502			
average	0.620	2.850	13	0.014	0.024	0.584			
Portfolio-L									
first order	0.650	3.083	13	0.009	0.757	0.651		NO	
lagged	0.473	1.935	13	0.075	0.081	0.569	NO	NO	
average	0.577	2.547	13	0.024	0.214	0.223		NO	
BFL3									
Single co									
first order	0.347	3.179	74	0.002	0.417	0.957			
lagged	0.255	2.266	74	0.026	0.313	0.436	log(3.2)		
average	0.273	2.442	74	0.017	0.494	0.494	log(3.2)		
Portfolio-B									
first order	0.706	3.596	13	0.003	0.014	0.902			
lagged	0.667	3.226	13	0.007	0.019	0.619			
average	0.687	3.413	13	0.005	0.036	0.252			
Portfolio-L									
first order	0.601	2.714	13	0.018	0.551	0.564			
lagged	0.554	2.400	13	0.032	0.637	0.562			
average	0.671	3.264	13	0.006	0.395	0.964		NO	

BFL1 = Tlia / Tass
BFL2 = Atlia / Tass
BFL3 = Tlia / Atass

Comments:

7.3.1.1.1 Single company level

Significant association was indicated in all of the total regressions, with an average significance probability level of 0.014. Default risk financial leverage was shown to explain as much as 14% (0.373^2) of the variability in the single company beta. The total regressions exhibited a positive association, as hypothesised. No consistent difference was found in the association of the first order, lagged and average relationships.

Logarithmic transformations proved successful in eliminating the heteroscedasticity in all but one of the regressions in which it was present. The transformed regressions indicated weaker associations than their transformed counterparts, but were all statistically significant. No violations of normality or dependence of the residuals on the independent variable were recorded with the result that the total regressions were well specified.

No consistent difference was found in the association of the upper and lower regressions, only one of which indicated significance at the 0.05 level.

7.3.1.1.2 Portfolio level

Significant association was found at the portfolio level. Default risk financial leverage was shown to explain as much as 50% (0.706^2) of the variability in beta at the portfolio level. As expected, the total regressions were consistently positively associated. As in the single company case, no consistent difference was found in the associations of the first order, lagged and average relationships.

The portfolios ranked on the basis of beta exhibited consistently greater association with beta than the leverage portfolios. An analysis of the upper and lower regressions corroborates this and indicates that it is likely to be as a result of significant association present amongst higher beta companies which is absent from their lower beta counterparts. No consistent difference

was found between the association of the upper and lower regressions of the leverage portfolios.

To test the dependence of the association on the level of beta, the upper and lower regressions were repeated based on the level of beta (as opposed to the level of leverage as reflected in Table 7.5). All upper regressions for both the single company and beta portfolio cases were significantly associated at the 0.05 level, while none of the lower regressions indicated significant association. None of the leverage portfolios' upper or lower regressions were found to be significant. This corroborates the observation that the association is stronger for higher beta companies than it is for lower beta companies.

The beta portfolio total regressions were well specified with no violations of the OLS assumptions detected. The leverage portfolios were not as well specified and exhibited violations of both the normality and homoscedasticity assumptions, although these were not consistently detected. While caution should be exercised in the interpretation of the leverage portfolio associations in the presence of these violations, it is submitted that the violations were unlikely to have induced significant association into an otherwise statistically insignificant relationship. The reasons for this are that there is little difference between the associations of the leverage portfolios that indicated violations and those that did not, and the existence of strong, well specified associations by the portfolio constituents in the single company regressions.

In both the single company and portfolio cases, the association was consistent across the different debt and asset definitions which were employed. The null hypothesis of no significant association between systematic risk and balance sheet measures of default risk financial leverage (class one) is rejected at the 0.05 level.

7.3.1.1.3 Comparison to prior research

The finding of significant positive association between beta and the average Tlia/Tass ratio is consistent with the findings of all the prior research reviewed [i.e. **Retief et al (1986,p.154);**

Thompson (1976,p.181); Rosenberg & McKibben (1973,p.325) and **Beaver et al (1970,p.654)**]. **Dhingra (1982,p.195)** was the only previous study to examine the first order relationship but significant association at the 0.05 level was not found by his study. The prior research reviewed had not distinguished the association based on the level of either beta or leverage. The finding of a significant first order relationship between beta and balance sheet financial leverage and a greater association for higher beta companies are therefore contributions of this study.

7.3.1.2 Income statement measures

Table 7.6 presents the results of the regressions performed between beta and income statement measures of default risk financial leverage (class one).

Table 7.6: Beta vs. Income Statement Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL1									
Single Co									
first order	-0.234	-2.017	70	0.048	0.913	0.663			
lagged	-0.197	-1.677	70	0.098	0.815	0.540			
average	-0.239	-2.056	70	0.043	0.685	0.882			
Portfolio-B									
first order	-0.321	-1.176	12	0.262	0.696	0.086		NO	
lagged	-0.294	-1.064	12	0.308	0.760	0.569		NO	
average	-0.365	-1.356	12	0.200	0.546	0.711		NO	
Portfolio-L									
first order	-0.701	-3.406	12	0.005	0.056	0.121		NO	
lagged	-0.709	-3.479	12	0.005	0.981	0.806		NO	
average	-0.485	-1.923	12	0.079	0.793	0.794		NO	

IFL1 = Ebit / Tlia

Comments:

7.3.1.2.1 Single company level

Significant association at the 0.05 level was indicated in two of the total regressions with the third regression found to be significant at the 0.1 level. All of the total regressions exhibited the hypothesised negative association and were well specified with no detected violations of the OLS assumptions. No consistent difference was evident between the association of the upper and lower regressions, none of which exhibited significant association.

7.3.1.2.2 Portfolio level

The association in the portfolio regressions was dependent upon the portfolio formation procedure. Significant association was found in the leverage portfolios with two of the three regressions significantly associated at the 0.05 level, and the third at the 0.1 level. The beta regressions, on the other hand, did not indicate significant association. The reason for this cannot be determined with certainty.

All of the total regressions violated the normality assumption. The violation of normality was expected in the income statement relationships as a result of the extreme values, particularly in the case of the leverage portfolios where these values are grouped together. Although the causes of these violations differed, the majority of the beta portfolios exhibited negative kurtosis and the majority of the leverage portfolios indicated negative skewness.

As in the single company case, all of the total regressions exhibited the hypothesised negative association. No consistent difference was detected in the associations of the upper and lower regressions in either the beta or leverage portfolios. Similarly, no consistent difference was found in the associations of the first order, lagged and average regressions.

An examination of the full sample results showed that while the single company and leverage portfolios indicated similar associations to the trimmed sample results, two of the beta

portfolio associations were significant at the 0.05 level, and the remaining regression at the 0.1 level. As in the trimmed sample, the portfolios consistently violated the normality assumption. The trimming of the sample may therefore have resulted in a loss of information and have impacted the beta portfolio associations.

The null hypothesis of no significant association between systematic risk and income statement measures of default risk financial leverage (class one) is rejected in respect of the single company and leverage portfolio instances, but not in respect of the beta portfolios.

7.3.1.2 Comparison with prior research

None of the reviewed prior research had examined similar relationships.

7.3.1.3 Cash flow measures

Table 7.7 presents the results of the regressions performed between beta and cash flow measures of default risk financial leverage (class one).

Table 7.7: Beta vs. Cash Flow Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL1									
Single Co									
first order	-0.172	-1.462	70	0.148	0.924	0.804			
lagged	-0.144	-1.218	70	0.227	0.543	0.729			
average	-0.175	-1.490	70	0.141	0.492	0.845			
Portfolio-B									
first order	-0.417	-1.591	12	0.138	0.822	0.174		NO	
lagged	-0.129	-0.450	12	0.661	0.627	0.461			
average	-0.253	-0.905	12	0.383	0.156	0.534			
Portfolio-L									
first order	-0.398	-1.501	12	0.159	0.637	0.875			
lagged	-0.516	-2.084	12	0.059	0.821	0.369		NO	
average	-0.388	-1.459	12	0.170	0.870	0.998			

CFL1 = Cash2 / Tlia

Comments:

7.3.1.3.1 Single company level

In contrast with the balance sheet and income statement findings, no significant association was detected in the cash flow total regressions. All of the total regressions indicated the hypothesised negative association and were well specified with no violations of the OLS assumptions. No difference in the significance of the upper and lower regressions was detected as none of the upper or lower regressions exhibited any significant association.

7.3.1.3.2 Portfolio level

No significant association was found at the portfolio level. All portfolio total regressions were found to be negative, as expected, and were found to be well specified with the exception of two violations of normality. No significant association was detected in either the upper or lower regressions.

7.3.1.3.3 Full sample results

The total sample results are included in Appendix 13.1. The total results were found to be significantly different from the trimmed sample results and therefore warrant discussion. A greater degree of significance was found in the total sample regressions. Two of the nine total relationships were found to be significant at the 0.05 level, and a further three significant at the 0.1 level. However, four of the nine total sample regressions violated the normality assumption.

While it is possible that information loss may have occurred in trimming the sample, there is little evidence of significant association in the trimmed sample and the null hypothesis of no significant association between systematic risk and cash flow measures of default risk (class one) cannot be rejected.

7.3.1.3.4 Comparison with prior research

The finding of no significant association in the average relationship is consistent with the findings of **Thompson (1976,p.181)**. None of the prior research that was reviewed indicated any findings to the contrary.

7.3.2. BETA VERSUS DEFAULT RISK FINANCIAL LEVERAGE (CLASS TWO)

No comparisons will be drawn in this section between the findings of this research and those of prior research as no similar relationships have been examined by the reviewed prior research.

7.3.2.1 Balance sheet measures

Table 7.8 presents the results of the regressions performed between beta and balance sheet measures of default risk financial leverage (class two).

Table 7.8: Beta vs. Balance Sheet Default Risk (II)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL4									
Single Co									
first order	0.275	2.462	74	0.016	0.102	0.100	log(2.7)		
lagged	0.302	2.729	74	0.008	0.139	0.026	NO		
average	0.301	2.712	74	0.008	0.128	0.070	NO		
Portfolio-B									
first order	0.697	3.508	13	0.004	0.101	0.691			
lagged	0.610	2.779	13	0.016	0.005	0.407			
average	0.647	3.056	13	0.009	0.075	0.544			
Portfolio-L									
first order	0.662	3.182	13	0.007	0.071	0.186		NO	
lagged	0.554	2.402	13	0.032	0.161	0.106		NO	
average	0.591	2.641	13	0.020	0.090	0.186			
BFL5									
Single co									
first order	0.236	2.086	74	0.040	0.751	0.002	NO		
lagged	0.236	2.086	74	0.040	0.751	0.002	NO		
average	0.224	1.978	74	0.052	0.991	0.031	NO		
Portfolio-B									
first order	0.562	2.448	13	0.029	0.004	0.076			
lagged	0.482	1.984	13	0.069	0.012	0.312			
average	0.498	2.070	13	0.059	0.007	0.352			
Portfolio-L									
first order	0.428	1.709	13	0.111	0.650	0.167		NO	
lagged	0.419	1.662	13	0.120	0.793	0.672			
average	0.409	1.616	13	0.130	0.883	0.391			

BFL4 = Nibd / Tass
BFL5 = Anibd / Tass

Comments:

7.3.2.1.1 Single company level

Significant association was found in all total regressions with the exception of one, which was found to be significant at the 0.052 level. The total regressions all indicated the expected positive association. The lower regressions indicated stronger associations than the upper regressions, particularly in respect of the BFL5 ratio. This suggests that companies with proportionately less non interest bearing debt exhibit a greater degree of association with beta.

The total regressions were not well specified as a result of heteroscedasticity which did not respond to the logarithmic transformation. Examination of the upper and lower regressions showed lower RSS for the lower regressions, giving rise to statistically significant Goldfeld-Quandt *F*-ratios. This was particularly evident in the BFL5 ratio. The effect of the heteroscedasticity on the significance probability levels is unknown and caution should therefore be exercised in their interpretation. No consistent difference in association was evident between the first order, lagged and average relationships.

7.3.2.1.2 Portfolio level

Consistently significant association was found in the total regressions for the BFL4 ratio. In contrast, the BL5 ratio indicated little significant association with respect to the beta portfolios and none with respect to the leverage portfolios.

The pattern of reduced significance for the BFL5 ratio is also found in the single company case. The difference between the two ratios is that the BFL5 ratio excludes outside shareholders' interest from its definition of non interest bearing debt (i.e. numerator). The bigger impact of outside shareholders' interest on the class two default risk relationship than the class one relationship is expected. Outside shareholders' interest represents a considerably bigger portion of non-interest bearing debt than it does of total debt, and therefore has a greater impact on the examined relationship.

The total regressions were better specified than the single company regressions although violations of the normality assumption were detected. The upper regressions exhibited greater association with beta than the lower regressions, particularly with respect to the beta portfolios of the BFL5 ratio. This is contrary to the single company finding and suggests that the association is greater for higher beta companies. To further test the dependence of the relationship on the level of beta, the upper and lower regressions were re-performed based on rankings of beta. Neither the upper nor lower regressions indicated significant association. It cannot therefore be concluded that the association is greater for higher beta companies.

The total regressions all indicated the expected positive association and no consistent difference was found between the association of the first order, lagged and average regressions. The null hypothesis of no significant association between systematic risk and balance sheet measures of default risk (class two) is rejected at the 0.05 level.

7.3.2.2 Income statement measures

Table 7.9 presents the results of the regressions performed between beta and income statement measures of default risk financial leverage (class two).

Table 7.9: Beta vs. Income Statement Default Risk (II)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL2									
Single Co									
first order	-0.306	-2.690	70	0.009	0.493	0.763			
lagged	-0.210	-1.793	70	0.077	0.997	0.726			
average	-0.234	-2.017	70	0.048	0.524	0.908			
Portfolio-B									
first order	-0.477	-1.882	12	0.084	0.692	0.137		NO	
lagged	-0.287	-1.040	12	0.319	0.965	0.521		NO	
average	-0.338	-1.243	12	0.238	0.554	0.554		NO	
Portfolio-L									
first order	-0.578	-2.455	12	0.030	0.540	0.926			
lagged	-0.466	-1.822	12	0.093	0.934	0.841		NO	
average	-0.549	-2.277	12	0.042	0.582	0.860			

IFL2 = Ebit / Nibd

Comments:

7.3.2.2.1 Single company level

Significant association was found in the total regressions, all of which indicated the hypothesised negative association. The regressions were all well specified with no violations

of the OLS assumptions detected. No consistent difference was found between the association of the upper and lower regressions, none of which indicated statistical significance with beta. The first order relationship exhibited the highest level of association.

7.3.2.2.2 Portfolio level

Significant association was detected in the portfolio regressions, but was dependent upon the portfolio ranking procedures. While significant association was indicated in the leverage portfolios it was absent from the beta portfolios. The beta portfolio regressions were also less well specified than the with the detection of three violations of the normality assumption to the one of the leverage portfolios. These findings, while surprising, are consistent with the income statement measures of class one default risk.

The examination of the full sample results also yielded consistent results with the class one equivalent. The full sample results are contained in Appendix 13.2. These results corroborate those of the trimmed sample with respect to the single company level. However, at the portfolio level all six of the full sample relationships were found to be significant at the 0.05 level, with only two of the six relationships indicating violations of the normality assumption. It is possible that the trimming of the sample may have resulted in an information loss which has had an impact on the beta portfolios' associations.

The impact of the normality violations on the significance probability levels is not known, but it is considered unlikely that the normality violations are causing an otherwise significant association to be so mis-stated (i.e. a Type II error) in the beta portfolio regressions. The null hypothesis of no significant association between systematic risk and income statement measures of default risk financial leverage (class two) is rejected in respect of the single company and leverage portfolio instances, but not in the case of the beta portfolios.

7.3.2.3 Cash flow measures

Table 7.10 presents the results of the regressions performed between beta and cash flow measures of default risk financial leverage (class two).

Table 7.10: Beta vs. Cash Flow Default Risk (II)

Grouping	Total				Upper Lower		Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL2									
Single Co									
first order	-0.131	-1.104	70	0.273	0.114	0.228			
lagged	-0.236	-2.033	70	0.046	0.638	0.730			
average	-0.338	-3.009	70	0.004	0.199	0.758			
Portfolio-B									
first order	-0.304	-1.105	12	0.291	0.410	0.355			
lagged	-0.421	-1.609	12	0.134	0.244	0.058		NO	
average	-0.559	-2.338	12	0.038	0.387	0.180		NO	
Portfolio-L									
first order	-0.382	-1.432	12	0.178	0.789	0.831		NO	
lagged	-0.498	-1.990	12	0.070	0.539	0.801			
average	-0.577	-2.445	12	0.031	0.221	1.000			

CFL2 = Cash2 / Nibd

Comments:

7.3.2.3.1 Single company level

Significant association at the 0.05 level was found in respect of two of the three single company regressions. The associations were all negative, as expected, and no violations of the OLS assumptions were detected. None of the upper or lower regressions indicated significant association. Greater association was found in respect of the average relationship than the first order and lagged relationships.

7.3.2.3.2 Portfolio level

Significant association was evident in both the beta and leverage portfolios but was not consistent in either. The total regressions all indicated the hypothesised negative association, but half were found to violate the normality assumption. No consistent difference was detected between the association of the upper and lower regressions, none of which indicated significant association.

As in the single company case, the average regressions indicated consistently greater association with beta than the first order or lagged regressions. These findings are difficult to interpret. The statistically significant average association may indicate an overall significance between beta and income statement measures of default risk, which is masked by the inherent volatility in respect of the single year relationships, but indicated by the more stable averaged relationship. On the other hand, it may reflect an aggregation induced significant association.

The pattern of significant association in the average regressions was also observed in the full sample results. The cause of this cannot be determined with certainty, but the consistency of the pattern does indicate that average cash flow default risk (class two) is significantly associated with beta. The null hypothesis of no significant association between systematic risk and cash flow measures of default risk financial leverage (class two) is rejected in respect of the average relationship but not in respect of the first order or lagged relationships.

7.4 RESULTS OF THE REGRESSIONS BETWEEN BETA AND INTEREST RISK FINANCIAL LEVERAGE

7.4.1 Balance sheet measures

Table 7.11 presents the results of the regressions performed between beta and balance sheet measures of interest risk financial leverage.

Table 7.11: Beta vs. Balance Sheet Interest Risk

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL6									
Single Co									
first order	0.131	1.138	74	0.259	0.027	0.361			
lagged	0.114	0.984	74	0.328	0.049	0.869			
average	0.117	1.015	74	0.314	0.045	0.924			
Portfolio-B									
first order	0.301	1.138	13	0.276	0.761	0.275			
lagged	0.281	1.055	13	0.311	0.228	0.446		NO	
average	0.281	1.055	13	0.311	0.157	0.965		NO	
Portfolio-L									
first order	0.338	1.295	13	0.218	0.007	0.085			
lagged	0.216	0.796	13	0.440	0.004	0.788	NO	NO	
average	0.338	1.295	13	0.218	0.037	0.439		NO	
BFL7									
Single co									
first order	0.108	0.935	74	0.353	0.011	0.371			
lagged	0.106	0.916	74	0.363	0.054	0.854			
average	0.103	0.893	74	0.375	0.083	0.905			
Portfolio-B									
first order	0.250	0.932	13	0.368	0.175	0.199			
lagged	0.266	0.996	13	0.337	0.144	0.513		NO	
average	0.253	0.945	13	0.362	0.165	0.879		NO	
Portfolio-L									
first order	0.266	0.993	13	0.339	0.072	0.093			
lagged	0.214	0.790	13	0.444	0.002	0.791	NO	NO	
average	0.268	1.005	13	0.333	0.167	0.440		NO	

BFL6 = Ibd / Tass
BFL7 = Ibd / Atass

Comments:

7.4.1.1 Single company level

None of the total regressions indicated significant association and the lowest observed significance probability level was 0.218. The total regressions exhibited the expected positive association and were well specified with no violations of the OLS assumptions detected.

The association was found to differ between high and low leverage companies. Significant associations were found in the upper regressions, although these were not consistent, while no statistical significance was detected in the lower regressions. This suggests that while there appears to be no overall association between the level of use of interest bearing debt and beta, there may be an association for firms who utilise high levels of interest bearing debt.

7.4.1.2 Portfolio level

As in the single company case, no significant association was found in the total regressions and all total regressions exhibited the expected positive association. The regressions were not well specified as a result of the majority violating the normality assumption and the presence of heteroscedasticity in two of the regressions.

A difference was evident in the association of the upper and lower regressions in respect of the leverage portfolios. The upper regressions indicated significant association, although not consistent, while none was evident in the lower regressions. This finding corroborates that of the single company case. The beta portfolios, on the other hand, indicated no significant association. No consistent difference was found between the associations of the first order, lagged and average regressions.

The lack of significant association with beta exhibited by the total regressions of balance sheet interest risk measures contrasts with the significant association found in both classes of balance sheet default risk measures. The null hypothesis of no significant association between beta and cash flow interest risk is rejected at the 0.05 level.

7.4.1.3 Comparison with prior research

While none of the reviewed prior research drew a distinction between default and interest risk measures of financial leverage, **Belkaoui (1978,p.9)**, **Lev & Kunitzky (1974,p.259)** and

Breen & Lerner (1973,p.339) all examined the ratio of long term liabilities (excluding outside shareholders) to total assets. This measure is likely to be highly correlated with the interest risk measure of interest bearing debt to total assets as the vast majority of long term liabilities are interest bearing. The major difference between default and interest risk measures is the exclusion of creditors from interest risk measures. Creditors are also excluded from the long term liability measure employed by these researchers. .

None of the prior researchers who examined the ratio of long term liabilities to total assets found significant association. The results of these studies caused uncertainty as to the nature of the relationship between beta and financial leverage. Other than these studies, prior research had examined total debt measures of financial leverage and had found significant positive association. The findings of this research are therefore consistent with those of prior research and the recognition of the dual risk nature of leverage provides a possible explanation for the apparent contradictions that existed.

7.4.2 Income statement measures

Table 7.12 presents the results of the regressions performed between beta and income statement measures of interest risk financial leverage.

Table 7.12: Beta vs. Income Statement Interest Risk

Grouping	Total				Upper Lower		Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL3									
Single Co									
first order	-0.098	-0.824	70	0.413	0.621	0.076			
lagged	-0.074	-0.617	70	0.539	0.119	0.430			
average	-0.041	-0.345	70	0.731	0.636	0.333			
Portfolio-B									
first order	-0.157	-0.551	12	0.592	0.531	0.313			
lagged	-0.181	-0.636	12	0.537	0.840	0.521		NO	
average	-0.051	-0.177	12	0.863	0.853	0.230			
Portfolio-L									
first order	-0.208	-0.736	12	0.476	0.485	0.359			
lagged	-0.168	-0.592	12	0.565	0.300	0.145		NO	
average	-0.208	-0.738	12	0.475	0.419	0.005	NO	NO	
IFL4									
Single Co									
first order	-0.059	-0.495	70	0.622	0.765	0.170			
lagged	-0.148	-1.250	70	0.215	0.556	0.912			
average	-0.340	-3.023	70	0.003	0.012	0.975			
Portfolio-B									
first order	-0.051	-0.178	12	0.861	0.201	0.373		NO	
lagged	-0.423	-1.616	12	0.132	0.357	0.651		NO	
average	-0.444	-1.716	12	0.112	0.193	0.690			
Portfolio-L									
first order	-0.301	-1.094	12	0.295	0.079	0.374		NO	
lagged	-0.273	-0.981	12	0.346	0.508	0.872		NO	
average	-0.544	-2.244	12	0.044	0.149	0.855		NO	

IFL3 = Ebit / Ibd
IFL4 = Ebit / Int

Comments:

7.4.2.1 Single company level

Although one of the six total regressions indicated statistical significance, this association was inconsistent and somewhat of an aberration when compared to the other regressions. The average significance probability level of all six regressions was found to be in excess of 0.420

and it is therefore concluded that significant association does not exist at the single company level.

All total regressions exhibited the expected negative association and were well specified with no violations of the OLS assumptions detected. No consistent difference was evident between the association of the upper and lower regressions. Similarly, no consistent difference was found between the association of the first order, lagged and average regressions.

7.4.2.2 Portfolio level

No consistently significant association was detected in any of the total, upper or lower regressions. The total regressions were not well specified with two third's violating the normality assumption and heteroscedasticity present in one of the regressions. The portfolio regression results were consistent across both income statement measures, except that the inconsistent significant association was found only in the IFL4 ratio which also violated the normality assumption more frequently.

The null hypothesis of no significant association between beta and income statement measures of interest risk financial leverage cannot be rejected at the 0.05 level.

7.4.2.3 Comparison with prior research

The only prior study reviewed which examined income statement measures of interest risk was that of **Thompson (1976,p.181)** who examined the ratio of operating income to interest expense. This is equivalent to the IFL4 ratio in Table 7.12. Thompson did not find significant association at the 0.05 level and his results are therefore consistent with those of this study.

7.4.3 Cash flow measures

Table 7.13 presents the results of the regressions performed between beta and cash flow measures of interest risk financial leverage.

Table 7.13: Beta vs. Cash Flow Interest Risk

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL3									
Single Co									
first order	-0.159	-1.347	70	0.182	0.301	0.486			
lagged	-0.141	-1.195	70	0.236	0.094	0.392			
average	-0.034	-0.283	70	0.778	0.960	0.050			
Portfolio-B									
first order	-0.340	-1.251	12	0.235	0.464	0.536			
lagged	-0.423	-1.616	12	0.132	0.157	0.034		NO	
average	-0.095	-0.331	12	0.746	0.625	0.700		NO	
Portfolio-L									
first order	-0.424	-1.621	12	0.131	0.204	0.793			
lagged	-0.270	-0.970	12	0.351	0.178	0.362			
average	-0.237	-0.846	12	0.414	0.412	0.489		NO	
CFL4									
Single Co									
first order	-0.078	-0.655	70	0.515	0.888	0.957			
lagged	-0.101	-0.845	70	0.401	0.557	0.212			
average	-0.360	-3.225	70	0.002	0.017	0.115			
Portfolio-B									
first order	-0.252	-0.904	12	0.384	0.486	0.527			
lagged	-0.279	-1.005	12	0.335	0.997	0.642		NO	
average	-0.513	-2.071	12	0.061	0.995	0.256		NO	
Portfolio-L									
first order	-0.394	-1.485	12	0.163	0.699	0.262			
lagged	-0.171	-0.599	12	0.560	0.737	0.080			
average	-0.599	-2.594	12	* 0.023	0.139	0.594			

CFL3 = Cash2 / Ibd
CFL4 = Cash2 / Int

Comments:

7.4.3.1 Single company level

Although the average regression in respect of the CFL4 ratio indicated significant association, this was not consistent with the other single company regressions. The average significance probability level of all six total regressions was found to be 0.35. All total regressions indicated the expected negative association and no violations of the OLS assumptions were recorded.

No consistent difference in the association of the upper and lower regressions was recorded. No consistent difference was evident between the association of the first order, lagged and average regressions, although, as in the income statement measure, statistical significance was found in the average regression.

7.4.3.2 Portfolio level

No consistent significance was detected at the portfolio level. All of the portfolio total regressions exhibited negative association. The major difference between the single company and portfolio regressions was with respect to specification. The portfolio regressions violated the assumption of normality in five of the nine total regressions with a greater occurrence in the beta portfolios.

No consistent significance was detected in either the upper or lower regressions. As in the single company and income statement measures, the average relationship in the ratio denominated with interest (CFL4) was found to exhibit stronger associations than the first order or lagged relationships. These findings may indicate genuine significance which is masked by the volatility of the income statement and cash flow measures in the single year regressions. However, the consistent lack of significance in the beta portfolio average regressions and the relatively high significance probability levels in all of the first order and lagged regressions prevent this conclusion from being drawn. The full sample results also do

not provide any evidence of such an association. The results are presented in Appendix 13.3. No significant association is evident and the directions of the associations were unexpectedly positive in twelve of the eighteen total regressions.

The null hypothesis of no significant association between beta and cash flow measures of interest risk financial leverage cannot be rejected at the 0.05 level.

7.4.3.3 Comparison with prior research

None of the prior research that was reviewed had examined cash flow measures of interest risk and no comparison can therefore be drawn.

7.5 RESULTS OF THE REGRESSIONS BETWEEN BETA AND TIME SERIES FINANCIAL LEVERAGE

7.5.1 Income statement measures

Table 7.14 presents the results of the regressions performed between beta and time series measures of financial leverage (DFL).

Table 7.14: Beta vs. DFL

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
DFL									
Single Co									
first order	-0.235	-1.583	43	0.121	0.145	0.621		NO	
Portfolio-B									
5-company	-0.537	-1.685	7	0.136	0.880	0.741		NO	
3-company	-0.367	-1.422	13	0.179	0.322	0.750		NO	
Portfolio-L									
5-company	-0.631	-2.153	7	0.068	0.105	0.247		NO	
3-company	-0.533	-2.269	13	0.041	0.093	0.899			

DFL = Degree of financial leverage

Comments:

7.5.1.1 Single company level

No significant association was observed in the total regression. The sign of the slope coefficient indicated a negative association, which is opposite to the hypothesised positive relationship. The single company relationship was not well specified and was found to violate the normality assumption. Neither the upper nor lower regressions exhibited significant association with beta.

7.5.1.2 Portfolio level

While significant association with beta was detected in the leverage portfolio regressions, it was not consistent at the 0.05 level. No significance was found in respect of the beta portfolios. As in the single share case, the relationships were unexpectedly found to be negative. In addition, the portfolio regressions were not well specified, with all but one violating the normality assumption. No consistent difference in the association of the upper and lower regressions was evident, none of which were found to be significant.

The null hypothesis of no significant association between beta and time series measures of interest risk financial leverage cannot be rejected.

7.5.1.3 Comparison with prior research

The finding of no consistent significance with a negative association is contrary to **Mandelker & Rhee (1984,p.51)** who found a positive association that was significant at the 0.01 level. The reason for the difference cannot be determined with any certainty. Possible reasons for the difference include:

i. Mandelker & Rhee utilised a twenty year time horizon for their financial leverage measure as opposed to the ten year period utilised by this study, and had a considerably bigger sample size. The smaller sample size (as a result of the small size of the JSE) and the shorter period (utilised as a result of the instability of the twenty year DFL estimated by this study) may have resulted in a mis-specification of the relationship.

ii. The relationship might be dependent upon the magnitude and stability of the interest rate and inflation rate structure in the country, with the higher and more unstable rates in South Africa giving rise to a different relationship.

7.6 SUMMARY

Table 7.15 presents the significance levels of all cross sectional total regressions performed between beta and financial leverage.

Table 7.15: Systematic Risk vs. Financial Leverage: Results' Summary

	Default risk (class I)					Default risk (class II)				Interest risk					
	Bal. sheet			Inc.stat.	C/flow	Bal. sheet		Inc.stat.	C/flow	Bal. sheet		Inc.stat.		C/flow	
Grouping	Tlia / Tass	Atlia / Tass	Tlia / Atass	Ebit / Tlia	Cash2 / Tlia	Nibd / Tass	Anibd / Tass	Ebit / Nibd	Cash2 / Nibd	Ibd / Tass	Ibd/ Atass	Ebit / Ibd	Ebit / Int	Cash2 / Ibd	Cash2 / Int
Single co.															
first order	0.001	0.017	0.002	0.048	0.148	0.016	0.040	0.009	0.273	0.259	0.353	0.413	0.622	0.182	0.515
lagged	0.022	0.016	0.026	0.098	0.227	0.008	0.040	0.077	0.046	0.328	0.363	0.539	0.215	0.236	0.401
average	0.013	0.012	0.017	0.043	0.141	0.008	0.052	0.048	0.004	0.314	0.375	0.731	0.003	0.778	0.002
Portfolio-B															
first order	0.002	0.008	0.003	0.262	0.138	0.004	0.029	0.084	0.291	0.276	0.368	0.592	0.861	0.235	0.384
lagged	0.006	0.022	0.007	0.308	0.661	0.016	0.069	0.319	0.134	0.311	0.337	0.537	0.132	0.132	0.335
average	0.003	0.014	0.005	0.200	0.383	0.009	0.059	0.238	0.038	0.311	0.362	0.863	0.112	0.746	0.061
Portfolio-L															
first order	0.011	0.009	0.018	0.005	0.159	0.007	0.111	0.030	0.178	0.218	0.339	0.476	0.295	0.131	0.163
lagged	0.006	0.075	0.032	0.005	0.059	0.032	0.120	0.093	0.070	0.440	0.444	0.565	0.346	0.351	0.560
average	0.013	0.024	0.006	0.079	0.170	0.020	0.130	0.042	0.031	0.218	0.333	0.475	0.044	0.414	0.023

Bal. sheet = Balance sheet; Inc. stat. = Income statement; C/flow = Cash flow statement.

The class one and two default risk measures indicated similar findings which were markedly different to those of the interest risk measures of leverage. This supports the distinction between the two risks that has been made by this study.

Balance sheet default risk indicated significant levels of positive association at both single company and portfolio levels, and was shown to explain as much as 14% of the variability in beta at the single company level and 53% at the portfolio level. The regressions were well specified with few violations of the OLS assumptions detected. Companies and portfolios with higher betas showed greater association with class one measures of default risk than their lower beta counterparts. **The null hypothesis of no significant association between systematic risk and balance sheet measures of default risk financial leverage is rejected.**

The significant association detected in the income statement measures was neither as consistent nor as strong as the balance sheet associations but was evident in both default risk classes for single companies and leverage portfolios. The results indicated a lack of statistical significance for both classes in respect of the portfolios ranked on beta. This finding could not be explained, especially considering both classes indicated significant association in the beta portfolio full sample regressions. **The null hypothesis of no significant association**

between beta and income statement measures of default risk is rejected for both single companies and leverage portfolios, but not for beta portfolios.

The findings in relation to the cash flow measures differed with respect to the different classes of default risk. The class one cash flow measures indicated no statistical significance. The class two measures found consistent significance in respect of the average regressions only. **The null hypothesis of no significant association between beta and cash flow measures of default risk is not rejected in respect of the class one measures or the contemporaneous and lagged measures of class two, but is rejected in respect of the average class two measures.**

The default risk relationships were found to be consistent across the different measures employed within the financial statement components, although the significance was found to decrease as the outside shareholders were excluded from the balance sheet measures of class two. The explanatory power of the default risk measures was found to increase as companies were aggregated into portfolios which suggests that default risk is undiversifiable. Other than the class to cash flow measures, no pattern of difference was found between the associations of the first order, lagged and average regressions.

In respect of the interest risk measures, no consistent significance was found in the total regressions at either single company or portfolio levels in the balance sheet, income statement or cash flow statement. All regressions exhibited the expected positive association but were distinctly less significant than the default risk measures. While violations of OLS assumptions were detected, and the normality assumption in particular, these were confined to approximately 40% of the regressions and no differences were detected between the regressions which complied with the assumptions and those that did not. **The null hypothesis of no significant association between beta and interest risk financial leverage cannot be rejected for the balance sheet, income statement or cash flow measures.**

The time series measure of financial leverage did not exhibit significant association at the single company level and evidence of significance was only found in one of the leverage portfolios. The regression slope coefficients indicated negative signs which are contrary to

the hypothesised positive association. **The null hypothesis of no significant association between beta and time series financial leverage could not be rejected.**

The findings of this chapter are consistent with prior research (where the specific relationships have been examined by prior research) except in the case of the time series measure. By drawing a distinction between the default and interest risks inherent in financial leverage this study has provided a possible basis for the reconciliation of the findings of prior research.

CHAPTER EIGHT : THE RELATIONSHIP BETWEEN SYSTEMATIC RISK AND OPERATING LEVERAGE

8.1 INTRODUCTION

This chapter examines the relationship between operating leverage and measures of both levered and unlevered systematic risk (beta). The chapter is divided into six sections. The first section specifies the regression variables used in the correlation analysis. The second and third sections present the results of the regressions between levered beta and, respectively, cross sectional and time series measures of operating leverage. Similarly, sections four and five present the results of the regressions between unlevered beta and cross sectional measures, and unlevered beta and time series measures of operating leverage. The chapter is summarised in the sixth section.

8.2 CORRELATION ANALYSIS

The standardised correlation analysis[1] was employed to examine the associations between operating leverage and beta by performing regressions on the variables stated in Table 8.1.

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1 *See Chapter 6, Section 6.3.*

Table 8.1: Beta vs. Operating Leverage : Regression Variables

Risk	Fin. Stat. Component	Independent Var.	Dependent Var.
Operating Leverage	Balance Sheet	FASS / TASS	BETA
		FASS / ATASS	BETA
		FASS / OASS	BETA
	Income Statement	(EBIT+DEPR)/ EBIT	BETA
	Cash Flow	CASH1 / CASH2	BETA
Time Series Operating Lev.	Income Statement	DOL [per eq. (5.2)]	BETA
Operating Leverage	Balance Sheet	FASS / TASS	UNLEVBETA
		FASS / ATASS	UNLEVBETA
		FASS / OASS	UNLEVBETA
	Income Statement	(EBIT+DEPR)/ EBIT	UNLEVBETA
	Cash Flow	CASH1 / CASH2	UNLEVBETA
Time Series Operating Lev.	Income Statement	DOL [per eq. (5.2)]	UNLEVBETA

Lev. = Leverage; Fin. Stat. = Financial Statement; Var = Variable; UNLEVBETA = Unlevered Beta.

The hypothesised direction of association between beta (both levered and unlevered) and operating leverage is positive. The balance sheet, income statement, cash flow and time series based regressions appearing in Table 8.1 are all expected to have positive association as the operating leverage measures examined are all positively associated with operating leverage.

In total 300[2] regressions were performed to test the relationship between beta and operating leverage. The results will be presented in the standardised tables discussed in Section 7.2.2. A plot of the first single company average regression in each table is presented in Appendix 14. The numbering of the graphs corresponds to the numbering of the table containing the regression, i.e. the first single company average regression contained in Table 8.2 will appear as graph 14.2.

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2 *This is calculated as [10(cross sectional measures of leverage) * 3 (single share, beta portfolio and leverage portfolio) * 3 (first order, lagged and average) * 3 (full sample, upper and lower observations)] + [2(time series measure of leverage) * 5 (one single share regression + two leverage portfolio regressions + two beta portfolio regressions) * 3 (total, upper and lower observations)]. This excludes regressions performed in respect of log transformations.*

8.3 RESULTS OF THE REGRESSIONS BETWEEN LEVERED BETA AND CROSS SECTIONAL OPERATING LEVERAGE MEASURES

8.3.1 Balance sheet measures

Table 8.2 presents the results of the regressions performed between beta and balance sheet measures of operating leverage.

Table 8.2: Beta vs. Balance Sheet Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BO1									
Single Co									
first order	-0.054	-0.464	74	0.644	0.169	0.627	NO		
lagged	-0.028	-0.238	74	0.813	0.135	0.971	NO		
average	-0.019	-0.166	74	0.869	0.135	0.616	NO		
Portfolio-B									
first order	-0.192	-0.707	13	0.492	0.481	0.368			
lagged	-0.165	-0.605	13	0.556	0.310	0.338	NO		
average	-0.137	-0.500	13	0.625	0.620	0.373			
Portfolio-L									
first order	-0.134	-0.489	13	0.633	0.288	0.115			
lagged	-0.081	-0.295	13	0.773	0.150	0.919			
average	-0.102	-0.369	13	0.718	0.190	0.737			
BO2									
Single co									
first order	-0.065	-0.564	74	0.574	0.181	0.619	NO		
lagged	-0.032	-0.272	74	0.787	0.136	0.957	NO		
average	-0.026	-0.223	74	0.824	0.139	0.610	NO		
Portfolio-B									
first order	-0.220	-0.813	13	0.431	0.460	0.775	NO		
lagged	-0.178	-0.652	13	0.525	0.288	0.353	NO		
average	-0.156	-0.569	13	0.579	0.283	0.408			
Portfolio-L									
first order	-0.155	-0.565	13	0.582	0.241	0.446		NO	
lagged	-0.073	-0.264	13	0.796	0.312	0.847			
average	-0.104	-0.377	13	0.712	0.424	0.676			
BO3									
Single co									
first order	-0.046	-0.392	74	0.696	0.098	0.089	NO		
lagged	-0.032	-0.278	74	0.782	0.130	0.642	NO		
average	-0.023	-0.200	74	0.842	0.228	0.321	NO		
Portfolio-B									
first order	-0.156	-0.569	13	0.579	0.880	0.493			
lagged	-0.176	-0.643	13	0.531	0.692	0.344			
average	-0.137	-0.499	13	0.626	0.785	0.329			
Portfolio-L									
first order	-0.146	-0.531	13	0.604	0.077	0.123		NO	
lagged	-0.121	-0.439	13	0.668	0.109	0.805		NO	
average	-0.077	-0.280	13	0.784	0.408	0.390			

BO1 = Fass / Tass
BO2 = Fass / Atass
BO3 = Fass / Oass

Comments:

8.3.1.1 Single company level

No significant association was found in any of the single company total regressions. The lowest significance probability level was found to be 0.574, with all total regressions indicating negative association. This association is contrary to the hypothesised positive association.

The total regressions were not well specified as they consistently violated the assumption of homoscedasticity. The consistent violation of this assumption should result in caution in the interpretation of significance levels. However, the association is so weak that the existence of heteroscedasticity is unlikely to have caused consistently significant associations to be mis-stated (i.e. a Type II error).

The presence of heteroscedasticity is likely to have been caused by the difference in the associations of the upper and lower regressions. The upper regressions reflected consistently lower residual sum of squares than the lower regressions and this resulted in a statistically significant Goldfeld-Quandt F-statistic. Although the upper regressions indicate consistently lower significance probability levels than the lower regressions, they do not indicate any statistically significant association.

8.3.1.2 Portfolio level

The portfolio findings were similar to those of the single companies. No significance was detected in any of the total regressions and the lowest significance probability level was found to be 0.43. The portfolios returned a consistently negative association which was independent of the basis of calculating the portfolios.

The portfolio regressions indicated less frequent violations of the OLS assumptions than the single company regressions. Three of the eighteen total regressions were found to violate the

homoscedasticity assumption and the same number violated the normality assumption. As in the single company case, these OLS assumption violations are unlikely to have induced the level of insignificance which was found. The absence of any considerable change in association as shares are grouped into portfolios, and heteroscedasticity is aggregated away, corroborates the suggestion that the heteroscedasticity was unlikely to have caused a significant association in the single company case to be mis-stated. No consistent pattern was evident in the association of the upper and lower regressions or the first order, lagged and average regressions.

In respect of both single company and portfolio regressions, the balance sheet ratios indicated consistent results with beta and were not affected by the different asset denominators that were employed. The null hypothesis of no significant association between beta and balance sheet measures of operating leverage cannot be rejected.

8.3.1.3 Comparison with prior research

Although the insignificant negative association is contrary to the hypothesised relationship it is consistent with the findings of the majority of prior empirical research, including **Dhingra (1982,p.195)** and **Rosenberg & McKibben (1973,p.325)**.

8.3.2 Income statement measures

Table 8.3 presents the results of the regressions performed between beta and the income statement measure of operating leverage.

Table 8.3: Beta vs. Income Statement Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
ISOL1									
Single Co									
first order	0.026	0.220	70	0.826	0.465	0.651			
lagged	0.209	1.788	70	0.078	0.792	0.855			
average	0.046	0.387	70	0.700	0.116	0.915			
Portfolio-B									
first order	-0.105	-0.367	12	0.720	0.250	0.041			
lagged	0.311	1.134	12	0.279	0.882	0.932		NO	
average	-0.039	-0.134	12	0.896	0.245	0.390			
Portfolio-L									
first order	0.156	0.548	12	0.594	0.601	0.096		NO	
lagged	0.394	1.484	12	0.164	0.682	0.346		NO	
average	0.209	0.741	12	0.473	0.078	0.312		NO	

ISOL1 = (Ebit + Depr) / Ebit

Comments:

8.3.2.1 Single company level

No significant association was detected in the total regressions. The lagged regression indicated a greater degree of association than the first order and average regressions but was not significant at the 0.05 level. Contrary to the balance sheet regressions, the associations were all found to be positive, as hypothesised. The regressions were well specified with no violations of the OLS assumptions being recorded. No consistent difference was found in the associations between the upper and lower regressions.

8.3.2.2 Portfolio level

No significant association was detected in the total relationships. This is well illustrated by the average significant probability level of 0.521. The sign of the regression slope coefficients was found to vary amongst the regressions, although the majority indicated

positive association. The total regressions were not well specified as a result of violations of the normality assumption. No consistent difference in the significance of the upper and lower regressions was detected. As in the single company case, the lagged regressions consistently exhibited the greatest association but were not found to be significant.

The null hypothesis of no significant association between beta and income statement measures of operating leverage cannot be rejected at the 0.05 level.

8.3.2.3 Comparison with prior research

The lack of significant association is consistent with the findings of **Rosenberg & McKibben (1973,p.325)** who are the only other study reviewed to examine cross sectional income statement measures. Unfortunately the authors do not indicate the direction of the association.

8.3.3 Cash flow measures

Table 8.4 presents the results of the regressions performed between beta and the cash flow measure of operating leverage.

Table 8.4: Beta vs. Cash Flow Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFOL1									
Single Co									
first order	0.042	0.353	70	0.725	0.954	0.912			
lagged	-0.077	-0.642	70	0.523	0.060	0.061			
average	-0.042	-0.354	70	0.724	0.405	0.376			
Portfolio-B									
first order	0.139	0.488	12	0.634	0.748	0.488		NO	
lagged	-0.265	-0.953	12	0.359	0.959	0.525		NO	
average	-0.140	-0.489	12	0.634	0.275	0.760		NO	
Portfolio-L									
first order	0.211	0.748	12	0.469	0.211	0.205		NO	
lagged	-0.022	-0.075	12	0.942	0.124	0.894		NO	
average	0.057	0.198	12	0.846	0.442	0.913		NO	

CFOL1 = Cash1 / Cash2

Comments:

8.3.3.1 Single company level

No significant association was found in the total regressions with the lowest significance probability level found to be in excess of 0.50. The direction of the association of the total regressions was found to vary, with the majority exhibiting unexpected negative associations. The total regressions were well specified and no violations of OLS assumptions were recorded. The upper and lower regressions exhibited similar associations and no statistical significance was detected in either.

8.3.3.2 Portfolio level

No significant association was found in any of the total, upper or lower regressions. The direction of the associations was found to vary with equal occurrence of both positive and negative association. The total regressions consistently violated the normality assumption.

The violations were not consistent but the majority related to negative kurtosis. No consistent difference was evident between the associations of the upper and lower regressions.

The null hypothesis of no significant association between beta and cash flow measures of operating leverage cannot be rejected at the 0.05 level.

8.3.4.3 Comparison with prior research

None of the prior research reviewed had examined the relationship between cash flow measures of operating leverage and levered beta and no comparisons can therefore be drawn

8.4 RESULTS OF THE REGRESSIONS BETWEEN LEVERED BETA AND TIME SERIES MEASURES OF OPERATING LEVERAGE

8.4.1 Income statement measures

Table 8.5 presents the results of the regressions performed between beta and the time series measure of operating leverage (DOL).

Table 8.5: Beta vs. DOL

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
DOL									
Single Co									
first order	-0.115	-0.759	43	0.452	0.796	0.944			
Portfolio-B									
5-company	-0.306	-0.849	7	0.424	0.205	0.361			
3-company	-0.215	-0.792	13	0.442	0.736	0.261			
Portfolio-L									
5-company	-0.430	-1.258	7	0.249	0.821	0.027	NO	NO	
3-company	-0.214	-0.791	13	0.443	0.969	0.890		NO	

DOL = Degree of operating leverage

Comments:

8.4.1.1 Single company level

No significant association was found in the total regression and no violations of the OLS assumptions were detected. The direction of the association was negative which is opposite to the hypothesised positive association, but is consistent with the association exhibited by the other operating leverage measures in this study. Neither the upper nor lower regressions exhibited significant association.

8.4.1.2 Portfolio level

No significant association was found in the total regressions and all associations were found to be negative. The leverage portfolio regressions were not well specified with violations of both the normality and homoscedasticity assumptions being recorded. Although significance was found in one of the lower regressions, no consistent difference in significance was evident between the upper and lower regressions.

The null hypothesis of no significant association between beta and time series measures of operating leverage cannot be rejected at the 0.05 level.

8.4.1.3 Comparison with prior research

The finding of a negative association with no significance is not consistent with the findings of studies by **Mandelker & Rhee (1984,p.523)** and **Lev (1974,p.636)**, both of which found a significant positive association. The time series measurement of Lev's operating leverage measure was quite different to that employed by this study and his sample consisted only of American utility companies. The differences with Lev's findings could therefore be as a result of the different time series variables measuring different factors, or a lack of applicability of his findings to the different and considerably broader sample used in this study.

The difference with Mandelker and Rhee's findings are not as easily reconciled and can not be determined with certainty. Although the authors detected statistical significance, their reported r^2 was only 10.4% at the portfolio level and did not indicate significant explanatory power. The highest r^2 in Table 8.5 in this study was 18.5%, based on an insignificant relationship. Two possible reasons for the differences are discussed Chapter 7, Section 7.5.3 and these apply equally to this section.

8.5 RESULTS OF THE REGRESSIONS BETWEEN UNLEVERED BETA AND CROSS SECTIONAL OPERATING LEVERAGE MEASURES

8.5.1 Balance sheet measures

Table 8.6 presents the results of the regressions performed between unlevered beta and balance sheet measures of operating leverage.

Table 8.6: Unlevered Beta vs. Balance Sheet Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BO1									
Single Co									
first order	0.511	5.074	73	0.000	0.203	0.708			
lagged	0.481	4.685	73	0.000	0.157	0.629			
average	0.519	5.184	73	0.000	0.089	0.959			
Portfolio-B									
first order	0.782	4.520	13	0.001	0.099	0.068		NO	
lagged	0.764	4.272	13	0.001	0.090	0.125		NO	
average	0.790	4.638	13	0.000	0.067	0.101		NO	
Portfolio-L									
first order	0.766	4.292	13	0.001	0.045	0.897	NO	NO	
lagged	0.825	5.262	13	0.000	0.099	0.857			
average	0.811	4.994	13	0.000	0.095	0.782			
BO2									
Single co									
first order	0.513	5.107	73	0.000	0.166	0.984			
lagged	0.482	4.697	73	0.000	0.134	0.623			
average	0.522	5.224	73	0.000	0.069	0.828			
Portfolio-B									
first order	0.786	4.587	13	0.001	0.086	0.057		NO	
lagged	0.769	4.341	13	0.001	0.078	0.117		NO	
average	0.795	4.728	13	0.000	0.056	0.091		NO	
Portfolio-L									
first order	0.789	4.635	13	0.000	0.005	0.842	NO	NO	
lagged	0.787	4.599	13	0.000	0.234	0.772		NO	
average	0.731	3.865	13	0.002	0.278	0.690		NO	
BO3									
Single co									
first order	0.543	5.529	73	0.000	0.128	0.075			
lagged	0.513	5.101	73	0.000	0.128	0.866			
average	0.541	5.499	73	0.000	0.053	0.721			
Portfolio-B									
first order	0.823	5.214	13	0.000	0.027	0.067		NO	
lagged	0.814	5.044	13	0.000	0.013	0.052		NO	
average	0.826	5.285	13	0.000	0.010	0.060		NO	
Portfolio-L									
first order	0.805	4.892	13	0.000	0.164	0.311		NO	
lagged	0.851	5.854	13	0.000	0.229	0.654			
average	0.764	4.275	13	0.001	0.208	0.726			

BO1 = Fass / Tass
BO2 = Fass / Atass
BO3 = Fass / Oass

Comments:

8.5.1.1 Single company level

The total regressions indicated high levels of association with all of the significance probability levels found to be less than 0.000. Balance sheet operating leverage was found to explain as much as 30% (0.543^2) of the variability in the single company unlevered beta. All of the total regressions were found to be well specified with no violations of the OLS assumptions and all indicated the hypothesised positive association. The high degree of positive association contrasts sharply with the relationship between the same balance sheet measures and levered beta, which indicated no significance and a negative direction.

No consistent difference was detected between the significance of the upper and lower regressions, none of which were significant at the 0.05 level. As all total regressions were significant beyond the 0.000 level, no difference was detected in the association of the first order, lagged and average relationships.

8.5.1.2 Portfolio level

The portfolio regressions indicated high levels of association with the highest significance probability level recorded as 0.002. The balance sheet measures of operating leverage were found to explain as much as 72% (0.851^2) of the variability in unlevered beta. As in the single company case, all total regressions exhibited the hypothesised positive association.

The portfolio total regressions were not as well specified as those of the single companies. Two thirds of the regressions were found to violate the assumption of normality in the residuals, and heteroscedasticity was present in two of the regressions. The violations were more prevalent amongst the portfolios ranked on the unlevered beta.

While any violation of a regression assumption is a cause for concern, in this instance the violation of normality has taken place in a regression with only 15 observations where the

ungrouped observations were not found to violate the assumption. The violation may have been induced by a combination of the grouping procedure and small sample size. When this is considered together with the magnitude of the single company associations, it is unlikely that the normality violation has falsely induced significance into the portfolio regressions.

Differences were detected between the associations of the upper and lower regressions. While the upper regressions consistently indicated greater association than the lower regressions, only five of the eighteen upper regressions were statistically significant. Although the difference in association was greater for the leverage portfolios, more of the unlevered beta portfolios indicated significance in the upper regressions.

To further test the dependence of the associations on the level of unlevered beta, the upper and lower regressions were repeated for both single companies and portfolios, based on rankings of unlevered beta. All of the single company and beta portfolio upper regressions were significant beyond the 0.005 level, while none of the lower regressions were significant. This suggests that the association is stronger for firms with higher unlevered betas and was probably masked in Table 8.6 by the upper and lower distinction based on operating leverage.

In respect of both single company and portfolio regressions, the balance sheet ratios indicated consistent results with beta and were not affected by the different asset denominators that were employed. The null hypothesis of no significant association between unlevered beta and balance sheet measures of operating leverage is rejected at the 0.05 level.

8.5.2 Income statement measures

Table 8.7 presents the results of the regressions performed between unlevered beta and the income statement measure of operating leverage.

Table 8.7: Unlevered Beta vs. Income Statement Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
ISOL1									
Single Co									
first order	0.129	1.085	69	0.282	0.775	0.456			
lagged	0.097	0.808	69	0.422	0.775	0.014			
average	0.127	1.067	69	0.290	0.949	0.202			
Portfolio-B									
first order	0.264	0.946	12	0.363	0.291	0.136			
lagged	0.189	0.665	12	0.519	0.668	0.091			
average	0.295	1.070	12	0.306	0.747	0.279			
Portfolio-L									
first order	0.346	1.276	12	0.226	0.968	0.189			
lagged	0.184	0.649	12	0.528	0.832	0.091			
average	0.409	1.551	12	0.147	0.702	0.162		NO	

ISOL1 = (Ebit + Depr)/ Ebit

Comments:

8.5.2.1 Single company level

None of the total regressions indicated significant association and the average significance probability level was 0.33. The total regressions exhibited the expected positive association. This finding is consistent with the balance sheet regressions and, as in the balance sheet measures, contrasts the finding of a negative association between the levered measure of beta and operating leverage.

None of the regressions violated any of the tested OLS assumptions. Although the lower regressions exhibited lower significance probability levels than the upper regressions, none were found to be significant.

8.5.2.2 Portfolio level

The portfolio results were similar to those of the single companies. No significant association was detected in any of the total regressions. The total associations showed the expected positive slope coefficients and were well specified with the exception of one violation of the normality assumption. None of the upper or lower regressions indicated significant association.

The null hypothesis of no significant association between unlevered beta and income statement measures of operating leverage cannot be rejected at the 0.05 level.

8.5.3 Cash flow measures

Table 8.8 presents the results of the regressions performed between unlevered beta and the cash flow measure of operating leverage.

Table 8.8: Unlevered Beta vs. Cash Flow Operating Leverage

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFOL1									
Single Co									
first order	-0.115	-0.966	69	0.338	0.269	0.521			
lagged	-0.071	-0.589	69	0.558	0.006	0.472			
average	-0.256	-2.204	69	0.031	0.000	0.068			
Portfolio-B									
first order	-0.313	-1.141	12	0.276	0.182	0.433		NO	
lagged	-0.251	-0.898	12	0.387	0.845	0.934			
average	-0.661	-3.048	12	0.010	0.216	0.301		NO	
Portfolio-L									
first order	-0.100	-0.348	12	0.734	0.990	0.406			
lagged	-0.072	-0.249	12	0.808	0.009	0.469		NO	
average	-0.274	-0.988	12	0.343	0.025	0.182			

CFOL1 = Cash1 / Cash2

Comments:

8.5.3.1 Single company level

Although one of the three total regressions was found to be significant, this appears to be somewhat of an aberration when it is considered that the lowest significance probability level of the remaining regressions is in excess of 0.30. In contradiction to the balance sheet and income statement regressions, the cash flow regressions indicated unexpected negative association. The regressions were found to be well specified with no violations of the OLS assumptions. The upper regressions exhibited greater association than the lower regressions and two of the three upper regressions were statistically significant.

8.5.3.2 Portfolio level

As in the single company case, no consistently significant association was found in the total regressions and all associations were negative in direction. The portfolio regressions were not well specified with half of them violating the normality assumption.

No difference was found between the upper and lower regressions in respect of the beta portfolios, but the leverage portfolios confirmed the single company finding of greater significance for the upper regressions, although this was not consistently observed. The existence of significant negative association for companies with high operating leverage is contrary to both theory and the balance sheet and income statement findings. The reason for this cannot be determined with certainty, but it may be that the cash flow operating leverage proxy is inappropriate.

The inconsistency of the findings is evidenced by the statistical significance for the lagged and average upper regressions in respect of the leverage portfolio relationships, while the corresponding first order regression indicates a significance probability level of 0.990. The null hypothesis of no significant association between unlevered beta and cash flow measures of operating leverage cannot be rejected at the 0.05 level.

8.6 RESULTS OF THE REGRESSIONS BETWEEN UNLEVERED BETA AND TIME SERIES MEASURES OF OPERATING LEVERAGE

8.6.1 Income statement measures

Table 8.9 presents the results of the regressions performed between unlevered beta and the time series measures of operating leverage (DOL).

Table 8.9: Unlevered Beta vs. DOL

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
DOL									
Single Co									
first order	0.136	0.902	43	0.372	0.491	0.680			
Portfolio-B									
5-company	0.421	1.227	7	0.259	0.319	0.832	NO	NO	
3-company	0.321	0.896	13	0.400	0.704	0.706			
Portfolio-L									
5-company	0.475	1.429	7	0.196	0.172	0.382			
3-company	0.311	1.181	13	0.259	0.367	0.466			

DOL = Degree of operating leverage

Comments:

8.6.1.1 Single company level

The single company regression indicated the expected positive association, but was not statistically significant. The total regression was well specified with no detected violations of the OLS assumptions. Neither the upper nor lower regressions exhibited significant association.

8.6.1.2 Portfolio level

None of the total regressions indicated significant association. The total associations were positive in direction and were found to be well specified with the exception of one violation of normality. No consistent difference was found in the significance of the upper and lower regressions, none of which were significant. The association was found to increase as the portfolio size increased from three to five shares, although neither were statistically significant.

The finding of a consistently positive relationship between DOL and unlevered beta contrasts the unexpected negative association between DOL and the levered measure of beta. The null hypothesis of no significant association between unlevered beta and time series measures of operating leverage cannot be rejected at the 0.05 level.

8.7 SUMMARY

Table 8.10 presents the significance probability levels of the total regressions performed between cross sectional measures of operating leverage and both levered and unlevered beta. The time series measures have not been included in the table as a result of their different format.

Table 8.10: Systematic Risk vs. Operating Leverage: Results' Summary

	Levered Beta					Unlevered Beta				
	Bal. sheet			Inc.stat.	C/flow	Bal. sheet			Inc.stat.	C/flow
Grouping	Fass / Tass	Fass / Atass	Fass / Oass	(Ebit+ Dep)/ Ebit	Cash1 / Cash2	Fass / Tass	Fass / Atass	Fass / Oass	(Ebit+ Dep)/ Ebit	Cash1 / Cash2
Single Co.										
first order	0.644	0.574	0.696	0.826	0.725	0.000	0.000	0.000	0.282	0.338
lagged	0.813	0.787	0.782	0.078	0.523	0.000	0.000	0.000	0.422	0.558
average	0.869	0.824	0.842	0.700	0.724	0.000	0.000	0.000	0.290	0.031
Portfolio-B										
first order	0.492	0.431	0.579	0.720	0.634	0.001	0.001	0.000	0.363	0.276
lagged	0.556	0.525	0.531	0.279	0.359	0.001	0.001	0.000	0.519	0.387
average	0.625	0.579	0.626	0.896	0.634	0.000	0.000	0.000	0.306	0.010
Portfolio-L										
first order	0.633	0.582	0.604	0.594	0.469	0.001	0.000	0.000	0.226	0.734
lagged	0.773	0.796	0.668	0.164	0.942	0.000	0.000	0.000	0.528	0.808
average	0.718	0.712	0.784	0.473	0.846	0.000	0.002	0.001	0.147	0.343

Bal. sheet = Balance sheet; Inc stat. = Income statement; C/flow = Cash flow statement.

The income statement and time series measures of operating leverage did not indicate significant association in respect of the regressions with either levered or unlevered beta. The regressions on levered beta indicated an unexpected negative association while those on unlevered beta showed positive association, although the income statement regressions were found to vary with respect to direction. These regressions were well specified with few detected violations of the OLS assumptions. **The null hypothesis of no significant association between operating leverage and both levered and unlevered beta cannot be rejected in respect of income statement and time series measures of operating leverage.**

The cash flow measures of operating leverage did not indicate significant association in the total regressions and exhibited negative slope coefficients with both the levered and unlevered beta. As in the income statement and time series measures, these regressions were well specified with few violations of the OLS assumptions. The regression on unlevered beta indicated greater association for the higher leverage companies and leverage portfolios than their lower leverage counterparts. These upper regressions showed statistical significance, although not consistently. This finding is inconsistent with the rest of the results in this

chapter and cannot be explained. **The null hypothesis of no significant association between cash flow measures of operating leverage and both levered and unlevered beta cannot be rejected.**

No significant association was detected between the balance sheet measures of operating leverage and levered beta, with the lowest significance probability level found to be 0.574. All of the associations with beta indicated an unexpected negative association which was shown to be consistent with the majority of prior research.

The ability to draw conclusions on the balance sheet relationship with levered beta was compromised by the presence of heteroscedasticity in the single company regressions. However, the associations were so consistently weak, and did not improve as aggregation into portfolios eliminated the heteroscedasticity, that the lack of significance is unlikely to have been induced by the heteroscedasticity. The heteroscedasticity was likely to have been caused by the difference in the associations of the upper and lower regressions, none of which were statistically significant. **The null hypothesis of no significant association between balance sheet operating leverage and beta cannot therefore be rejected.**

On the other hand, the results indicated a highly significant association between unlevered beta and balance sheet measures of operating leverage. Operating leverage was shown to explain as much as 29% of the variability in unlevered beta at the single company level, and 72% at the portfolio level. The association was found to be positive and the explanatory power of operating leverage increased as aggregation into portfolios took place. This suggests that operating leverage is an undiversifiable risk. No consistent difference was detected between the significance of the upper and lower balance sheet regressions or the first order, lagged and average regressions. **The null hypothesis of no significant association is rejected between unlevered beta and balance sheet operating leverage.**

In conclusion it is necessary to explain why the finding of a negative relationship with levered beta (although not significant) and a positive relationship with unlevered beta may be consistent with theory. The **Hamada (1969,p.29)** and **Rubenstein (1973,p.167)**

formulations[3] state that levered beta is a positive function of the unlevered beta and the ratio of the company's market value of equity to its market value of debt plus equity. **Lev (1974,p.632)** and **Brealey & Myers (1991,p.200)**, in turn, have shown that unlevered beta is a positive function of operating leverage.

In a static, *ceteris paribus* enviroment, this would suggest that the higher the operating leverage, the higher the unlevered beta and consequently the higher the levered beta. However, a negative (or reduced significance) relationship between operating leverage and levered beta could occur if the change in the operating leverage precipitated, or was accompanied by, a decrease in the use of a variable which was positively related to beta, like default risk financial leverage. In this dynamic scenario, the increase in operating leverage increases the unlevered beta but the accompanying decrease in financial leverage, if sufficient enough, reduces the levered beta or off-sets any increase that may have occurred .

Thus if companies were found to trade operating and financial leverage off against each other it would provide an explanation for the results presented which is theoretically consistent. This trade-off hypothesis is examined in the next chapter (Chapter Nine).

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3 *See Chapter 2, Section 2.6.*

CHAPTER NINE : THE TRADE-OFF BETWEEN OPERATING AND FINANCIAL LEVERAGE

9.1 INTRODUCTION

This chapter examines the relationship between operating and financial leverage and is divided into five sections. The first section specifies the regression variables employed in the correlation analysis. Sections two and three present the results of the regressions between operating leverage and, respectively, cross sectional measures of default risk and interest risk financial leverage. The fourth section details the results of the time series measures of operating and financial leverage. The chapter is concluded with a summary of the results and interpretation in the fifth section.

9.2 CORRELATION ANALYSIS

The standardised correlation analysis[1] was employed to examine the associations between operating and financial leverage by performing regressions on the variables stated in Table 9.1.

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1 *See Chapter 6, Section 6.3.*

Table 9.1: Operating Leverage vs. Financial Leverage : Regression Variables

Risk Trade-off	Fin. Stat. Component	Independent Var.	Dependent Var.
Operating Leverage vs. Default Risk (Class I) Financial Leverage	Balance Sheet	FASS / TASS	TLIA / TASS
		FASS / TASS	TLIA / EQUITY
		FASS / OASS	TLIA / TASS
	Income Statement	(EBIT+DEPR) / EBIT	EBIT / TLIA
	Cash Flow	CASH1 / CASH2	CASH2 / TLIA
Operating Leverage vs. Default Risk (Class II) Financial Leverage	Balance Sheet	FASS / TASS	NIBD / TASS
		FASS / TASS	NIBD / EQUITY
		FASS / OASS	NIBD / TASS
	Income Statement	(EBIT+DEPR) / EBIT	EBIT / NIBD
	Cash Flow	CASH1 / CASH2	CASH2 / NIBD
Operating Leverage vs. Interest Risk Financial Leverage	Balance Sheet	FASS / TASS	IBD / TASS
		FASS / TASS	IBD / EQUITY
		FASS / OASS	IBD / TASS
	Income Statement	(EBIT+DEPR) / EBIT	EBIT / IBD
		(EBIT+DEPR) / EBIT	EBIT / INT
	Cash Flow	CASH1 / CASH2	CASH2 / IBD
		CASH1 / CASH2	CASH2 / INT
Time Series (DOL vs. DFL)	Income Statement	DOL [per eq. (5.2)]	DFL [per eq. (5.3)]

Fin. Stat. = Financial Statements; Var. = Variable.

Operating leverage was regarded as the independent variable for the purposes of the regressions. The reason for this is that the asset/cost structure decision is often made prior to the financing decision and offers less flexibility once made.

The hypothesised direction of association between financial and operating leverage is negative. The balance sheet based regressions appearing in Table 9.1 are all expected to have negative association as the operating and financial leverage ratios examined are positively associated with operating and financial leverage respectively. However, the income statement and cash flow based regressions are all expected to exhibit positive association as the financial

leverage ratios are negatively associated with financial leverage while those relating to operating leverage are positively related. The time series regressions are expected to exhibit negative association as both time series measures are positively associated with their leverage counterparts.

The ratios containing adjusted debt numerators or adjusted asset denominators were not examined in the trade off between operating and financial leverage as the adjustments were found to have little, if any, effect on the relationships with beta. The equity denominated ratios were examined to eliminate potential spurious correlation which may have been induced as a result of using total assets as a denominator in both the dependent and independent variables.

In total 474[2] regressions were performed to test the relationship between operating and financial leverage. The results will be presented in the standardised tables discussed in Section 7.2.2. A plot of the first single company average regression in each table is contained in Appendix 15. The numbering of the graphs corresponds to the numbering of the table containing the regression, i.e. the first single company average regression contained in Table 9.2 will appear as graph 15.2.

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2 *This is calculated as [17(cross sectional measures of leverage) * 3 (single share, beta portfolio and leverage portfolio) * 3 (first order, lagged and average) * 3 (full sample, upper and lower observations)]+ [1(time series measure of leverage) * 5 (one single share regression + two leverage portfolio regresions + two beta portfolio regressions) * 3 (total, upper and lower observations)]. This excludes regressions performed in respect of logarithmic transformations.*

9.3. RESULTS OF THE REGRESSIONS BETWEEN OPERATING LEVERAGE AND DEFAULT RISK FINANCIAL LEVERAGE

9.3.1 OPERATING LEVERAGE VERSUS DEFAULT RISK FINANCIAL LEVERAGE (CLASS ONE)

9.3.1.1. Balance sheet measures

Table 9.2 presents the results of the regressions performed between the balance sheet measures of operating leverage and default risk financial leverage (class one).

Table 9.2: Operating Leverage vs. Balance Sheet Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL1-BOL1									
Single Co									
first order	-0.555	-5.737	74	0.000	0.004	0.951		NO	
lagged	-0.505	-5.028	74	0.000	0.003	0.994			
average	-0.542	-5.549	74	0.000	0.001	0.440	NO		
Portfolio-B									
first order	-0.456	-1.847	13	0.088	0.770	0.181		NO	
lagged	-0.380	-1.481	13	0.162	0.773	0.274		NO	
average	-0.432	-1.729	13	0.107	0.846	0.316		NO	
Portfolio-L									
first order	-0.846	-5.721	13	0.000	0.016	0.954			
lagged	-0.815	-5.074	13	0.000	0.085	0.806			
average	-0.912	-8.036	13	0.000	0.000	0.599		NO	
BFL4-BOL1									
Single co									
first order	-0.457	-4.294	70	0.000	0.119	0.558	NO	NO	
lagged	-0.438	-4.072	70	0.000	0.016	0.427	NO	NO	
average	-0.394	-3.589	70	0.001	0.026	0.243	NO	NO	
Portfolio-B									
first order	-0.288	-1.041	12	0.318	0.657	0.858		NO	
lagged	-0.207	-0.732	12	0.478	0.048	0.525			
average	-0.394	-1.484	12	0.164	0.902	0.268			
Portfolio-L									
first order	-0.814	-4.854	12	0.000	0.003	0.622	NO	NO	
lagged	-0.798	-4.583	12	0.001	0.023	0.642		NO	
average	-0.810	-4.787	12	0.000	0.098	0.098			
BFL1-BOL2									
Single co									
first order	-0.564	-5.868	74	0.000	0.001	0.151		NO	
lagged	-0.524	-5.293	74	0.000	0.001	0.449			
average	-0.553	-5.706	74	0.000	0.000	0.275			
Portfolio-B									
first order	-0.383	-1.495	13	0.159	0.989	0.418		NO	
lagged	-0.343	-1.319	13	0.210	0.640	0.257		NO	
average	-0.374	-1.455	13	0.169	0.690	0.248		NO	
Portfolio-L									
first order	-0.728	-3.831	13	0.002	0.001	0.459	log(-5.5)	NO	
lagged	-0.843	-5.644	13	0.000	0.004	0.466		NO	
average	-0.855	-5.932	13	0.000	0.020	0.647			

BFL1-BOL1 = Tlia / Tass versus Fass / Tass
BFL4-BOL1 = Tlia / Equity versus Fass / Tass
BFL1-BOL2 = Tlia / Tass versus Fass / Oass

Comments:

9.3.1.1.1 Single company level

A highly significant association was evident in the total regressions with an average significance probability level of 0.000. Operating leverage was found to explain as much as 32% (0.564^2) of the variability in default risk financial leverage. All of the total regressions indicated the expected negative association.

A marked difference was evident between the associations of the upper and lower regressions. All but one of the upper regressions indicated significant association and they recorded an average significance probability of 0.019. None of the lower regressions indicated significant association and recorded an average significance probability level of 0.50. This suggests that companies with higher operating leverage engage in trade-offs more actively than their lower operating leverage counterparts.

The total regressions were not well specified. This was evident in the BFL4-BOL1 relationship in particular where violations of both normality and homoscedasticity assumptions were recorded.

9.3.1.1.2 Portfolio level

The portfolio associations were dependent on the portfolio ranking procedure. The portfolios ranked on the basis of operating leverage exhibited highly significant association. Operating leverage was shown to explain as much as 83% (0.912^2) of the variability in default risk financial leverage. The leverage portfolios exhibited a consistently negative slope coefficient, as expected. As in the single company regressions, the leverage portfolios found significant association in the upper regressions, with no significant association evident in the lower regressions. This corroborates the suggestion that high operating leverage companies engage more actively in trade-offs of financial and operating leverage.

The beta portfolios, although negatively associated, did not indicate significant association. This lack of statistical significance does not contradict the findings of the single company and leverage portfolio regressions. Chapter Seven found no evidence of a significant association between operating leverage and beta and that any association that does exist is negative. Beta rankings are therefore unlikely to correspond with the operating leverage rankings. This results in high operating leverage companies being grouped with medium and low operating leverage companies and averaging of both the dependent and independent variables. The high levels of significant negative association which were found in high operating leverage companies may have been averaged away by the grouping procedure based on beta.

The relationships were found to be consistent across the various balance sheet definitions of operating and financial leverage. The evidence of statistical significance across different denominators indicates that the correlation is unlikely to have been spuriously induced by the use of a total asset denominator in both the dependent and independent variables.

The total regressions were not well specified, particularly in the beta portfolios where violations of normality were prevalent. The incidence of heteroscedasticity was limited to one regression, which was considerably less than that found in the single company regressions.

Caution should be exercised in interpreting the results in the presence of OLS violations. However, these violations were not consistent in the single company and leverage portfolios and their presence did not appear to have any impact on the pattern of significant association. The heteroscedasticity is likely to have been caused by the difference between the association of the upper and lower regressions and was found to reduce significantly as a result of portfolio formation without changes in the significance of the association. It is submitted that the violations of the OLS assumptions were unlikely to have induced the high levels of significant association in otherwise statistically insignificant relationships.

The null hypothesis of no significant association between balance sheet measures of operating leverage and default risk financial leverage (class one) is therefore rejected at the 0.05 level.

9.3.1.1.3 Comparison with prior research

The finding of a significant negative relationship in the Tlia / Tass versus Fass / Tass (i.e. BFL1-BOL1) regression is consistent with the findings of **Ferri & Jones (1979,p.631)** who found significance at the 0.05 level. The negative association found by this study is also consistent with the direction of the association found by **Jordaan, Hamman & Smit (1994,p.21)**. It is not possible to determine comparative significance probability levels in respect of the Jordaan et al study.

9.3.1.2 Income statement measures

Table 9.3 presents the results of the regressions performed between income statement measures of operating leverage and default risk financial leverage (class one).

Table 9.3: Operating Leverage vs. Income Statement Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL1-IOL1									
Single Co									
first order	-0.226	-1.883	66	0.064	0.593	0.898		NO	
lagged	-0.329	-2.830	66	0.006	0.131	0.295		NO	
average	-0.178	-1.469	66	0.146	0.306	0.310		NO	
Portfolio-B									
first order	-0.359	-1.277	11	0.228	0.246	0.445		NO	
lagged	-0.495	-1.887	11	0.086	0.053	0.821	NO	NO	
average	-0.324	-1.137	11	0.280	0.810	0.271		NO	
Portfolio-L									
first order	-0.662	-2.929	11	0.014	0.415	0.021		NO	
lagged	-0.795	-4.347	11	0.001	0.135	0.596			
average	-0.534	-2.096	11	0.060	0.363	0.218			

IFL1-IOL1 = Ebit / Tlia versus (Ebit + Depr) / Ebit

Comments:

9.3.1.2.1 Single company level

No consistent significant association was found in the total regressions. Statistical significance was found in respect of the lagged regression, but not in either of the first order or average regressions. The associations were found to be consistently negative which is contrary to the positive association that was hypothesised. None of the total regressions were well specified as they repeatedly violated the normality assumption. No consistent difference was detected in the association of the upper and lower regressions, none of which indicated significance.

9.3.1.2.2 Portfolio level

As in the single company case, significant association was detected but was not consistent at the 0.05 level. The significant association was found in the leverage portfolios and none was evident in respect of the beta portfolios. The total regressions were not well specified, particularly with respect to the beta portfolios which all violated the assumption of normality. No consistent difference was found between the association of the upper and lower regressions, only one of which was significant at the 0.05 level. The lagged relationship exhibited greater association than either the first order or average associations.

As in the single company case, the portfolio regressions returned consistently negative slope coefficients. This does not necessarily imply a positive relationship between operating leverage and default risk financial leverage, and may just represent a non significant relationship. This is as a result of a shortcoming in the regression variables. A company with a given level of default risk debt and a given income before fixed costs (depreciation) that increases its fixed assets and therefore fixed costs (operating leverage) will reflect a negative association in the regression performed. The increase in the fixed cost will increase the operating leverage surrogate by decreasing the denominator (i.e. EBIT) and will decrease the same figure in the numerator of the financial leverage surrogate.

As a result of the lack of a consistent pattern of significant association, the null hypothesis of no significant association between income statement measures of operating leverage and default risk financial leverage (class one) cannot be rejected.

9.3.1.2.3 Comparison with prior research

No similar relationships had been examined by the reviewed prior research.

9.3.1.3 Cash flow measures

Table 9.4 presents the results of the regressions performed between cash flow measures of operating leverage and default risk financial leverage (class one).

Table 9.4: Operating Leverage vs. Cash Flow Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL1-COL1									
Single Co									
first order	-0.365	-3.185	66	0.002	0.123	0.986		NO	
lagged	-0.151	-1.239	66	0.220	0.087	0.241	NO	NO	
average	-0.411	-3.660	66	0.001	0.016	0.008		NO	
Portfolio-B									
first order	-0.384	-1.379	11	0.195	0.891	0.122			
lagged	-0.034	-0.114	11	0.911	0.933	0.530	NO	NO	
average	0.140	0.469	11	0.648	0.947	0.948			
Portfolio-L									
first order	-0.735	-3.591	11	0.004	0.259	0.245		NO	
lagged	-0.436	-1.609	11	0.136	0.024	0.721			
average	-0.510	-1.966	11	0.075	0.237	0.649		NO	

CFL1-COL1 = Cash2 / Tlia versus Cash1 / Cash2

Comments:

9.3.1.3.1 Single company level

While evidence of significant association was found in the total regressions, it was not consistent. All regressions were found to violate the normality assumption and heteroscedasticity was detected in the lagged regression. The total regressions all exhibited negative association which is contrary to the hypothesised positive association. No consistent difference was found between the significance of the upper and lower regressions.

9.3.1.3.2 Portfolio level

No consistent significance was found in either the beta or the leverage portfolios. As in the balance sheet and income statement regressions, the leverage portfolios exhibited greater association than the beta portfolios. The leverage portfolios showed a consistent negative association while the beta portfolios were found to vary with respect to the sign of the regression slope coefficients.
The total regressions were not well specified, with half indicating violations of the normality assumption and one regression also indicating the presence of heteroscedasticity. No consistent difference was evident in the association of the upper and lower regressions, only one of which was significant.

As a result of the lack of a pattern of significant association, the majority of statistically insignificant associations and the extensive violations of the OLS assumptions, the null hypothesis of no significant association between cash flow measures of operating leverage and default risk financial leverage (class one) cannot be rejected.

9.3.1.3.3 Comparison with prior research

No similar relationships had been examined by the reviewed prior research.

9.3.2 OPERATING LEVERAGE VERSUS DEFAULT RISK FINANCIAL LEVERAGE (CLASS TWO).

9.3.2.1 Balance sheet measures

Table 9.5 presents the results of the regressions performed between balance sheet measures of operating leverage and default risk financial leverage (class two).

Table 9.5: Operating Leverage vs. Balance Sheet Default Risk (II)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL5-BOL1									
Single Co									
first order	-0.465	-4.514	74	0.000	0.000	0.542	NO	NO	
lagged	-0.417	-3.947	74	0.000	0.007	0.512	NO		
average	-0.432	-4.118	74	0.000	0.002	0.439	NO		
Portfolio-B									
first order	-0.569	-2.497	13	0.027	0.747	0.137		NO	
lagged	-0.501	-2.089	13	0.057	0.781	0.984		NO	
average	-0.518	-2.186	13	0.048	0.725	0.950		NO	
Portfolio-L									
first order	-0.890	-7.056	13	0.000	0.006	0.801			
lagged	-0.877	-6.576	13	0.000	0.040	0.361			
average	-0.894	-7.180	13	0.000	0.002	0.407			
BFL8-BOL1									
Single co									
first order	-0.490	-4.705	70	0.000	0.002	0.365	NO	NO	
lagged	-0.470	-4.452	70	0.000	0.021	0.256	NO	NO	
average	-0.486	-4.649	70	0.000	0.001	0.062	NO	NO	
Portfolio-B									
first order	-0.165	-0.578	12	0.574	0.260	0.870		NO	
lagged	-0.173	-0.608	12	0.554	0.810	0.662		NO	
average	-0.277	-0.998	12	0.338	0.666	0.842		NO	
Portfolio-L									
first order	-0.800	-4.614	12	0.001	0.030	0.573			
lagged	-0.709	-3.480	12	0.005	0.005	0.481	log(-4.2)		
average	-0.819	-4.942	12	0.000	0.006	0.574	log(-5.3)	NO	
BFL5-BOL2									
Single co									
first order	-0.466	-4.529	74	0.000	0.000	0.089	NO	NO	
lagged	-0.477	-4.667	74	0.000	0.005	0.423	NO	NO	
average	-0.441	-4.229	74	0.000	0.001	0.157	NO	NO	
Portfolio-B									
first order	-0.464	-1.889	13	0.081	0.927	0.922		NO	
lagged	-0.491	-2.031	13	0.063	0.869	0.992		NO	
average	-0.438	-1.758	13	0.102	0.963	0.741		NO	
Portfolio-L									
first order	-0.807	-4.920	13	0.000	0.008	0.406	NO	NO	
lagged	-0.820	-5.174	13	0.000	0.027	0.934	NO	NO	
average	-0.850	-5.808	13	0.000	0.022	0.729		NO	

BFL5-BOL1 = Nibd / Tass versus Fass / Tass
BFL8-BOL1 = Nibd / Equity versus Fass / Tass
BFL5-BOL2 = Nibd / Tass versus Fass / Oass

Comments:

9.3.2.1.1 Single company level

A highly significant association was found, with all of the total regressions significant at the 0.000 level. Operating leverage was found to explain as much as 24% (0.490^2) of the variability in the second class default risk. All of the total regressions exhibited the hypothesised negative association.

As in the balance sheet measures of class one default risk, a marked difference was evident between the association of the upper and lower regressions. The upper regressions exhibited consistently high levels of significant association while no statistical significance was evident in the lower regressions.

The total regressions were, however, not well specified, and all indicated heteroscedasticity which did not respond to logarithmic transformations. The majority of total regressions were also found to violate the normality assumption.

9.3.2.1.2 Portfolio level

The portfolio associations were dependent on the portfolio ranking procedure. The portfolios ranked on the basis of operating leverage exhibited highly significant association. Operating leverage was shown to explain as much as 80% (0.894^2) of the variability in default risk financial leverage. The leverage portfolios exhibited a consistently negative slope coefficient, as expected. The beta portfolios, as in the first class of default risk, did not indicate consistently significant association.

As in the single company regressions, the leverage portfolios found significant association in the upper regressions, with no significant association evident in the lower regressions. These findings are consistent with those of the class one measure of balance sheet default risk and

corroborate the suggestion that high operating leverage companies engage more actively in trade-offs of financial and operating leverage.

The relationships were found to be consistent across the various balance sheet definitions of operating and financial leverage. The finding of significance across different denominators indicates that the correlation is unlikely to have been spuriously induced by the use of a total asset denominator in both the dependent and independent variables.

The total regressions were not well specified, particularly in the beta portfolios where violations of normality were prevalent. The causes of the normality violations were not unanimous, but the majority indicated departures in respect of both positive skewness and positive kurtosis which were more pronounced in the case of the equity denominated financial leverage ratio, i.e. the BFL8-BOL1 regression.

The incidence of heteroscedasticity was limited to two regressions, which was considerably less than that found in the single company regressions. Caution should be exercised in interpreting the results in the presence of OLS violations. However, the same argument applies to the second class of default risk measures that applied to the class one measures. The violations were not consistent in the single company and leverage portfolios and their presence did not appear to have any impact on the pattern of significant association.

The heteroscedasticity is likely to have been caused by the difference between the association of the upper and lower regressions and was found to reduce significantly as a result of portfolio formation without changes in the significance of the association. The violations of the OLS assumptions were unlikely to have induced the high levels of significant association in otherwise statistically insignificant relationships. This conclusion is supported by the consistency of the findings across the class one and two measures of balance sheet default risk.

The null hypothesis of no significant association between balance sheet measures of operating leverage and default risk financial leverage (class two) is therefore rejected.

9.3.2.1.3 Comparison with prior research

None of the prior research reviewed in Chapter Three had examined the relationships tested in 9.3.2. The only prior research to examine a similar relationship was that of **Jordaan, Hamman & Smit (1994,p.21)**, who regressed the ratio of current liabilities to total assets on the ratio of fixed assets to total assets. The ratio of current liabilities to total assets is likely to be significantly correlated to the ratio of Nibd / Tass as the largest component of both is creditors (trade accounts payable). Jordaan et al examined the relationships across entire sectors only, and found significant negative association at the 0.10 level in twelve of the nineteen sectors and positive association at the same level in only one sector. The authors did not differentiate between significance levels. The results of this section therefore appear to be consistent with prior research.

9.3.2.2 Income statement measures

Table 9.6 presents the results of the regressions performed between income statement measures of operating leverage and default risk financial leverage (class two).

Table 9.6: Operating Leverage vs. Income Statement Default Risk (II)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL2-IOL1									
Single Co									
first order	-0.171	-1.412	66	0.163	0.430	0.678		NO	
lagged	-0.286	-2.421	66	0.018	0.099	0.074		NO	
average	-0.168	-1.386	66	0.170	0.418	0.052		NO	
Portfolio-B									
first order	-0.165	-0.555	11	0.590	0.075	0.684		NO	
lagged	-0.269	-0.928	11	0.373	0.539	0.788		NO	
average	-0.390	-1.405	11	0.188	0.828	0.658		NO	
Portfolio-L									
first order	-0.509	-1.960	11	0.076	0.192	0.201		NO	
lagged	-0.816	-4.683	11	0.001	0.118	0.379		NO	
average	-0.615	-2.588	11	0.025	0.146	0.757			

IFL2-IOL1 = Ebit / Nibd versus (Ebit + Depr) / Ebit

Comments:

9.3.2.2.1 Single company level

No consistent significant association was found in the total regressions. Statistical significance was found in respect of the lagged regression, but not in either of the first order or average regressions. The associations were found to be consistently negative which is contrary to the positive association that was hypothesised. None of the total regressions were well specified as they repeatedly violated the normality assumption. No consistent difference was detected in the significance of the upper and lower regressions, none of which were found to be significant.

9.3.2.2.2 Portfolio level

Significant association was detected in the leverage portfolio regressions but was not consistent at the 0.05 level. The beta portfolios did not exhibit any significant association.

The total regressions were not well specified, particularly with respect to the beta portfolios which all violated the assumption of normality. No consistent difference was found between the association of the upper and lower regressions, none of which were significant at the 0.05 level. The lagged relationship exhibited greater association than either the first order or average associations.

The portfolio regressions returned consistently negative slope coefficients. This does not necessarily imply a positive relationship between operating leverage and default risk financial leverage, and may just represent a non significant relationship as a result of a shortcoming in the regression variables[3]. The results of the class two measures of income statement default risk are consistent with those of the class one equivalents.

As a result of the lack of a consistent pattern of significant association, the null hypothesis of no significant association between income statement measures of operating leverage and default risk financial leverage (class two) cannot be rejected.

9.3.2.2.3 Comparison with prior research

None of the prior research reviewed had examined similar relationships.

9.3.2.3 Cash flow measures

Table 9.7 presents the results of the regressions performed between cash flow measures of operating leverage and default risk financial leverage (class two).

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3 *See Section 9.3.1.2.2 for reasoning.*

Table 9.7: Operating Leverage vs. Cash Flow Default Risk (II)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL2-COL1									
Single Co									
first order	-0.386	-3.402	66	0.001	0.069	0.965		NO	
lagged	-0.209	-1.740	66	0.087	0.014	0.578		NO	
average	-0.269	-2.270	66	0.026	0.007	0.091			
Portfolio-B									
first order	-0.455	-1.693	11	0.119	0.570	0.208			
lagged	0.050	0.167	11	0.870	0.873	0.781	NO	NO	
average	0.165	0.554	11	0.591	0.932	0.313			
Portfolio-L									
first order	-0.697	-3.224	11	0.008	0.247	0.370			
lagged	-0.444	-1.642	11	0.129	0.004	0.076			
average	-0.333	-1.173	11	0.266	0.312	0.841			

CFL2-COL1 = Cash2 / Nibd versus Cash1 / Cash2

Comments:

9.3.2.3.1 Single company level

Significant association was detected in both the first order and average regressions. All of the total regressions indicated an unexpected negative association and two thirds of the total regressions violated the normality assumption. The upper regressions were found to exhibit greater association than the lower regressions and, unlike the income statement relationships, the first order regression indicated greater significance than the lagged or average regressions.

9.3.2.3.2 Portfolio level

No consistent significance was found in either the beta or the leverage portfolios. As in the balance sheet and income statement regressions, the leverage portfolios exhibited greater association than the beta portfolios. The leverage portfolios showed a consistent negative association while the beta portfolios were found to vary with respect to the sign of the regression slope coefficients and indicated a dominant positive association.

The total regressions were found to be well specified, with only one regression violating the OLS assumptions. No consistent difference was evident in the association of the upper and lower regressions.

As a result of the lack of a pattern of significant association, the majority of statistically insignificant associations and the sign reversal indicated in the portfolio regressions, the null hypothesis of no significant association between cash flow measures of operating leverage and default risk financial leverage (class two) cannot be rejected.

9.3.2.3.3 Comparison with prior research

None of the prior research reviewed had examined similar relationships.

9.4 RESULTS OF THE REGRESSIONS BETWEEN OPERATING LEVERAGE AND INTEREST RISK FINANCIAL LEVERAGE.

9.4.1 Balance sheet measures

Table 9.8 presents the results of the regressions performed between balance sheet measures of operating leverage and interest risk financial leverage.

Table 9.8: Operating Leverage vs. Balance Sheet Interest Risk

Grouping	Total				Upper Lower		Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
BFL9-BOL1									
Single Co									
first order	-0.159	-1.386	74	0.170	0.507	0.248		NO	
lagged	-0.153	-1.328	74	0.188	0.146	0.270		NO	
average	-0.187	-1.641	74	0.105	0.132	0.875		NO	
Portfolio-B									
first order	0.022	0.079	13	0.938	0.963	0.899	NO	NO	
lagged	0.060	0.218	13	0.831	0.492	0.016		NO	
average	-0.013	-0.048	13	0.963	0.847	0.027		NO	
Portfolio-L									
first order	-0.338	-1.294	13	0.218	0.283	0.800		NO	
lagged	-0.263	-0.982	13	0.344	0.352	0.165		NO	
average	-0.403	-1.586	13	0.137	0.007	0.855	NO		
BFL10-BOL1									
Single co									
first order	-0.193	-1.645	70	0.104	0.279	0.415	log(-1.7)	NO	
lagged	-0.187	-1.591	70	0.116	0.165	0.225		NO	
average	-0.131	-1.104	70	0.274	0.190	0.788	log(-1.4)		
Portfolio-B									
first order	-0.408	-1.548	12	0.148	0.606	0.519		NO	
lagged	0.141	0.494	12	0.630	0.132	0.789		NO	
average	-0.289	-1.045	12	0.317	0.580	0.945		NO	
Portfolio-L									
first order	-0.381	-1.429	12	0.179	0.336	0.987	NO		
lagged	-0.414	-1.578	12	0.141	0.302	0.698		NO	
average	-0.378	-1.416	12	0.182	0.044	0.758	log(-1.5)	NO	
BFL9-BOL2									
Single co									
first order	-0.170	-1.486	74	0.141	0.215	0.437		NO	
lagged	-0.159	-1.386	74	0.170	0.106	0.751		NO	
average	-0.190	-1.663	74	0.100	0.080	0.495		NO	
Portfolio-B									
first order	-0.004	-0.015	13	0.988	0.903	0.089		NO	
lagged	0.049	0.178	13	0.862	0.952	0.064		NO	
average	-0.028	-0.100	13	0.922	0.544	0.131		NO	
Portfolio-L									
first order	-0.416	-1.650	13	0.123	0.002	0.741	NO		
lagged	-0.288	-1.086	13	0.297	0.132	0.621			
average	-0.404	-1.592	13	0.135	0.252	0.836		NO	

BFL9-BOL1 = Ibd / Tass versus Fass / Tass
BFL10-BOL1 = Ibd / Equity versus Fass / Tass
BFL9-BOL2 = Ibd / Tass versus Fass / Oass

Comments:

9.4.1.1 Single company level

In contrast to the corresponding default risk measures, no significant association was found in any of the interest risk total regressions. All of the total regressions exhibited the expected negative association. The regressions were not well specified and all but one were found to violate the normality assumption. Logarithmic transformations proved successful in eliminating heteroscedasticity that was present in two of the untransformed regressions.

No consistent difference was found between the associations of the upper and lower regressions, none of which were significant. Similarly, no consistent difference was found in the association of the first order, lagged and average relationships.

9.4.1.2 Portfolio level

As in the single company case, none of the total regressions indicated significant association. The direction of the association was found to vary in respect of the beta portfolios, although the majority of slope coefficients were negative. Neither the beta nor the leverage portfolios were well specified with all but one of the regressions recording violations of OLS assumptions.

The beta portfolios indicated greater association in the lower regressions than the upper regressions while the leverage portfolios found greater association in the upper regressions. These findings are consistent. The leverage portfolios are ranked in descending order of operating leverage. The beta portfolios, on the other hand, are more likely to be ranked in ascending order of operating leverage as a result of the Chapter Seven finding that beta and operating leverage are negatively, although not significantly, associated. These results are therefore consistent with the hypothesis that higher leverage companies engage more actively in trade-offs, although none of the upper or lower regressions indicated consistent significance.

No consistent difference was found in the association of the first order, lagged and average regressions. The findings were consistent across the various leverage definitions employed.

9.4.1.3 Comparison with prior research

Chapter Three [4] showed that no consensus exists regarding either the direction or significance of the association between operating leverage and long term/interest bearing measures of financial leverage. The findings of this section are consistent with those of **Titman & Wessels (1988,p.1)** who found a predominantly negative association that was statistically insignificant. On the other hand, the findings of this section are contrary to those of **Friend & Lang (1988,p.271)** who found a significant, consistently positive association. Neither the reviewed prior research nor this study has found a consistently significant negative association, as was found with the default risk measures of financial leverage.

9.4.2 Income statement measures

Table 9.9 presents the results of the regressions performed between income statement measures of operating leverage and interest risk financial leverage.

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4 *See Section 3.2.4.*

Table 9.9: Operating Leverage vs. Income Statement Interest Risk

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL3-IOL1									
Single Co									
first order	-0.071	-0.581	66	0.564	0.384	0.492	NO	NO	
lagged	-0.080	-0.648	66	0.519	0.909	0.711		NO	
average	-0.021	-0.171	66	0.865	0.855	0.910		NO	
Portfolio-B									
first order	-0.205	-0.695	11	0.501	0.287	0.658		NO	
lagged	-0.283	-0.979	11	0.349	0.819	0.750		NO	
average	-0.124	-0.414	11	0.687	0.566	0.673		NO	
Portfolio-L									
first order	-0.175	-0.588	11	0.568	0.405	0.234		NO	
lagged	-0.225	-0.766	11	0.460	0.823	0.983		NO	
average	0.032	0.108	11	0.916	0.578	0.639		NO	
IFL4-IOL1									
Single Co									
first order	-0.251	-2.104	66	0.039	0.199	0.538	NO	NO	
lagged	-0.218	-1.818	66	0.074	0.489	0.501	NO	NO	
average	-0.188	-1.554	66	0.125	0.133	0.118	NO	NO	
Portfolio-B									
first order	-0.542	-2.139	11	0.056	0.017	0.901			
lagged	-0.498	-1.904	11	0.083	0.340	0.820		NO	
average	-0.338	-1.192	11	0.258	0.419	0.920		NO	
Portfolio-L									
first order	-0.602	-2.499	11	0.030	0.359	0.062		NO	
lagged	-0.425	-1.557	11	0.148	0.733	0.781	NO	NO	
average	-0.395	-1.427	11	0.181	0.544	0.308		NO	

IFL3-IOL1 = Ebit / Ibd versus (Ebit + Depr) / Ebit
IFL4-IOL1 = Ebit / Int versus (Ebit + Depr) / Ebit

Comments:

9.4.2.1 Single company level

The two income statement measures exhibited different associations at the single company level but neither indicated consistent significance. Significant association was found in the first order regression in respect of the IFL4-IOL1 relationship, but not the lagged or average

regressions. All of the regressions in respect of this relationship violated both the normality and homoscedasticity assumptions. The IFL3-IOL1 relationship, on the other hand, exhibited no significant association with a lowest significance probability level in excess of 0.50 and was also not well specified.

As in the income statement measures of default risk, all of the total regressions exhibited an unexpected negative association. No consistent difference was detected between the association of the upper and lower regressions, none of which were found to be significant.

9.4.2.2 Portfolio level

The portfolio results were similar to the single company results. Greater levels of association were found in the IFL4-IOL1 regressions, although the significance was found to be even less consistent at the portfolio level than at the single company level. The IFL4-IOL1 regressions all indicated negative association which was opposite to the hypothesised association. The IFL3-IOL1 regressions, on the other hand, were found to vary with respect to the direction of association, although a negative association was dominant.

Neither of the relationships indicated well specified regressions with all but one violating the normality assumption and heteroscedasticity present in one of the regressions. The consistent violations of the normality assumption may have caused a mis-statement in the reported significance probability levels. No consistent difference was found between the association of the upper and lower regressions.

The null hypothesis of no significant association between income statement measures of operating leverage and interest risk financial leverage cannot be rejected at the 0.05 level.

9.4.2.4 Comparison with prior research

None of the reviewed prior research had examined the interactions between income statement measures of operating and financial leverage. The closest relationship examined was that of Ebit/Int versus Fass/Tass by **Jordaan, Hamman & Smit (1994,p.21)**. The Ebit/Int ratio is equivalent to the IFL4 ratio utilised in Table 9.9 and represents an interest risk measure of financial leverage. The Jordaan et al finding of no significant association with operating leverage is therefore consistent with the findings of this study.

9.4.3 Cash flow measures

Table 9.10 presents the results of the regressions performed between cash flow measures of operating leverage and interest risk financial leverage.

Table 9.10: Operating Leverage vs. Cash Flow Interest Risk

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL3-COL1									
Single Co									
first order	-0.158	-1.300	66	0.198	0.620	0.158	NO	NO	
lagged	-0.174	-1.437	66	0.155	0.320	0.143	NO	NO	
average	-0.186	-1.535	66	0.130	0.370	0.124	NO	NO	
Portfolio-B									
first order	-0.524	-2.042	11	0.066	0.986	0.516	log(-1.6)	NO	
lagged	-0.181	-0.610	11	0.554	0.956	0.305		NO	
average	0.099	0.330	11	0.747	0.863	0.287		NO	
Portfolio-L									
first order	-0.453	-1.683	11	0.120	0.316	0.562		NO	
lagged	-0.411	-1.494	11	0.163	0.449	0.339		NO	
average	-0.447	-1.656	11	0.126	0.445	0.918		NO	
CFL4-COL1									
Single Co									
first order	-0.199	-1.647	66	0.104	0.491	0.182	NO	NO	
lagged	-0.131	-1.077	66	0.285	0.120	0.266	NO	NO	
average	-0.170	-1.399	66	0.166	0.170	0.297	NO	NO	
Portfolio-B									
first order	-0.212	-0.720	11	0.487	0.964	0.717	NO	NO	
lagged	0.059	0.196	11	0.848	0.965	0.158		NO	
average	0.118	0.394	11	0.701	0.412	0.113		NO	
Portfolio-L									
first order	-0.679	-3.064	11	0.011	0.146	0.660	log(-1.8)	NO	
lagged	-0.395	-1.427	11	0.181	0.185	0.886		NO	
average	-0.379	-1.358	11	0.202	0.262	0.795		NO	

CFL3-COL1 = Cash2 / Ibd versus Cash1 / Cash2
CFL4-COL1 = Cash2 / Int versus Cash1 / Cash2

Comments:

9.4.3.1 Single company level

No significant association was evident in the total regressions, all of which exhibited a negative association which is opposite to the hypothesised relationship. Each of the total regressions violated both the normality and homoscedasticity assumptions. Logarithmic transformations proved ineffective in correcting for the heteroscedasticity.

No consistent difference was evident in the association of the upper and lower regressions, none of which indicated significant association.

9.4.3.2 Portfolio level

Significant association was found in only one of the twelve total regressions and no consistent significance was therefore evident. While the leverage portfolio total regressions exhibited consistently negative slope coefficients, the direction of association varied in the beta portfolios with equal occurrence of positive and negative slope coefficients.

As in the single company case, all of the total regressions violated the normality assumption. The incidence of heteroscedasticty, on the other hand, was considerably reduced on aggregation with only one violation detected. Log transformations proved successful in eliminating the heteroscedasticity present in two of the portfolio regressions and was found to increase the *t*-value markedly in both. The leverage portfolio in the CFL4-COL1 ratio showed an increase in its t-value from -1.8 to -3.064 as a result of the logarithmic transformation. The violations of normality, and the possibility of undetected heteroscedasticity which, if transformed, could indicate significance, may have caused a mis-statement in the reported significance probability levels.

No consistent difference was found in the association of the upper and lower regressions, none of which were significant. Similarly, no consistent difference in the association of the first order, lagged and average regressions was detected. The findings were consistent across the different cash flow definitions employed.

The null hypothesis of no significant association between cash flow measures of operating leverage and interest risk financial leverage cannot be rejected at the 0.05 level.

9.4.3.3 Comparison with prior research

None of the reviewed prior research had examined similar relationships.

9.5 RESULTS OF THE REGRESSIONS BETWEEN TIME SERIES MEASURES OF OPERATING AND FINANCIAL LEVERAGE

9.5.1 Income statement measures

Table 9.11 presents the results of the regressions performed between the degree of operating leverage (DOL) and the degree of financial leverage (DFL).

Table 9.11: DOL vs. DFL

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
DFL-DOL									
Single Co									
first order	0.089	0.585	43	0.561	0.668	0.150		NO	
Portfolio-B									
5-company	0.421	1.227	7	0.259	0.319	0.832	NO	NO	
3-company	0.485	2.002	13	0.067	0.664	0.254		NO	
Portfolio-L									
5-company	0.171	0.460	7	0.659	0.966	0.432		NO	
3-company	0.117	0.424	13	0.678	0.851	0.637			

DFL-DOL = Degree of financial leverage versus Degree of operating leverage

Comments:

9.5.1.1 Single company level

No significant association was evident in the total regression which indicated an un-hypothesised positive association. The regression was found to violate the OLS assumption of normality. Neither the upper nor lower regression was found to be significant.

9.5.1.2 Portfolio level

No significant association was found in the total regressions. As in the single company case, the slope coefficients exhibited positive associations. The regressions were not well specified with violations of both normality and homoscedasticity being recorded. The causes of the normality violations were varied and did not exhibit any discernible pattern. No consistent difference was found in the association of the upper and lower regressions.

Although the positive association is contrary to the hypothesised negative association, it is consistent with the other results in this study. The DFL is effectively an income statement interest risk measure as it measures the impact of a change in before interest income on after interest income. It is consistent with the other income statement interest risk measures to the extent that it has reflected the opposite relationship to the hypothesis. The null hypothesis of no significant association between time series measures of operating and financial leverage cannot be rejected at the 0.05 level.

9.5.1.3 Comparison with prior research

The findings of no significant association in a positive direction is contrary to the finding of a consistently significant negative relationship by **Mandelker & Rhee (1984,p.523)**. The difference in the findings is consistent with the differences between this study and Mandelker & Rhee which were encountered in both Chapter Seven and Chapter Eight. The reason for the difference cannot be determined with certainty, but two possibilities were discussed in Chapter Seven, Section 7.5.3 and these apply equally to this Section.

9.6 SUMMARY

Table 9.12 presents the significance probability levels of the total regressions performed between cross sectional measures of financial and operating leverage. The time series measures have not been included in the table as a result of their different format.

Table 9.12: Operating Leverage vs. Financial Leverage: Results' Summary

	Default risk (class I)					Default risk (class II)					Interest risk						
	Bal. sheet			Inc.stat.	C/flow	Bal. sheet			Inc.stat.	C/flow	Bal. sheet			Inc.stat.		C/flow	
Financial leverage	Tlia / Tass	Tlia / Equity	Tlia / Tass	Ebit / Tlia	Cash2 / Tlia	Nibd / Tass	Nibd / Equity	Nibd / Tass	Ebit / Nibd	Cash2 / Nibd	Ibd / Tass	Ibd / Equity	Ibd / Tass	Ebit / Ibd	Ebit / Int	Cash2 / Ibd	Cash2 / Int
Operating leverage	Fass / Tass	Fass / Tass	Fass / Oass	(Ebit+ Dep)/ Ebit	Cash1 / Cash2	Fass / Tass	Fass / Tass	Fass / Oass	(Ebit+ Dep)/ Ebit	Cash1 / Cash2	Fass / Tass	Fass / Tass	Fass / Oass	(Ebit+ Dep)/ Ebit	(Ebit+ Dep)/ Ebit	Cash1 / Cash2	Cash1 / Cash2
Single co.																	
first order	0.000	0.000	0.000	0.064	0.002	0.000	0.000	0.000	0.163	0.001	0.170	0.104	0.141	0.413	0.622	0.198	0.104
lagged	0.000	0.000	0.000	0.006	0.220	0.000	0.000	0.000	0.018	0.087	0.188	0.116	0.170	0.539	0.215	0.155	0.285
average	0.000	0.001	0.000	0.146	0.001	0.000	0.000	0.000	0.170	0.026	0.105	0.274	0.100	0.731	0.003	0.130	0.166
Portfolio-B																	
first order	0.088	0.318	0.159	0.228	0.195	0.027	0.574	0.081	0.590	0.119	0.938	0.148	0.988	0.592	0.861	0.066	0.487
lagged	0.162	0.478	0.210	0.086	0.911	0.057	0.554	0.063	0.373	0.870	0.831	0.630	0.862	0.537	0.132	0.554	0.848
average	0.107	0.164	0.169	0.280	0.648	0.048	0.338	0.102	0.188	0.591	0.963	0.317	0.922	0.863	0.112	0.747	0.701
Portfolio-L																	
first order	0.000	0.000	0.002	0.014	0.004	0.000	0.001	0.000	0.076	0.008	0.218	0.179	0.123	0.476	0.295	0.120	0.011
lagged	0.000	0.001	0.000	0.001	0.136	0.000	0.005	0.000	0.001	0.129	0.344	0.141	0.297	0.565	0.346	0.163	0.181
average	0.000	0.000	0.000	0.060	0.075	0.000	0.000	0.000	0.025	0.266	0.137	0.182	0.135	0.475	0.044	0.126	0.202

Bal. sheet = Balance sheet; Inc. stat. = Income statement; C/flow = Cash flow.

The class one and two default risk measures indicated similar results which were markedly different to those of the interest risk measures. This was also observed in the relationship between beta and financial leverage (Chapter Seven) and supports the distinction between the risks that has been drawn by this study.

The balance measures of default risk indicated highly significant associations with operating leverage at both single company and leverage portfolio levels, with average significance probability levels of 0.000 in both. The associations were consistently negative, as hypothesised. Operating leverage was shown to explain as much as 32% of the variability in default risk financial leverage at the single company level and 83% at the leverage portfolio level. Both default risk classes found significant association in the upper regressions which was not present in the lower regressions. This suggests that high operating leverage companies engage in trade-offs more actively than companies with low levels of operating leverage. No consistent difference was evident between the associations of the first order, lagged and average regressions.

Unlike the single company and leverage portfolio regressions, the beta portfolios did not indicate significant association, although their associations were also found to be negative.

This lack of statistical significance does not contradict the findings of the single company and leverage portfolio regressions. Chapter Seven found no evidence of a significant association between operating leverage and beta and that any association that does exist is negative. Beta rankings will therefore not correspond with the operating leverage rankings. This results in high operating leverage companies being grouped with medium and low operating leverage companies and averaging of both the dependent and independent variables. The high levels of significant negative association which were found in high operating leverage companies are likely to have been averaged away by the grouping procedure based on beta.

The balance sheet regressions between operating leverage and default risk financial leverage were not well specified with the detection of violations of both normality and homoscedasticity assumptions. The incidence of the OLS violations should result in caution in the interpretation of the reported significance probability levels. However, the violations were not consistent in the single company and leverage portfolio regressions and their presence did not appear to have any impact on the pattern of significant association.

The heteroscedasticity is likely to have been caused by the difference between the association of the upper and lower regressions. The violations were less frequent as aggregation into portfolios took place without changes in the significance of the associations. It is submitted that the violations of the OLS assumptions were unlikely to have induced the high levels of significant association in otherwise statistically insignificant relationships. **The null hypothesis of no significant association between balance sheet measures of operating leverage and default risk financial leverage is rejected at the 0.05 level.**

Evidence of significance was found in the regressions between operating leverage and income statement/cash flow measures of default risk financial leverage. However, the significance was neither consistent nor present in the majority of regressions. The significance of the income statement associations was found to increase as aggregation into leverage portfolios took place, while that of the cash flow regressions was found to decrease. The regressions indicated a positive relationship between financial and operating leverage which is contrary to the hypothesised negative association. The relationships were not well specified with frequent violations of the normality assumption detected. **The null hypothesis of no significant**

association between operating leverage and default risk financial leverage is rejected in respect of the income statement and cash flow measures.

None of the balance sheet measures of interest risk indicated significant association with operating leverage at either the single company or portfolio levels. All total regressions showed the anticipated negative association. The income statement and cash flow measures of interest risk indicated significant association with operating leverage but this was sporadic and only present in three of the thirty six regressions. The signs of the regression slope coefficients were found to vary and the majority of the relationships reflected associations which were contrary to the hypotheses. **The null hypothesis of no significant association between operating leverage and interest risk financial leverage cannot be rejected in respect of balance sheet, income statement or cash flow measures.**

The time series association between operating and financial leverage was not found to be significant. The regressions exhibited positive associations which are contrary to the hypothesised negative relationships. **The null hypothesis of no significant association between time series measures of operating and financial leverage cannot be rejected at the 0.05 level.**

The findings of this chapter are consistent with prior research where the specific relationships have been previously examined, except in the case of the time series measure. As in the relationship between financial leverage and beta discussed in Chapter Seven, prior trade-off/capital structure research had not distinguished between long term or interest bearing debt and total debt measures of financial leverage. The failure draw an adequate distinction between the different risks inherent in the different debt measures resulted in findings which appeared to be contradictory. By drawing a distinction between the default and interest risks of financial leverage this study has provided a possible basis for the reconciliation of the findings of prior research.

This chapter has also provided a possible explanation for the findings of the operating leverage/beta relationship as discussed in Chapter Eight. The trade-off between operating and financial leverage offers an explanation for the existence of a significant positive relationship

between unlevered beta and operating leverage but an insignificant negative relationship between operating leverage and levered beta. The impact of an increase in operating leverage on levered beta may be reduced or offset by the decrease in default risk resulting from the trade-off hypothesis.

CHAPTER TEN : SUMMARY, IMPLICATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

10.1 SUMMARY

The objective of this study was to empirically determine the nature of the inter-relationships between systematic risk (as measured by beta), financial leverage and operating leverage. An important distinction was drawn between the default and interest risks inherent in financial leverage, based on the theory of risk assessment in fixed-income instruments as developed by, amongst others, **Hickman (1958,p.1)** and **Altman (1989,p.909)**. Default risk is the extent of the repayment obligations inherent in debt, while interest risk is the extent to which debt increases the volatility in earnings as a result of interest charges.

In Chapter Two an *a priori* model of the inter-relationships was established, based on the formulations of **Hamada (1969,p.29)** and **Rubenstein (1973,p.167)** and **Mandelker & Rhee (1984,p.47)**. These formulations show that, analytically, a company's beta is a positive function of its unlevered or asset beta and the proportion of debt in its capital structure. **Brealey & Myers (1991,p.200)**, in turn, show that the unlevered beta is a positive function of operating leverage.

The third chapter reviewed the extensive prior research that has been published. In addition to the studies examining the relationship between market and accounting measures of risk, capital structure studies were reviewed to the extent that they investigated the effect of operating leverage surrogates on capital structure. The prior research was shown to be inconclusive and more contradictory than consistent. Prior research was also shown not to

have adequately distinguished between the differing natures/ risks of different financial leverage definitions. When the research was examined in terms of the different natures/risks inherent in financial leverage, the results were shown to be considerably more consistent, particularly with respect to the default risk measures.

Chapters Four and Five comprised the measurement phase of the study. Considerable effort was spent on obtaining the best possible beta and leverage estimates. Systematic risk, as measured by beta, was estimated by applying the Market Model to 3-years of bi-weekly share returns. Share returns were adjusted to include equivalent dividends and the trade-to-trade method was employed to counteract the effects of thin trading. Cross sectional leverage measures were drawn from all aspects of the financial statements and included refined cash flow measures which were obtained by the construction of cash flow statements according to GAAP statement AC118. The debt and equity nature of financing instruments was considered on the basis of economic substance rather than legal form, accounting policies were standardised across the sample to allow comparability, and time series leverage estimates were obtained using the **Mandelker & Rhee (1984,p.47)** formulations.

Chapters Six to Nine comprised the testing phase of the study. The two variable OLS regression model was employed in a standardised cross sectional correlation analysis which included testing of the residuals for the OLS assumptions of normality, homoscedasticity and independence of the independent variable. The inter-relationships were examined at both single share and portfolio levels and a distinction was drawn between the contemporaneous (first order), lagged and average relationships. Each of these relationships were separately examined over high and low values of the independent variable to determine whether the association varies based on the level of risk in the company.

Chapter Seven examined the relationship between beta and financial leverage. Both classes of balance sheet default risk were found to exhibit highly significant positive association at both single company and portfolio levels. Balance sheet measures of default risk were shown to explain as much as 14% of the variability in beta at the company level and 53% at the portfolio level. The regressions were well specified with few violations of the OLS

assumptions detected. High beta companies and portfolios exhibited greater association than their low beta counterparts in respect of the first class of default risk.

The income statement measures of default risk showed significant positive association at both single company and leverage portfolio levels. The significance of the association of the income statement measures was neither as high nor as consistent as the balance sheet measures and they explained as much as 9.4% of the variability of beta at the company level and 50% at the portfolio level. Significant positive association was also found in the cash flow measures but this was inconsistent and sporadic.

In sharp contrast to the default risk measures, no consistent significance was found in the interest risk measures at single company or portfolio levels in the balance sheet, income statement or cash flow statement. The time series measures of leverage, which are essentially interest risk based as they relate to the effect of interest charges on changes in profitability, also indicated no consistent significance. Unlike the cross sectional measures of interest risk which indicated the expected positive association, the time series measures exhibited a negative association.

Chapter Eight examined the association between operating leverage and levered beta as well as unlevered beta. The income statement and cash flow measures of operating leverage did not indicate significant association with either beta or unlevered beta and were found to vary with respect to the direction of the association. The time series measures of operating leverage also indicated a lack of significance with both beta and unlevered beta, although the regressions with beta indicated unexpected negative association while those with unlevered beta were found to be positive.

The balance sheet measures of operating leverage did not exhibit significant association with levered beta. The lowest significance probability level observed was 0.574. The associations indicated a negative association which, while contrary to the hypothesised positive relationship, is consistent with the majority of prior empirical research. The ability to draw conclusions on the relationships with levered beta was compromised by the presence of heteroscedasticity in the single company regressions. However, the associations were so

weak, and did not improve as aggregation into portfolios eliminated the heteroscedasticity, that it is unlikely the lack of significance was induced by the heteroscedasticity.

In contrast, the balance sheet measures of operating leverage exhibited highly significant associations with unlevered beta. The average significance probability level was 0.000 at both single company and portfolio levels and all associations indicated the expected positive association. Balance sheet measures of operating leverage were shown to explain as much as 29% of the variability in unlevered beta at the single company level and 72% at the portfolio level.

Chapter Nine, the last chapter in the testing section of this report, examined the trade-off between financial and operating leverage. As in the relationship between financial leverage and beta there was a marked difference in the trade-offs between the default and interest risk measures of financial leverage.

The balance sheet measures of both classes of default risk indicated high levels of significant association with an average significance probability level of 0.000 at both single company and portfolio levels. Operating leverage was shown to explain as much as 32% of the variability in default risk at the single company level and 83% at the leverage portfolio level. The upper regressions exhibited highly significant associations across both balance sheet classes of default risk, while the lower regressions did not indicate significant association. This suggests that high operating leverage companies engage more actively in trade-offs than lower operating leverage companies.

The balance sheet measures of default risk were not well specified with violations of homoscedasticity and normality being recorded, particularly in the class two single company regressions. The presence of these violations was shown to be unlikely to significantly effect the ability to draw conclusions. The heteroscedasticity was likely to have been caused by the difference in the significance of the upper and lower regressions and no drop in significance was detected as the heteroscedasticity was eliminated in the formation of leverage portfolios.

While evidence of significance was found in the income statement and cash flow regressions this was neither as consistent nor to the same extent as the balance sheet. These findings were contrary to the hypothesised relationship in that they indicated a positive association between financial and operating leverage. The regressions were not well specified with violations of the normality assumption being recorded.

The interest risk measures of financial leverage did not indicate significant association with operating leverage at the single company or portfolio level in the balance sheet, income statement or cash flow regressions. The balance sheet associations indicated the expected negative direction. The income statement and cash flow associations, on the other hand, varied with respect to direction and indicated a dominant positive association.

10.2 SYNTHESIS AND IMPLICATIONS

In drawing conclusions it is stressed that the correlation analysis employed cannot prove causation, but only association. For example, although this study has shown that default risk measures of financial leverage are highly negatively associated with operating leverage, it cannot be concluded that the changes in operating leverage will cause changes in default risk. The only conclusion that can be drawn is that the changes in operating leverage will be accompanied by opposite changes in default risk. It may be that both operating and financial leverage are responding in opposite directions to the same event, or that there is an item which is correlated to both operating and financial leverage that is effecting the resultant change in financial leverage.

The findings of the relationships involving financial leverage have indicated a marked difference between the findings of the default risk measures and the interest risk measures of financial leverage. Default measures of financial leverage were shown to be highly significantly associated to both beta and operating leverage, whereas interest measures showed no significant association. The chapters also indicated that both classes of default risk measures indicated similar results across the different balance sheet definitions that were employed.

These findings support the distinction between the two financial leverage risks that has been made by this study, but they cannot prove conclusively that the reason for the difference in the significance is a result of different risks or even the nature of the risks. Other plausible explanations may exist for the difference in the associations. However, this does not detract from the contribution that this report has made in indicating that there is a difference in the association between long term/interest bearing and total debt measures of financial leverage. The lack of distinction between these measures has resulted in apparent contradictions in the results of prior research. This report has provided a possible basis for the reconciliation of the findings of prior research and has corroborated this basis with its own findings.

A difference was evident between the association of the balance sheet leverage measures and those of the results and those of the income statement, cash flow and time series measures. The non balance sheet measures exhibited considerably lower levels of association, less consistency and often varying directions of association. This is not unexpected and is caused by the variability in these measures which are inherently more susceptible to aberrations than the balance sheet measures. The implication for financial managers and investors is that the balance sheet measures are likely to afford greater and more consistent predictive ability with respect to both risk and corporate strategy.

No consistent difference was found in the significance of the first order, lagged and average regressions. The only exception was the relationship between beta and cash flow default risk which indicated significant association in the average regressions, but nowhere else. The similarity between the first order, average and lagged associations is likely to be affected by the stability of the balance sheet measures. This has neither positive nor negative implications for the efficient market hypothesis as the stability masks the determination of whether investors may be reacting to most recent information or are lagging the available information.

One of the major contributions of this report is the comprehensive examination of the inter-relationships in the Hamada-Rubenstein and Mandelker & Rhee formulations. Previous researchers examined aspects of these formulations in isolation and with the apparent contradictions in the findings these researchers were unable to draw conclusions regarding the

interactions of the variables. By providing a basis for reconciling past research and indicating consistent findings in a thorough examination of the interactions, this research is able to draw conclusions that would previously have been more speculative than substantiated. The interactions between beta and balance sheet measures of financial and operating leverage, and the implications of these interactions, are discussed below.

10.2.1 Beta and financial leverage

The results of the correlation analysis between beta and financial leverage indicate that the relevant decision variable for financial managers and investors is default risk. Practically this means that as the default risk in a company's financial structure increases it will be accompanied by an increase in beta, *ceteris paribus*. This does not imply that an increase in interest risk will not be accompanied by an increase in beta. Interest risk leverage has default risk and to the extent that an increase in interest bearing debt is not offset by a reduction in another category of debt, it will also be accompanied by a change in beta.

The findings would also suggest that if a company replaced interest free debt (e.g. creditors) with interest bearing debt, this may be accompanied by a reduction in beta. Practically, this is an unlikely substitution for a company to make unless there is concern over the maturity (i.e. short term nature) of the financing, in which case there is likely to be less default risk in the longer term debt.

The examination of the beta/financial leverage relationship over different risk classes (i.e. upper and lower regressions) has not been undertaken by any of the reviewed prior research. The finding of greater levels of association in companies with higher betas than those with lower betas implies that investors and financial managers may use the changes in default risk financial leverage to predict changes in beta more accurately in higher beta companies. A possible justification for this finding is the existence of a risk threshold beyond which default risk becomes relevant, i.e. default risk has an effect on beta, but only once a certain level of systematic risk has been achieved.

The degree of explanation was shown to increase markedly as the firms were aggregated into portfolios. Three possible explanations can be advanced for this. It may be that as shares are grouped into portfolios, the impact of other variables on the single company beta are effectively diversified away thereby increasing the explanatory power of default risk. Another possible explanation is that as shares are aggregated into portfolios the measurement error inherent in the single company variables is reduced. The third possible explanation is that significance is induced by the aggregation that occurs in the portfolio formation.

It is impossible to determine, with certainty, which of the above reasons, or combination thereof, is responsible for the increased significance in the portfolio relationships. However, the magnitude and consistency of the increase in association, which has also been observed in prior research, would suggest that it is unlikely to be induced solely by aggregation. This indicates that financial leverage is a relevant decision variable at the portfolio level and is not completely diversifiable. The increased significance in the portfolio regressions was also observed in the relationships between operating leverage and unlevered beta and between operating leverage and default risk financial leverage. The same implications are applicable to these relationships as to the beta/ financial leverage relationship and the arguments will therefore not be repeated in Sections 10.2.2 and 10.2.3.

10.2.2 Beta and operating leverage

Prior research into the relationship between operating leverage and beta indicated an insignificant negative association. This was a confusing finding and appeared to contradict the theoretical formulations. This report has shown prior research to have two shortcomings. The first is the non-examination of the relationship between operating leverage and unlevered beta. The theoretical formulations indicate that operating leverage impacts beta, but does this by effecting the unlevered beta. The second shortcoming is the examination of the operating leverage/beta relationship in isolation.

This study has also found an insignificant negative association between operating leverage and beta, but it has shown that this may be consistent with theory, prior empirical research

and the results of this study. Operating leverage was shown to have a highly significant association with unlevered beta which was positive in direction. This implies that an increase in operating leverage is accompanied by an increase in the unlevered or asset beta.

The trade-off between operating and financial leverage provides a possible reconciliation between the results of the operating leverage/beta relationship and the operating leverage/unlevered beta relationship. The results of the trade-off analysis indicate that an increase in operating leverage is accompanied by a decrease in default risk financial leverage. This is accompanied by a decrease in beta (as default risk is positively related to beta) which may reduce, or off-set, the increase in unlevered beta resulting from the operating leverage increase. Therefore, in assessing the impact of changes in operating leverage on beta, companies and investors must look beyond the static *ceteris paribus* framework examined by prior researchers and consider any accompanying changes in default risk financial leverage.

10.2.3 Financial and operating leverage

The hypothesis that firms trade-off operating and financial leverage to stabilise risk not only raises the question of whether firms engage in such trade-offs, but if so, are these strategies effective in stabilising risk and are they consistent with maximisation of shareholder wealth. This relationship also has implications for the beta/financial leverage relationship and capital structure research. These questions and implications are examined below.

10.2.3.1 Do firms engage in trade-offs?

The highly significant negative association found by this study indicates that an increase in operating leverage will be accompanied by a decrease in default risk measures of financial leverage, and vice versa. While the correlation analysis employed by this study cannot prove that this is a result of a trade-off hypothesis, when considered in the light of the *a priori* theoretical specification, this is likely.

Practically, financial managers and investors should exercise caution in predicting corporate strategy based on this trade off. The hypothesis is likely to be a better predictor of corporate strategy where:

i. Changes in operating leverage are the driving factor than when changes in default risk financial leverage are the driving factor. The operating leverage decision is based on the asset and cost structure of the business. This decision is often made before the financing decision and offers considerably less flexibility. It is much easier for a company to undertake a rights issue to repay default risk debt with equity than it is to change the production process from capital intensive to labour intensive in order to reduce the relative proportion of fixed costs. Default risk financial leverage is therefore more likely to respond quickly to changes in operating leverage than vice versa.

ii. Companies have relatively higher levels of operating leverage. This is evidenced by the finding that companies with higher levels of operating leverage exhibit greater association with default risk than their lower operating leverage counterparts.

10.2.3.2 What effect do trade-offs have on the beta/financial leverage relationship ?

The trade off findings are unlikely to have serious implications for the relationship between beta and default risk financial leverage. It may seem logical that a change to default risk financial leverage will be accompanied by an opposite change to operating leverage and that the two changes are likely to counteract each other in the determination of the accompanying change in beta. If this was the case a significant positive relationship between beta and default risk financial leverage would not be expected. However, as explained in Section 10.2.3.1, operating leverage is less flexible than financial leverage and therefore less likely to respond quickly to changes in financial leverage than vice versa. Changes in default risk financial leverage are therefore not likely to be fully extinguished by opposite changes in operating leverage, and the existence of a significant positive association between default risk and beta is consistent.

10.2.3.3 Are trade-offs effective in stabilising risk?

Financial and operating leverage are both positively associated components of total corporate risk and any trade-off will therefore stabilise total risk. However, this theoretical relationship does not provide any evidence of the practical efficacy of such strategies in stabilising systematic or undiversifiable risk (beta). From the correlation analysis it is not possible to determine with certainty whether or not operating leverage/default risk trade-offs result in stabilisation of beta. However, the results of this research suggest that trade-off strategies may be effective in risk stabilisation. This is corroborated by the following findings:

i. The finding that operating leverage and default risk financial leverage are relevant risks at both the single company and the portfolio level and do not appear to be diversifiable. Had the results indicated that interest risk measures of financial leverage were traded off against operating leverage, this would not support the effectiveness of the stabilisation strategies as interest risk measures are unrelated to beta.

ii. The finding that an increase in operating leverage may not result in an increase in beta. If this is as a result of the accompanying reduction in default risk, as proposed in this conclusion, then trade-off strategies are effective in stabilising risk. As financial leverage is likely to be more elastic to changes in operating leverage than vice versa, the trade-offs are likely to be more effective when driven by changes to operating leverage than to default risk financial leverage.

10.2.3.4 Does risk stabilisation maximise shareholder wealth?

To the extent that trade-off strategies are effective in stabilising systematic risk, as proposed in section 10.2.3.3, then, *ceteris paribus*, these are consistent with maximisation of shareholder wealth. In the DCF (Discounted Cash Flow) model of corporate value the reduction of risk reduces the required rate of investor's returns (the denominator), which, *ceteris paribus*, increases the net present value.

Shapiro & Titman (1986,p.332) state that even if these risks were diversifiable, and therefore the trade-offs were not effective in reducing systematic risk, risk stabilisation techniques would still be consistent with shareholder value maximisation. They state that although total risk may not affect shareholders' required returns, unsystematic risks, if unmanaged, can substantially reduce the value of the firm. When viewed in terms of the DCF model of firm value, diversifiable risks may not affect the denominator (discount rate), but they can significantly impact the firm's expected cash flows (the numerator).

The authors argue that firms with higher total risk, *ceteris paribus*, are more susceptible to financial distress. Financial difficulties in turn are likely to disrupt the operating side of the business, reducing the level of future operating cash flows. Financial distress can also result in management incentives that conflict with other parties who do business with the firm and this can adversely affect sales and operating costs. Furthermore, variability in corporate cash flows can impact the firm's ability to utilise tax credits and write-offs.

10.2.3.5 What are the capital structure implications of trade-offs?

Although the scope of this report, as defined, has excluded the huge body of capital structure research, its findings have three major implications in this regard. These are:

i. Both local and international research has indicated a lack of consistency in the identification of the determinants of corporate capital structure. Where determinants have indicated significant association this has been inconsistent and/or the degree of explanation has been low. The lack of consistency with respect to operating leverage as a determinant has been shown to stem from the failure to distinguish between the risks inherent in different capital structure measures.

ii. The finding that operating leverage explains as much as 32% of default risk financial leverage at the single company level and 83% at the portfolio level represents the highest level of association of any capital structure determinant examined by the reviewed prior research.

iii. Prior research has proposed the matching theory of corporate capital structure. This theory states that companies match the maturity of their financing (both debt and equity) to the maturity of their assets. The finding of the highly significant negative relationship between operating leverage and the non-interest bearing measures (class two) of default risk financial leverage would support this theory. The class two measures are highly correlated with short term debt measures which would be expected to decrease as the proportion of fixed (i.e. long term) assets increases. No conclusion can be drawn in respect of the interest bearing or total debt measures of leverage as these exclude equity and the matching theory refers to total financing.

10.3 SUGGESTIONS FOR FURTHER RESEARCH

While the balance sheet findings of this research are consistent and provide a basis for reconciling prior research, they are based on a limited sample size and a limited time period. The results should therefore be regarded as indicative rather than conclusive and should serve as a basis for future research. Some of the possible future research areas include:

i. The impact of risk classes on the inter-relationships should be examined. The concept of upper and lower relationships that was examined in this study should be extended to more than two classes in an effort to test for the existence of risk thresholds beyond which the relationships are significant but below which there is little impact, or vice versa. The total sample should be as large as possible to achieve the maximum data points for each risk class. The starting point should be the classes which were found by this research to differ with respect to significance of association, i.e. the high and low beta companies in the beta/default risk relationship, and the high and low operating leverage companies in the operating leverage/default risk trade-off

ii. The inter-relationships should be examined within groupings of similar industry sectors. This applies particularly to the operating leverage relationships. The operating risks in different industries are often quite different and this may result in the masking of the significance of relationships where no industry differentiation is

made. If the relationships are found to differ across industries this has important implications for investors and financial managers who are predicting changes in risk or corporate strategy based on the findings of this study.

iii. The methodology of this study should be incorporated into a study involving sub-periods and time series analysis of balance sheet relationships, so that the significant inter-relationships may be examined over time. The time series analysis may be achieved by the regression of corresponding dependent and independent variable observations collected over a number of years or by examining the relationship between the changes in the independent and dependent variables.

iv. Social Science based research should be conducted into the decision processes of investors and corporate strategy formulators in an attempt to establish whether the significant relationships identified by this study are based on a cause and effect relationship, or exist as a result of mutual correlation with another unidentified variable. This researcher has little expertise in this type of research and is therefore unable to make constructive suggestions regarding methodological design.

v. The impact of "South African factors" on the relationships should be examined. These would include the effect of pyramid companies, the relatively high historical inflation rate and relatively low real interest rates, restricted access to international capital markets and foreign exchange restrictions.

vi. The methodology of this study should be repeated on as many different samples over as many different time periods as possible. In the words of **McQueen (1986,p.73)**:

> "Karl Popper is a philosopher of science who has pointed out that, even if a particular theory were "right," you could never actually prove it. All you can ever hope to do is prove that it is wrong. If you have a new theory, you keep testing it in as many different ways as possible to see if it doesn't work. As long as it works fairly well, you can assume that it might be right, but you will never know for sure. A good theory is generally reckoned to be one that works quite well most of the time."

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APPENDIX 1

COMPANY SAMPLE

ABBREVI-ATION	COMPANY NAME	YEAR END	SECTOR
ADCOCK	Adcock Ingram Ltd.	September	Pharmaceutical and Medical
ADONIS	Adonis Knitwear Holdings Ltd.	September	Clothing, Footwear and Textiles
AECI	A E C I Ltd.	December	Chemicals and Oils
AFCOL	Associated Furniture Companies Ltd.	March	Furniture and Household
AFROX	African Oxygen Ltd.	September	Engineering
ALEXNDR	Fraser Alexander Ltd.	June	Engineering
AMREL	Amalgamated Retail Ltd.	March	Furniture and Household
ANG ALPHA	Anglo Alpha Ltd.	December	Building and Construction
BERZACK	Berzack-Illman Investment Corporation Ltd.	June	Engineering
BLUE CIRC	Blue Circle Ltd.	December	Building and Construction
BOUMAT	Boumat Ltd.	March	Building and Construction
CADSWEP	Cadbury-Schweppes SA Ltd.	December	Food
CAXTON	Caxton Ltd.	March	Printing and Publishing
CEMENCO	Cementation Co (Africa) Ltd.	September	Engineering
CHUBB	Chubb Holdings Ltd.	March	Engineering
CLAUDE NE	Claude Neon Ltd.	June	Engineering
CNAGALO	C N A Gallo Ltd.	March	Retailers and Wholesalers
COATES	Coates Brothers SA Ltd.	December	Paper and Packaging
CONCOR	Concor Ltd.	June	Building and Construction
CROOKES	Crookes Brothers Ltd.	March	Sugar
DELTA	Delta Electrical Industries Ltd.	December	Electronics, Electrical and Bat
DORBYL	Dorbyl Ltd.	September	Engineering
ED L BATE	Edward L Bateman Ltd.	June	Engineering
FEDFOOD	Fedfood Ltd.	March	Food
FOSCHINI	Foschini Ltd.	December	Retailers and Wholesalers
FRAME	Frame Group Holdings Limited	June	Clothing, Footwear and Textiles
GEN OPTIC	General Optical Co Ltd.	June	Pharmaceutical and Medical
GOLDSTEIN	S M Goldstein Ltd.	June	Building and Construction
GRINAKER	Grinaker Holdings Ltd.	June	Building and Construction
HAGGIE	Haggie Ltd.	December	Engineering
HIVELD	Highveld Steel and Vanadium Corp Ltd.	December	Steel and Allied
I C S	Imperial Cold Storage and Supply Co Ltd.	September	Food
I & J	Irvin & Johnson Ltd.	June	Food
LTA	L T A Ltd.	March	Building and Construction
MCCARTHY	McCarthy Group Ltd.	June	Motor
METAIR	Metair Investments Ltd.	December	Motor
METAL CLO	Metal Closures Group SA Ltd.	December	Paper and Packaging

ABBREVI-ATION	COMPANY NAME	YEAREND	SECTOR
MOBILE	Mobile Industries Ltd.	June	Transportation
NAMPAK	Nampak Ltd.	September	Paper and Packaging
NEI AFR	NEI Africa Holdings Ltd.	December	Engineering
NINIAN	Ninian and Lester Holdings Ltd.	December	Clothing, Footwear and Textiles
O K	O K Bazaars Ltd.	March	Retailers and Wholesalers
OCFISH	Oceana Fishing Group Ltd.	September	Fishing
OMNIA	Omnia Holdings Ltd.	December	Chemicals and Oils
OTIS	Otis Elevator Co Ltd.	November	Building and Construction
PEPKOR	Pepkor Ltd.	February	Retailers and Wholesalers
PICKNPAY	Pick 'n Pay Stores Ltd.	February	Retailers and Wholesalers
PORT	Brian Porter Holdings Ltd.	June	Motor
PORTHLD	Portland Holdings Ltd.	August	Building and Construction
POWTECH	Power Technologies Ltd.	February	Electronics, Electrical and Bat
PPC	Pretoria Portland Cement Co Ltd.	September	Building and Construction
PREM GRP	Premier Group Ltd.	March	Food
PROGRESS	Progress Industries Ltd.	December	Clothing, Footwear and Textiles
PUTCO	Putco Ltd.	June	Transportation
REUNERT	Reunert Ltd.	September	Electronics, Electrical and Bat
REX TRUE	Rex Trueform Clothing Co Ltd.	June	Clothing, Footwear and Textiles
ROMATEX	Romatex Ltd.	September	Clothing, Footwear and Textiles
SAFICON	Saficon Investments Ltd.	March	Motor
SEARDEL	Seardel Investment Corporation Ltd	June	Clothing, Footwear and Textiles
SENTRCHEM	Sentrachem Ltd.	March	Chemicals and Oils
SUNCRUSH	Suncrush Ltd.	June	Beverages and Hotels
SUTHSUN	Southern Sun Hotel Holdings Ltd.	March	Beverages and Hotels
TEGKOR	Technical Investment Corporation Ltd.	March	Tobacco and Match
TIGR OATS	Tiger Oats Ltd.	September	Food
TONGAAT	Tongaat-Hulett Group Ltd.	March	Sugar
TOYOTA	Toyota SA Ltd.	December	Motor
TRADGRO	Tradegro Ltd.	June	Retailers and Wholesalers
TRENCOR	Trencor Ltd.	June	Transportation
UNIHOLD	Unihold Ltd.	December	Engineering
USKO	Usko Limited	September	Steel and Allied
UTICO	Utico Holdings Ltd.	December	Tobacco and Match
VALARD	Valard Ltd.	March	Engineering
WALTONS	Waltons Stationery Co Ltd.	February	Retailers and Wholesalers
WINBEL	Winbel Ltd.	September	Engineering
WOOLTRU	Wooltru Ltd	June	Retailers and Wholesalers
YORKCOR	York Timber Organisation Ltd.	December	Building and Construction

APPENDIX 2

EQUIVALENT DIVIDEND MEASUREMENT

i. Capitalisation issue

A capitalisation, or "bonus" issue, involves a free issue of full paid shares to existing shareholders in proportion to their original holding. The increase in issued share capital is made from the companies' reserves. The new shares rank *pari passu* (equally) with existing shares of the same class. Theoretically, the market value of the investors' holding remains unchanged as the share price declines sufficiently to offset the increase in share holding. The equivalent dividend formula for a capitalisation issue is as follows:

$$ED_{i.t} = r_d * P_{i.t} \qquad \text{(a.1)}$$

Where:

$ED_{i.t}$ = equivalent dividend of share i at the end of period t, where the ex capitalisation date fell within period t.

r_d = number of new shares received for each one share held at the last day to register.

$P_{i.t}$ = price of share$i$ at the end of period t.

ii. Rights issue

A rights issue involves the issue of letters of allocation by the company to its shareholders. Such letters entitle the shareholder to purchase fully paid new shares in proportion to his existing shareholding. The letters of allocation (nil paid letters) may be traded on the market until the ex rights date, or alternatively they may be exercised by purchasing the offered shares. This study assumed that existing

shareholders always exercised their rights. The equivalent dividend formula for a rights issue is as follows:

$$ED_{i.t} = \frac{P_{i.t-1} * P_{i.t} * (1 + r_r)}{P_{i.t-1} + (r_r * PR_{i.t})} - P_{i.t} \qquad \text{(a.2)}$$

Where:

$ED_{i.t}$ = equivalent dividend of share i at the end of period t where the ex-rights date fell within period t.

r_r = number of new shares received for each one held at the last day to register.

$PR_{i.t}$ = issued price for each new share in rights issue of share i.

All other symbols have been previously defined.

iii. Share splits, consolidations and a combination of the two

A share split involves the effective division of existing shares into a greater number of new shares. To effect this, the company issues new shares in direct proportion to the existing shareholding, but without increasing issued share capital. Share splits are designed to lower the price of very highly priced shares, making them more marketable.

A share consolidation is the exact opposite of a share split. It involves the effective addition of existing shares into a lesser number of "new" shares. To effect this, the company may cancel all existing shares and issue a lesser number of new shares in direct proportion to the existing shareholding. Issued share capital is not reduced. Share consolidations are designed to increase the price of very low priced shares, in the hope that it will make them more attractive to investors.

The equivalent dividend formula used share splits, share consolidations or a combination of the two is as follows:

$$ED_{i.t} = P_{i.t} * \left(\frac{r_s}{r_c} - 1\right) \qquad \text{(a.3)}$$

Where:

$ED_{i.t}$ = equivalent dividend of share i at the end of period t where the subdivided shares were listed in period t.

r_s = number of new shares into which a single share has been split during period t.

r_c = number of shares consolidated into a single share during period t.

All other symbols have been previously defined.

When calculating the equivalent dividend from a share split only, r_c in equation (a.3) should be set equal to one. When calculating the equivalent dividend from a share consolidation only, r_s in equation (a.3) should be set equal to one.

iv. Reduction of capital

When a company announced a reduction of capital and this was accompanied by a cash repayment of the capital, the formula for the equivalent dividend was as follows:

$$Ed_{i.t} = CR \qquad \text{(a.4)}$$

Where:

CR = amount of capital repaid per share.

All other symbols have been previously defined.

APPENDIX 3

MARKET MODEL ESTIMATES

COMPANY	OBS.	*r*	ALPHA	BETA	STD. ERR. BETA	*t*-VALUE BETA	UNLEV. BETA
POWTECH	79	0.538	0.002	1.480	0.265	5.595	0.547
GOLDSTEIN	79	0.542	-0.009	1.451	0.256	5.658	0.406
TRADGRO	79	0.541	-0.009	1.339	0.237	5.642	0.098
GRINAKER	78	0.649	0.006	1.294	0.174	7.432	0.447
REUNERT	78	0.600	0.015	1.290	0.197	6.536	0.361
CHUBB	79	0.485	0.006	1.281	0.264	4.861	0.503
UNIHOLD	74	0.548	0.007	1.214	0.218	5.563	0.479
WINBEL*	79	0.313	-0.021	1.146	0.396	2.890	-0.118
VALARD*	77	0.439	-0.022	1.126	0.266	-4.232	0.393
SENTRCHE	79	0.570	0.009	1.113	0.183	6.093	0.514
MCARTHY	79	0.548	0.008	1.107	0.193	5.744	0.508
BLUE CIRC	78	0.653	0.002	1.086	0.144	7.521	0.648
TOYOTA	73	0.501	0.005	1.078	0.221	4.873	0.647
DELTA	78	0.544	0.007	1.074	0.190	5.646	0.578
USKO	78	0.358	0.022	1.066	0.319	3.341	0.431
FOSCHNI	73	0.558	0.006	1.061	0.187	5.670	0.504
ICS	79	0.599	0.005	1.045	0.159	6.568	0.508
ED-L-BAT	75	0.490	-0.007	1.037	0.216	4.802	0.262
DORBYL	78	0.613	0.005	1.033	0.153	6.771	0.553
SEARDEL	79	0.466	0.006	1.003	0.217	4.624	0.298
PUTCO	78	0.256	0.007	1.001	0.433	2.310	0.748
WALTONS	79	0.486	0.008	0.968	0.198	4.881	0.209
HIVELD	77	0.437	0.008	0.964	0.229	4.204	0.643
ADONIS	73	0.424	0.015	0.943	0.239	3.943	0.554
FEDFOOD	79	0.501	-0.004	0.922	0.182	5.075	0.452
CADSWEP	71	0.425	0.013	0.922	0.237	3.896	0.472
CNAGALO	79	0.508	0.009	0.921	0.178	5.180	0.435
PICKNPAY	79	0.602	-0.007	0.920	0.139	6.623	0.281
TONGAAT	79	0.672	0.000	0.917	0.115	7.972	0.630
SUNCRUSH	75	0.629	0.005	0.907	0.131	6.909	0.586
TEGKOR	78	0.565	0.012	0.891	0.149	5.964	0.454
NAMPAK	79	0.645	0.001	0.889	0.120	7.408	0.424
PEPKOR	79	0.310	0.008	0.882	0.308	2.861	0.255
PREM-GRP	78	0.575	0.002	0.880	0.144	6.125	0.540
TRENCOR	71	0.514	0.017	0.874	0.176	4.978	0.492
GEN-OPTI	31	0.569	0.026	0.859	0.248	3.462	0.272
SAFICON	78	0.405	0.012	0.847	0.219	3.861	0.312

COMPANY NAME	OBS.	r	ALPHA	BETA	STD. ERR. BETA	t-VALUE BETA	UNLEV. BETA
L-T-A	79	0.381	-0.008	0.841	0.232	3.620	0.183
ALEXNDR	76	0.382	0.001	0.827	0.233	3.555	0.358
PPC	79	0.709	0.005	0.825	0.094	8.816	0.679
PORT	64	0.419	0.007	0.822	0.226	3.637	0.303
METAIR	69	0.502	-0.002	0.821	0.173	4.745	0.558
TIGR-OAT	79	0.579	0.006	0.801	0.129	6.232	0.327
WOOLTRU	79	0.634	0.003	0.792	0.110	7.187	0.338
PORTHLD	73	0.410	0.021	0.789	0.208	3.787	0.506
I-&-J	79	0.543	0.006	0.787	0.139	5.672	0.424
OMNIA	74	0.410	0.015	0.765	0.200	3.820	0.268
CONCOR	79	0.265	-0.001	0.762	0.317	2.407	0.157
AMREL	75	0.342	-0.006	0.735	0.237	3.105	0.327
SUTHSUN	78	0.355	-0.002	0.735	0.222	3.309	0.433
UTICO	75	0.305	0.013	0.727	0.266	2.732	0.419
AECI	78	0.511	-0.002	0.714	0.138	5.183	0.333
BOUMAT	76	0.509	0.001	0.707	0.139	5.093	0.184
ROMATEX	79	0.592	0.003	0.699	0.109	6.438	0.435
AFCOL	78	0.409	-0.001	0.693	0.177	3.904	0.362
MOBILE	72	0.378	0.016	0.679	0.199	3.415	0.412
ANG-ALPH	78	0.555	0.002	0.677	0.116	5.822	0.558
O-K	79	0.411	-0.002	0.674	0.170	3.959	0.244
BERZACK	58	0.363	0.026	0.661	0.227	2.913	0.352
FRAME	50	0.438	-0.009	0.656	0.195	3.371	0.500
YORKCOR	34	0.432	0.029	0.633	0.234	2.709	0.330
ADCOCK	49	0.519	0.016	0.631	0.151	4.167	0.347
CEMENCO	71	0.396	0.008	0.623	0.174	3.579	0.248
HAGGIE	72	0.470	0.000	0.613	0.138	4.453	0.368
AFROX	79	0.472	0.003	0.607	0.129	4.692	0.349
COATES	47	0.481	0.010	0.607	0.165	3.678	0.311
CAXTON	31	0.891	0.021	0.600	0.137	4.389	0.192
CROOKES	55	0.481	0.003	0.593	0.148	3.997	0.555
PROGRESS	76	0.403	0.002	0.575	0.152	3.785	0.297
CLAUDE-N	77	0.273	-0.005	0.546	0.222	2.459	0.314
METAL-CL	55	0.586	-0.005	0.535	0.102	5.267	0.364
OTIS	79	0.293	0.001	0.459	0.171	2.693	0.160
NEI-AFR	78	0.432	-0.004	0.445	0.107	4.177	0.175
NINIAN	65	0.353	0.016	0.399	0.133	2.992	0.196
REX-TRUE	64	0.377	0.007	0.352	0.110	3.210	0.241
OCFISH	73	0.281	0.015	0.261	0.106	2.463	0.139

APPENDIX 4

STANDARDISED BALANCE SHEET

CAPITAL EMPLOYED

Ordinary Share Capital

Non-Distributable Reserves

Distributable Reserves

Add: Deferred Taxation

Less: Goodwill & other intangible assets

Ordinary shareholders interest ❍

Outside shareholders interest

Non-Redeemable/convertible/participating preference shares

Other preference shares (debt in preference shares)

Total owners interest

Long term borrowings

Convertible debentures

Non-Convertible debentures (debt in debentures)

EMPLOYMENT OF CAPITAL

Land and Buildings

Less: Accumulated depreciation

Other fixed assets

Less: Accumulated depreciation

Total fixed assets

Investments

Inventory

Debtors

Short term advances

Cash and bank

Other

Current assets

Short term borrowings

Creditors

Bank overdraft

Provision for taxation

Provision for dividends

Current liabilities

❍ = Items stated in bold represent balances or totals

APPENDIX 5

STANDARDISED INCOME STATEMENT

Turnover (Revenue)

Trading Profit

Depreciation expense

Investment income (including dividends from associates) *

Interest expense

Profit before taxation

Taxation (no deferred taxation)

Profit after taxation

Outside shareholders' interest

Preference dividend

Ordinary shareholders Profit

Ordinary dividend

Retained Profits for the year

* = The companies share of earnings retained in associates has been excluded from the income statement.

❍ = Items stated in bold represent balances or totals

APPENDIX 6

STANDARDISED CASH FLOW STATEMENT

	Note
Trading Profit	1
Items not involving a flow of cash	2
Investment income	3
Changes in non-cash components of working capital	4
Operating cash flow before interest, taxation and investment to maintain operations ❍	
Investment to maintain operations	5
Operating cash flow before interest and taxation	
Interest expense	6
Taxation paid	
Operating cash flow	

❍ = Items stated in bold represent balances or totals

Notes:

1. Trading Profit

This item represents trading profit as defined in the standardised income statement. This definition excludes depreciation expense.

2. Items not involving a flow of cash

This item represents the total of incomes and expenses included in trading profit which did not involve a flow of cash. This item does not appear on the standardised income statement, but was obtained from the BFA Financial Database.

3. Investment income

This item represents investment income as defined in the standardised income statement.

4. Changes in non-cash components of working capital

This item represents the cash utilised in increasing, or generated from decreasing, the investments in the non-cash operating components of working capital. It is calculated by summing the movements for the year of the following items: inventory; debtors; other current assets; and creditors. The movements in the provisions for taxation and dividends are not included as they are utilised in determining the cash flow with respect to taxation and dividends. Short term advances and borrowings have been excluded on the basis that they constitute investment and financing cash flows respectively, and not operating cash flows.

5. Investment to maintain operations

This item represents the net cash investment in fixed assets to maintain operations. As a result of difficulties incurred in the measurement of this figure, it was replaced by a surrogate in the form of an inflation adjusted depreciation charge. See Chapter 5, Section 5.2.5 for further details.

6. Interest expense

This item represents the interest expense as defined in the standardised income statement. The actual interest paid in cash could not be calculated as the creditor for interest is not required to be separately disclosed.

APPENDIX 7

1989 RATIO SUMMARY

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST.	C/FLOW	BAL. SHEET			INC. ST.	C/FLOW
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
POWTECH	0.681	0.545	0.681	2.130	0.208	0.069	0.569	0.434	1.782	0.248	0.082
GOLDSTEIN	0.734	0.684	0.637	2.763	-0.145	0.232	0.388	0.338	1.459	-0.275	0.440
TRADGRO	0.940	0.753	0.877	15.642	0.104	0.068	0.730	0.543	12.147	0.133	0.088
GRINAKER	0.695	0.579	0.695	2.276	0.236	0.280	0.625	0.509	2.047	0.263	0.311
REUNERT	0.758	0.622	0.758	3.134	0.213	0.075	0.595	0.459	2.461	0.271	0.096
CHUBB	0.608	0.608	0.584	1.549	0.385	0.238	0.525	0.525	1.337	0.445	0.276
UNIHOLD	0.633	0.560	0.633	1.721	0.354	0.177	0.275	0.203	0.750	0.813	0.406
WINBEL	1.072	0.773	0.875	-14.840	0.145	0.247	0.668	0.369	-9.251	0.233	0.396
VALARD	0.651	0.646	0.651	1.869	0.132	0.028	0.217	0.212	0.624	0.395	0.084
SENTRCHE	0.540	0.535	0.534	1.175	0.250	0.345	0.231	0.225	0.502	0.585	0.809
MCARTHY	0.542	0.538	0.535	1.184	0.442	0.230	0.455	0.451	0.993	0.526	0.274
BLUE CIRC	0.415	0.395	0.409	0.711	0.518	0.399	0.207	0.187	0.354	1.039	0.801
TOYOTA	0.400	0.400	0.400	0.666	0.617	0.659	0.268	0.268	0.447	0.920	0.982
DELTA	0.500	0.430	0.500	0.999	0.598	0.412	0.446	0.376	0.892	0.670	0.461
USKO	0.595	0.595	0.595	1.472	0.185	-0.104	0.185	0.185	0.457	0.596	-0.336
FOSCHNI	0.525	0.524	0.525	1.104	0.544	0.295	0.353	0.352	0.743	0.809	0.439
ICS	0.518	0.509	0.518	1.074	0.190	0.099	0.369	0.360	0.765	0.267	0.138
ED-L-BAT	0.754	0.726	0.754	3.072	0.084	0.106	0.707	0.679	2.878	0.089	0.113
DORBYL	0.472	0.455	0.472	0.894	0.294	0.222	0.367	0.351	0.695	0.377	0.285
SEARDEL	0.708	0.682	0.687	2.427	0.256	0.099	0.357	0.330	1.224	0.508	0.196
PUTCO	0.253	0.253	0.250	0.338	0.518	1.002	0.244	0.244	0.327	0.536	1.036
WALTONS	0.800	0.730	0.744	3.988	0.326	0.065	0.325	0.256	1.622	0.800	0.159
HIVELD	0.333	0.333	0.333	0.499	1.137	1.134	0.329	0.329	0.493	1.151	1.148
ADONIS	0.412	0.412	0.412	0.701	0.789	0.420	0.317	0.317	0.539	1.026	0.546
FEDFOOD	0.517	0.502	0.513	1.070	0.364	0.340	0.377	0.362	0.780	0.500	0.467
CADSWEP	0.496	0.479	0.496	0.984	0.337	0.148	0.274	0.258	0.544	0.609	0.268
CNAGALO	0.534	0.514	0.518	1.146	0.423	0.331	0.508	0.489	1.091	0.444	0.348
PICKNPAY	0.695	0.693	0.695	2.274	0.243	0.221	0.685	0.683	2.243	0.246	0.225
TONGAAT	0.323	0.308	0.311	0.476	0.433	0.273	0.214	0.200	0.316	0.652	0.412
SUNCRUSH	0.391	0.334	0.386	0.642	0.635	0.592	0.297	0.240	0.488	0.837	0.779
TEGKOR	0.841	0.153	0.831	5.282	0.201	0.157	0.811	0.123	5.093	0.208	0.163
NAMPAK	0.534	0.510	0.534	1.146	0.419	0.249	0.340	0.316	0.729	0.658	0.392
PEPKOR	0.723	0.648	0.705	2.613	0.262	0.195	0.491	0.415	1.773	0.386	0.287
PREM-GRP	0.434	0.356	0.414	0.768	0.309	0.195	0.283	0.205	0.501	0.473	0.299
TRENCOR	0.471	0.411	0.457	0.892	0.482	0.301	0.249	0.189	0.472	0.911	0.570
GEN-OPTI	0.684	0.684	0.680	2.161	0.249	0.069	0.231	0.231	0.731	0.735	0.204
SAFICON	0.635	0.626	0.635	1.740	0.367	0.227	0.471	0.463	1.291	0.495	0.306
L-T-A	0.784	0.778	0.784	3.634	0.064	0.051	0.666	0.660	3.088	0.076	0.060
ALEXNDR	0.567	0.567	0.553	1.312	0.439	0.438	0.303	0.303	0.700	0.823	0.819
PPC	0.180	0.176	0.180	0.220	1.291	0.874	0.168	0.164	0.205	1.383	0.936
PORT	0.632	0.624	0.632	1.715	0.234	0.102	0.408	0.401	1.109	0.363	0.158
METAIR	0.329	0.315	0.329	0.491	0.546	0.710	0.269	0.255	0.402	0.667	0.868
TIGR-OAT	0.617	0.554	0.617	1.608	0.310	0.252	0.428	0.366	1.117	0.446	0.364

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST.	C/FLOW	BAL. SHEET			INC. ST.	C/FLOW
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
WOOLTRU	0.574	0.572	0.535	1.345	0.433	0.519	0.483	0.481	1.133	0.515	0.616
PORTHLD	0.366	0.355	0.351	0.578	0.430	0.224	0.235	0.224	0.371	0.669	0.349
I-&-J	0.461	0.461	0.461	0.855	0.525	0.304	0.330	0.330	0.613	0.733	0.424
OMNIA	0.650	0.650	0.650	1.853	0.304	0.240	0.316	0.316	0.903	0.625	0.493
CONCOR	0.794	0.793	0.794	3.859	0.068	0.041	0.722	0.720	3.506	0.075	0.045
AMREL	0.555	0.555	0.551	1.247	0.241	0.210	0.234	0.234	0.526	0.572	0.498
SUTHSUN	0.551	0.313	0.533	1.229	0.082	0.069	0.320	0.082	0.714	0.142	0.119
UTICO	0.424	0.424	0.424	0.735	0.457	0.344	0.362	0.362	0.627	0.535	0.403
AECI	0.539	0.526	0.537	1.170	0.387	0.292	0.336	0.323	0.730	0.620	0.468
BOUMAT	0.742	0.737	0.742	2.875	0.193	0.146	0.603	0.598	2.336	0.238	0.179
ROMATEX	0.378	0.378	0.378	0.607	0.469	0.270	0.291	0.291	0.468	0.608	0.350
AFCOL	0.483	0.472	0.469	0.933	0.261	0.236	0.255	0.244	0.492	0.495	0.447
MOBILE	0.397	0.392	0.397	0.659	0.241	0.180	0.054	0.049	0.089	1.774	1.324
ANG-ALPH	0.177	0.173	0.177	0.215	0.672	0.402	0.099	0.095	0.120	1.204	0.721
O-K	0.642	0.630	0.642	1.790	0.097	0.094	0.462	0.450	1.290	0.135	0.130
BERZACK	0.493	0.446	0.491	0.971	0.518	0.383	0.375	0.328	0.739	0.680	0.504
FRAME	0.450	0.171	0.450	0.820	0.146	0.097	0.393	0.114	0.716	0.167	0.111
YORKCOR	0.479	0.479	0.450	0.920	0.287	0.448	0.228	0.228	0.439	0.603	0.940
ADCOCK	0.450	0.449	0.450	0.818	0.547	0.522	0.356	0.355	0.647	0.691	0.660
CEMENCO	0.602	0.600	0.602	1.510	0.189	-0.152	0.400	0.399	1.005	0.284	-0.228
HAGGIE	0.444	0.350	0.434	0.799	0.488	0.245	0.267	0.172	0.480	0.812	0.407
AFROX	0.433	0.419	0.433	0.763	0.399	0.346	0.193	0.180	0.340	0.895	0.776
COATES	0.492	0.484	0.492	0.967	0.492	0.376	0.394	0.385	0.774	0.614	0.470
CAXTON	0.768	0.493	0.763	3.302	0.235	0.009	0.559	0.284	2.405	0.323	0.012
CROOKES	0.064	0.064	0.063	0.068	1.576	1.580	0.057	0.057	0.061	1.746	1.750
PROGRESS	0.483	0.480	0.478	0.935	0.444	0.342	0.268	0.265	0.518	0.801	0.616
CLAUDE-N	0.425	0.416	0.425	0.739	0.389	-0.145	0.090	0.081	0.156	1.840	-0.685
METAL-CL	0.319	0.319	0.319	0.467	0.642	0.661	0.190	0.190	0.279	1.077	1.110
OTIS	0.651	0.651	0.651	1.864	0.681	0.449	0.445	0.445	1.275	0.995	0.656
NEI-AFR	0.608	0.605	0.603	1.550	0.314	0.252	0.594	0.592	1.516	0.321	0.258
NINIAN	0.509	0.507	0.509	1.038	0.406	0.011	0.286	0.284	0.583	0.723	0.019
REX-TRUE	0.316	0.197	0.316	0.462	0.574	0.240	0.138	0.019	0.202	1.311	0.548
OCFISH	0.477	0.457	0.477	0.914	0.665	0.560	0.426	0.406	0.816	0.745	0.627
STATISTICS											
MAX VAL	1.072	0.793	0.877	15.642	1.576	1.580	0.811	0.720	12.147	1.840	1.750
2nd MAX VAL	0.940	0.778	0.875	5.282	1.291	1.134	0.730	0.683	5.093	1.774	1.324
MIN VAL	0.064	0.064	0.063	-14.840	-0.145	-0.152	0.054	0.019	-9.251	-0.275	-0.685
2nd MIN VAL	0.177	0.153	0.177	0.068	0.064	-0.145	0.057	0.049	0.061	0.075	-0.336
MEAN	0.541	0.494	0.531	1.389	0.393	0.294	0.368	0.321	0.998	0.617	0.425
STD DEV	0.174	0.162	0.163	2.681	0.263	0.275	0.168	0.154	1.947	0.391	0.373

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST.	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
POWTECH	0.111	0.111	0.348	1.270	5.470	0.419	1.806	0.252	0.252	0.256	1.188	1.692
GOLDSTEIN	0.347	0.301	1.304	-0.308	-0.709	0.493	1.134	0.254	0.220	0.420	0.542	1.013
TRADGRO	0.210	0.196	3.495	0.464	2.587	0.304	1.697	0.160	0.149	0.169	1.211	1.306
GRINAKER	0.070	0.070	0.228	2.356	13.313	2.791	15.772	0.191	0.191	0.230	1.219	1.193
REUNERT	0.163	0.163	0.674	0.991	9.182	0.351	3.252	0.253	0.253	0.268	1.238	1.602
CHUBB	0.083	0.080	0.211	2.818	10.862	1.746	6.731	0.275	0.265	0.277	1.194	1.211
UNIHOLD	0.357	0.357	0.972	0.627	3.934	0.313	1.964	0.413	0.413	0.418	1.214	1.179
WINBEL	0.404	0.330	-5.589	0.386	1.737	0.655	2.952	0.255	0.208	0.267	1.180	1.097
VALARD	0.434	0.434	1.246	0.198	1.083	0.042	0.230	0.328	0.328	0.340	1.401	1.636
SENTRCHE	0.310	0.306	0.674	0.436	2.989	0.602	4.131	0.434	0.429	0.504	1.348	1.247
MCARTHY	0.087	0.086	0.191	2.745	11.972	1.427	6.224	0.098	0.097	0.113	1.024	1.027
BLUE CIRC	0.208	0.205	0.357	1.032	10.599	0.796	8.168	0.612	0.602	0.678	1.303	1.234
TOYOTA	0.132	0.132	0.219	1.876	2.917	2.003	3.113	0.430	0.430	0.455	1.330	1.084
DELTA	0.053	0.053	0.106	5.615	21.486	3.866	14.793	0.265	0.265	0.294	1.150	1.183
USKO	0.411	0.411	1.015	0.268	2.546	-0.151	-1.435	0.317	0.317	0.360	1.236	-0.059
FOSCHNI	0.172	0.172	0.362	1.661	8.761	0.901	4.752	0.133	0.133	0.136	1.144	1.115
ICS	0.149	0.149	0.309	0.662	5.308	0.343	2.749	0.415	0.415	0.464	1.380	1.930
ED-L-BAT	0.048	0.048	0.194	1.326	9.335	1.682	11.843	0.108	0.108	0.109	1.345	1.195
DORBYL	0.105	0.105	0.198	1.324	5.284	1.001	3.996	0.357	0.357	0.362	1.228	1.448
SEARDEL	0.351	0.341	1.203	0.517	2.873	0.199	1.107	0.141	0.137	0.146	1.152	1.429
PUTCO	0.008	0.008	0.011	15.970	247.0	30.884	477.7	0.471	0.465	0.570	1.350	1.142
WALTONS	0.474	0.441	2.365	0.549	4.566	0.109	0.906	0.191	0.177	0.200	1.145	1.364
HIVELD	0.004	0.004	0.006	94.611	80.347	94.376	80.148	0.518	0.517	0.534	1.074	1.129
ADONIS	0.095	0.095	0.162	3.419	17.950	1.819	9.550	0.295	0.295	0.300	1.220	1.539
FEDFOOD	0.140	0.139	0.290	1.345	5.700	1.256	5.324	0.380	0.378	0.410	1.257	1.306
CADSWEP	0.222	0.222	0.440	0.754	6.436	0.332	2.830	0.349	0.349	0.403	1.162	1.204
CNAGALO	0.026	0.025	0.055	8.799	49.200	6.894	38.550	0.234	0.227	0.293	1.149	1.173
PICKNPAY	0.010	0.010	0.032	17.357	23.365	15.834	21.315	0.348	0.348	0.388	1.225	1.305
TONGAAT	0.109	0.105	0.160	1.287	4.715	0.813	2.979	0.649	0.626	0.651	1.179	1.507
SUNCRUSH	0.094	0.093	0.155	2.639	12.163	2.458	11.329	0.528	0.521	0.647	1.120	1.104
TEGKOR	0.030	0.030	0.190	5.600	23.070	4.387	18.073	0.090	0.089	0.261	1.039	1.080
NAMPAK	0.194	0.194	0.417	1.151	6.966	0.686	4.148	0.426	0.426	0.433	1.211	1.451
PEPKOR	0.233	0.227	0.841	0.814	11.614	0.605	8.639	0.123	0.120	0.138	1.090	1.087
PREM-GRP	0.151	0.144	0.267	0.887	3.880	0.560	2.452	0.220	0.209	0.416	1.122	1.212
TRENCOR	0.222	0.215	0.420	1.023	8.859	0.640	5.542	0.228	0.221	0.376	1.155	1.181
GEN-OPTI	0.452	0.450	1.430	0.376	2.628	0.104	0.730	0.316	0.315	0.317	1.183	1.713
SAFICON	0.164	0.164	0.449	1.425	7.242	0.882	4.480	0.138	0.138	0.161	1.058	1.030
L-T-A	0.118	0.118	0.546	0.427	2.150	0.340	1.712	0.189	0.189	0.199	2.053	2.236
ALEXNDR	0.264	0.258	0.611	0.943	10.520	0.939	10.476	0.493	0.480	0.507	1.387	1.131
PPC	0.012	0.012	0.015	19.472	56.582	13.182	38.306	0.654	0.654	0.687	1.151	1.500
PORT	0.223	0.223	0.606	0.663	3.630	0.289	1.583	0.185	0.185	0.185	1.105	1.173
METAIR	0.060	0.060	0.089	2.994	8.438	3.896	10.981	0.439	0.439	0.494	1.374	1.090
TIGR-OAT	0.188	0.188	0.491	1.014	6.853	0.826	5.585	0.313	0.313	0.332	1.193	1.256

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
WOOLTRU	0.090	0.084	0.212	2.752	8.289	3.297	9.931	0.415	0.387	0.438	1.155	1.065
PORTHLD	0.131	0.126	0.207	1.201	16.654	0.627	8.692	0.420	0.402	0.455	1.200	1.429
I-&-J	0.131	0.131	0.243	1.850	14.478	1.070	8.376	0.334	0.334	0.342	1.184	1.397
OMNIA	0.333	0.333	0.950	0.594	2.472	0.468	1.950	0.448	0.448	0.462	1.212	1.337
CONCOR	0.073	0.073	0.353	0.748	5.405	0.448	3.237	0.182	0.182	0.187	2.008	2.646
AMREL	0.321	0.319	0.721	0.417	3.337	0.363	2.906	0.129	0.128	0.260	1.235	1.102
SUTHSUN	0.231	0.224	0.516	0.197	2.540	0.165	2.131	0.638	0.617	0.851	1.563	1.553
UTICO	0.062	0.062	0.107	3.127	23.222	2.357	17.500	0.333	0.333	0.333	1.200	1.213
AECI	0.203	0.202	0.440	1.029	5.882	0.777	4.445	0.341	0.340	0.370	1.236	1.591
BOUMAT	0.139	0.139	0.539	1.031	6.622	0.777	4.989	0.042	0.042	0.043	1.068	1.075
ROMATEX	0.086	0.086	0.138	2.058	12.435	1.185	7.159	0.399	0.399	0.406	1.252	1.621
AFCOL	0.228	0.222	0.441	0.553	4.232	0.499	3.823	0.215	0.209	0.293	1.155	1.216
MOBILE	0.343	0.343	0.569	0.278	1.966	0.208	1.467	0.001	0.001	0.005	1.002	1.001
ANG-ALPH	0.078	0.078	0.095	1.521	10.328	0.910	6.179	0.805	0.805	0.846	1.219	1.587
O-K	0.179	0.179	0.500	0.348	2.652	0.336	2.563	0.282	0.282	0.298	1.250	1.321
BERZACK	0.118	0.117	0.232	2.166	7.242	1.604	5.362	0.244	0.243	0.245	1.120	1.193
FRAME	0.057	0.057	0.104	1.155	6.963	0.763	4.597	0.480	0.480	0.489	1.542	1.433
YORKCOR	0.251	0.236	0.481	0.549	6.788	0.856	10.588	0.604	0.568	0.639	1.273	1.039
ADCOCK	0.094	0.094	0.171	2.612	11.760	2.496	11.236	0.406	0.406	0.430	1.178	1.071
CEMENCO	0.201	0.201	0.505	0.564	3.505	-0.454	-2.823	0.309	0.309	0.309	1.598	-0.013
HAGGIE	0.177	0.173	0.319	1.225	9.322	0.614	4.671	0.364	0.355	0.376	1.176	1.469
AFROX	0.240	0.240	0.423	0.721	7.482	0.625	6.485	0.658	0.658	0.704	1.241	1.119
COATES	0.098	0.098	0.193	2.464	10.955	1.884	8.375	0.152	0.152	0.152	1.131	1.161
CAXTON	0.209	0.208	0.898	0.865	5.584	0.032	0.207	0.325	0.323	0.350	1.301	6.627
CROOKES	0.006	0.006	0.007	16.245	46.824	16.286	46.941	0.631	0.629	0.910	1.229	1.180
PROGRESS	0.215	0.213	0.417	0.996	4.986	0.766	3.836	0.462	0.457	0.462	1.096	1.178
CLAUDE-N	0.335	0.335	0.582	0.494	4.488	-0.184	-1.671	0.106	0.106	0.107	1.105	0.894
METAL-CL	0.129	0.129	0.189	1.588	9.520	1.636	9.807	0.503	0.503	0.506	1.541	1.428
OTIS	0.205	0.205	0.588	2.156	34.840	1.421	22.960	0.183	0.183	0.197	1.100	1.078
NEI-AFR	0.013	0.013	0.034	14.177	4.292	11.374	3.443	0.176	0.174	0.178	1.081	1.125
NINIAN	0.223	0.223	0.455	0.927	5.109	0.024	0.134	0.174	0.174	0.199	1.239	13.773
REX-TRUE	0.178	0.178	0.259	1.021	24.538	0.427	10.256	0.096	0.096	0.097	1.082	1.598
OCFISH	0.051	0.051	0.098	6.210	147.9	5.226	124.5	0.239	0.239	0.336	1.136	1.189
STATISTICS												
MAX VAL	0.474	0.450	3.495	94.611	247.0	94.376	477.7	0.805	0.805	0.910	2.053	13.773
2nd MAX VAL	0.452	0.441	2.365	19.472	147.9	30.884	124.5	0.658	0.658	0.851	2.008	6.627
MIN VAL	0.004	0.004	-5.589	-0.308	-0.709	-0.454	-2.823	0.001	0.001	0.005	0.542	-0.059
2nd MIN VAL	0.006	0.006	0.006	0.197	1.083	-0.184	-1.671	0.042	0.042	0.043	1.002	-0.013
MEAN	0.173	0.169	0.391	3.732	15.895	3.431	15.954	0.323	0.319	0.361	1.225	1.505
STD DEV	0.116	0.112	0.871	11.322	33.806	11.542	56.586	0.169	0.168	0.189	0.195	1.592

APPENDIX 8

1988 RATIO SUMMARY

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST. C/FLOW		BAL. SHEET			INC. ST. C/FLOW	
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
POWTECH	0.588	0.399	0.588	1.426	0.215	0.168	0.543	0.354	1.317	0.232	0.182
GOLDSTEIN	0.778	0.745	0.777	3.512	0.026	0.061	0.565	0.531	2.549	0.035	0.084
TRADGRO	0.949	0.773	0.877	18.705	0.113	-0.028	0.701	0.524	13.804	0.153	-0.038
GRINAKER	0.647	0.512	0.647	1.835	0.263	0.122	0.593	0.458	1.682	0.287	0.133
REUNERT	0.771	0.630	0.771	3.373	0.280	0.212	0.637	0.496	2.783	0.339	0.256
CHUBB	0.620	0.620	0.592	1.632	0.312	0.283	0.567	0.567	1.491	0.341	0.310
UNIHOLD	0.639	0.554	0.639	1.768	0.286	0.024	0.253	0.169	0.701	0.722	0.061
WINBEL	0.998	0.826	0.894	422.3	-0.102	-0.116	0.556	0.384	235.2	-0.183	-0.208
VALARD	0.641	0.632	0.641	1.788	0.123	0.166	0.289	0.280	0.805	0.273	0.369
SENTRCHE	0.590	0.523	0.589	1.437	0.167	0.103	0.218	0.152	0.531	0.451	0.278
MCARTHY	0.578	0.575	0.578	1.368	0.369	0.258	0.502	0.499	1.188	0.425	0.297
BLUE CIRC	0.420	0.369	0.397	0.725	0.569	0.349	0.263	0.211	0.453	0.912	0.559
TOYOTA	0.395	0.395	0.395	0.653	0.706	0.521	0.226	0.226	0.374	1.235	0.911
DELTA	0.439	0.405	0.439	0.783	0.608	0.474	0.437	0.403	0.779	0.611	0.477
USKO	0.503	0.398	0.503	1.014	0.297	0.191	0.205	0.100	0.412	0.730	0.470
FOSCHNI	0.531	0.531	0.531	1.133	0.546	0.309	0.407	0.407	0.868	0.713	0.403
ICS	0.502	0.492	0.502	1.008	0.184	0.172	0.369	0.359	0.740	0.251	0.234
ED-L-BAT	0.760	0.755	0.760	3.172	0.066	0.080	0.717	0.711	2.991	0.070	0.085
DORBYL	0.472	0.446	0.472	0.893	0.247	0.100	0.336	0.310	0.636	0.347	0.140
SEARDEL	0.678	0.643	0.658	2.105	0.220	0.146	0.332	0.296	1.029	0.450	0.298
PUTCO	0.175	0.175	0.173	0.212	0.735	0.740	0.161	0.161	0.195	0.801	0.806
WALTONS	0.681	0.594	0.681	2.137	0.423	0.211	0.447	0.360	1.403	0.645	0.321
HIVELD	0.295	0.246	0.294	0.417	0.900	0.652	0.221	0.173	0.314	1.199	0.867
ADONIS	0.369	0.369	0.369	0.585	0.973	0.634	0.225	0.225	0.357	1.596	1.039
FEDFOOD	0.530	0.513	0.530	1.126	0.327	0.324	0.301	0.285	0.641	0.574	0.569
CADSWEP	0.421	0.421	0.421	0.728	0.456	0.471	0.317	0.317	0.548	0.605	0.625
CNAGALO	0.530	0.505	0.513	1.127	0.420	0.431	0.495	0.471	1.053	0.450	0.461
PICKNPAY	0.681	0.679	0.681	2.137	0.231	0.257	0.669	0.667	2.099	0.235	0.262
TONGAAT	0.428	0.405	0.407	0.748	0.329	0.276	0.247	0.224	0.431	0.571	0.479
SUNCRUSH	0.433	0.369	0.427	0.765	0.526	0.584	0.310	0.245	0.547	0.735	0.817
TEGKOR	0.816	0.090	0.816	4.448	0.131	0.165	0.804	0.077	4.378	0.133	0.167
NAMPAK	0.546	0.521	0.546	1.201	0.385	0.273	0.379	0.354	0.833	0.555	0.394
PEPKOR	0.709	0.630	0.709	2.439	0.310	0.314	0.487	0.408	1.675	0.451	0.457
PREM-GRP	0.471	0.348	0.447	0.889	0.235	0.223	0.275	0.153	0.520	0.401	0.381
TRENCOR	0.501	0.436	0.481	1.005	0.454	0.417	0.327	0.261	0.655	0.697	0.640
GEN-OPTI	0.629	0.629	0.626	1.698	0.245	0.131	0.245	0.245	0.661	0.629	0.337
SAFICON	0.638	0.612	0.638	1.760	0.299	0.231	0.422	0.396	1.164	0.452	0.349
L-T-A	0.759	0.754	0.759	3.150	0.055	0.071	0.651	0.646	2.700	0.065	0.083
ALEXNDR	0.583	0.583	0.559	1.399	0.275	0.151	0.258	0.258	0.620	0.621	0.340
PPC	0.190	0.187	0.190	0.235	1.075	0.816	0.158	0.155	0.196	1.293	0.982
PORT	0.617	0.609	0.617	1.612	0.189	0.007	0.437	0.429	1.141	0.267	0.010
METAIR	0.252	0.235	0.252	0.338	0.791	0.322	0.233	0.216	0.312	0.855	0.348
TIGR-OAT	0.630	0.552	0.630	1.700	0.260	0.060	0.406	0.329	1.096	0.404	0.093

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST.	C/FLOW	BAL. SHEET			INC. ST.	C/FLOW
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
WOOLTRU	0.524	0.519	0.491	1.102	0.444	0.419	0.378	0.373	0.796	0.614	0.580
PORTHLD	0.298	0.287	0.283	0.425	0.442	0.195	0.215	0.203	0.306	0.615	0.271
I-&-J	0.473	0.473	0.473	0.898	0.492	0.382	0.324	0.324	0.614	0.720	0.558
OMNIA	0.675	0.626	0.675	2.076	0.216	0.153	0.335	0.286	1.030	0.435	0.308
CONCOR	0.819	0.800	0.819	4.531	0.043	0.049	0.748	0.729	4.139	0.047	0.054
AMREL	0.582	0.582	0.578	1.395	0.174	0.270	0.217	0.217	0.519	0.467	0.725
SUTHSUN	0.465	0.225	0.445	0.868	0.051	0.053	0.311	0.071	0.580	0.076	0.079
UTICO	0.413	0.413	0.413	0.704	0.450	0.338	0.395	0.395	0.674	0.470	0.353
AECI	0.561	0.549	0.559	1.277	0.305	0.108	0.322	0.309	0.732	0.531	0.189
BOUMAT	0.750	0.739	0.750	2.995	0.190	0.135	0.559	0.549	2.234	0.254	0.182
ROMATEX	0.374	0.374	0.374	0.596	0.532	0.340	0.346	0.346	0.553	0.574	0.367
AFCOL	0.473	0.462	0.455	0.897	0.260	0.169	0.274	0.263	0.519	0.449	0.291
MOBILE	0.363	0.356	0.363	0.571	0.225	0.128	0.068	0.061	0.107	1.200	0.683
ANG-ALPH	0.186	0.181	0.186	0.228	0.605	0.482	0.088	0.084	0.109	1.270	1.012
O-K	0.626	0.613	0.626	1.674	0.064	0.107	0.440	0.427	1.176	0.091	0.153
BERZACK	0.568	0.523	0.565	1.316	0.311	0.327	0.382	0.336	0.883	0.463	0.487
FRAME	0.391	0.078	0.391	0.643	0.106	0.162	0.387	0.074	0.636	0.108	0.164
YORKCOR	0.436	0.428	0.404	0.774	0.388	0.483	0.265	0.257	0.470	0.639	0.796
ADCOCK	0.426	0.424	0.426	0.742	0.529	0.313	0.344	0.343	0.600	0.654	0.387
CEMENCO	0.647	0.646	0.647	1.834	0.161	0.074	0.449	0.447	1.272	0.232	0.107
HAGGIE	0.419	0.327	0.407	0.722	0.512	0.325	0.260	0.168	0.448	0.824	0.523
AFROX	0.366	0.349	0.366	0.578	0.464	0.405	0.213	0.197	0.337	0.796	0.694
COATES	0.558	0.549	0.558	1.263	0.374	-0.009	0.421	0.413	0.953	0.496	-0.013
CAXTON	0.692	0.452	0.683	2.247	0.285	0.225	0.530	0.290	1.721	0.372	0.294
CROOKES	0.048	0.048	0.048	0.051	3.058	1.528	0.043	0.043	0.045	3.438	1.717
PROGRESS	0.501	0.497	0.494	1.003	0.366	0.209	0.213	0.209	0.427	0.861	0.492
CLAUDE-N	0.316	0.304	0.316	0.462	0.615	0.201	0.116	0.103	0.169	1.683	0.549
METAL-CL	0.326	0.326	0.326	0.483	0.851	0.400	0.249	0.249	0.370	1.113	0.522
OTIS	0.610	0.610	0.610	1.561	0.846	0.663	0.544	0.544	1.394	0.948	0.743
NEI-AFR	0.577	0.577	0.577	1.364	0.278	0.311	0.553	0.553	1.306	0.291	0.324
NINIAN	0.492	0.489	0.492	0.968	0.457	0.112	0.336	0.333	0.661	0.668	0.163
REX-TRUE	0.362	0.225	0.362	0.567	0.387	0.353	0.141	0.004	0.220	0.996	0.908
OCFISH	0.518	0.494	0.518	1.075	0.743	0.591	0.425	0.401	0.882	0.905	0.720
STATISTICS											
MAX VAL	0.998	0.826	0.894	422.3	3.058	1.528	0.804	0.729	235.2	3.438	1.717
2nd MAX VAL	0.949	0.800	0.877	18.705	1.075	0.816	0.748	0.711	13.804	1.683	1.039
MIN VAL	0.048	0.048	0.048	0.051	-0.102	-0.116	0.043	0.004	0.045	-0.183	-0.208
2nd MIN VAL	0.175	0.078	0.173	0.212	0.026	-0.028	0.068	0.043	0.107	0.035	-0.038
MEAN	0.529	0.477	0.522	7.110	0.405	0.281	0.369	0.317	4.220	0.604	0.415
STD DEV	0.174	0.173	0.169	48.307	0.388	0.237	0.166	0.161	26.897	0.490	0.311

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST.	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
POWTECH	0.045	0.045	0.109	2.803	7.637	2.195	5.981	0.342	0.342	0.345	1.279	1.525
GOLDSTEIN	0.213	0.213	0.963	0.094	0.743	0.221	1.753	0.322	0.322	0.370	2.164	1.336
TRADGRO	0.249	0.230	4.901	0.431	3.756	-0.108	-0.944	0.177	0.163	0.186	1.221	0.266
GRINAKER	0.054	0.054	0.153	3.159	17.839	1.469	8.297	0.206	0.206	0.223	1.249	1.486
REUNERT	0.135	0.135	0.589	1.603	11.471	1.211	8.665	0.286	0.286	0.304	1.220	1.265
CHUBB	0.053	0.051	0.140	3.620	11.670	3.294	10.617	0.266	0.254	0.269	1.190	1.198
UNIHOLD	0.385	0.385	1.067	0.475	3.663	0.040	0.309	0.426	0.426	0.431	1.232	3.736
WINBEL	0.442	0.396	187.1	-0.230	-1.718	-0.262	-1.958	0.294	0.263	0.295	0.705	0.784
VALARD	0.353	0.353	0.983	0.224	1.246	0.302	1.682	0.305	0.305	0.318	1.470	1.077
SENTRCHE	0.372	0.372	0.906	0.264	2.934	0.163	1.808	0.404	0.404	0.496	1.418	1.677
MCARTHY	0.076	0.076	0.180	2.811	13.174	1.965	9.211	0.111	0.111	0.132	1.023	1.027
BLUE CIRC	0.158	0.149	0.272	1.517	6.320	0.930	3.875	0.564	0.533	0.652	1.213	1.571
TOYOTA	0.169	0.169	0.280	1.649	2.808	1.216	2.071	0.460	0.460	0.473	1.267	1.109
DELTA	0.002	0.002	0.004	126.1	74.844	98.263	58.344	0.183	0.183	0.212	1.137	1.172
USKO	0.299	0.299	0.601	0.501	4.406	0.322	2.837	0.395	0.395	0.421	1.234	1.847
FOSCHNI	0.124	0.124	0.265	2.337	16.721	1.322	9.459	0.099	0.099	0.104	1.125	1.197
ICS	0.133	0.133	0.268	0.694	5.550	0.646	5.164	0.420	0.420	0.468	1.423	1.496
ED-L-BAT	0.043	0.043	0.181	1.149	6.056	1.396	7.362	0.129	0.129	0.131	1.512	1.292
DORBYL	0.136	0.136	0.257	0.857	5.478	0.347	2.219	0.379	0.379	0.383	1.278	2.094
SEARDEL	0.346	0.336	1.076	0.431	3.533	0.285	2.337	0.122	0.119	0.133	1.172	1.250
PUTCO	0.014	0.014	0.017	8.972	3167.0	9.031	3188.0	0.476	0.470	0.510	1.454	1.507
WALTONS	0.234	0.234	0.733	1.233	14.882	0.615	7.419	0.183	0.183	0.195	1.102	1.151
HIVELD	0.073	0.073	0.104	3.619	37.968	2.619	27.474	0.638	0.637	0.657	1.151	1.353
ADONIS	0.144	0.144	0.228	2.491	11.360	1.623	7.400	0.185	0.185	0.190	1.123	1.492
FEDFOOD	0.228	0.228	0.485	0.758	4.992	0.751	4.946	0.372	0.372	0.405	1.251	1.246
CADSWEP	0.104	0.104	0.179	1.852	8.394	1.912	8.665	0.299	0.299	0.353	1.158	1.123
CNAGALO	0.035	0.034	0.074	6.426	39.932	6.594	40.974	0.246	0.238	0.319	1.150	1.127
PICKNPAY	0.012	0.012	0.038	13.057	114.3	14.560	127.4	0.353	0.353	0.389	1.261	1.230
TONGAAT	0.181	0.172	0.316	0.778	4.612	0.653	3.873	0.586	0.557	0.596	1.228	1.421
SUNCRUSH	0.124	0.122	0.218	1.844	13.902	2.049	15.446	0.545	0.538	0.657	1.112	1.089
TEGKOR	0.013	0.013	0.070	8.312	38.304	10.426	48.047	0.029	0.029	0.156	1.030	1.032
NAMPAK	0.167	0.167	0.368	1.259	14.597	0.893	10.354	0.435	0.435	0.440	1.231	1.355
PEPKOR	0.222	0.222	0.763	0.990	7.563	1.002	7.655	0.106	0.106	0.122	1.081	1.066
PREM-GRP	0.195	0.185	0.369	0.566	4.004	0.537	3.798	0.271	0.257	0.505	1.153	1.177
TRENCOR	0.175	0.167	0.350	1.303	16.515	1.197	15.172	0.252	0.242	0.392	1.151	1.144
GEN-OPTI	0.384	0.382	1.037	0.401	4.342	0.215	2.329	0.276	0.275	0.277	1.206	1.395
SAFICON	0.216	0.216	0.596	0.883	7.216	0.682	5.567	0.225	0.225	0.275	1.083	1.044
L-T-A	0.108	0.108	0.450	0.387	2.187	0.496	2.798	0.232	0.232	0.248	2.396	1.978
ALEXNDR	0.325	0.311	0.779	0.494	8.337	0.271	4.572	0.554	0.532	0.574	1.602	1.515
PPC	0.032	0.032	0.040	6.370	25.054	4.837	19.024	0.689	0.689	0.723	1.174	1.429
PORT	0.180	0.180	0.471	0.647	5.526	0.025	0.211	0.193	0.193	0.193	1.107	3.650
METAIR	0.019	0.019	0.025	10.514	18.858	4.277	7.671	0.491	0.491	0.506	1.201	1.316
TIGR-OAT	0.224	0.224	0.604	0.732	11.489	0.168	2.640	0.281	0.281	0.317	1.188	1.892

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST.	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
WOOLTRU	0.146	0.137	0.306	1.595	7.719	1.506	7.285	0.473	0.444	0.494	1.177	1.123
PORTHLD	0.084	0.079	0.119	1.576	34.118	0.696	15.059	0.464	0.440	0.498	1.250	1.629
I-&-J	0.150	0.150	0.284	1.557	16.604	1.207	12.874	0.348	0.348	0.352	1.183	1.248
OMNIA	0.340	0.340	1.046	0.428	2.378	0.304	1.688	0.485	0.485	0.498	1.258	1.457
CONCOR	0.071	0.071	0.393	0.491	12.686	0.565	14.600	0.190	0.190	0.193	2.270	2.045
AMREL	0.366	0.363	0.875	0.277	2.438	0.430	3.785	0.121	0.120	0.266	1.276	1.082
SUTHSUN	0.154	0.148	0.288	0.152	1.768	0.160	1.856	0.670	0.642	0.865	1.920	1.778
UTICO	0.018	0.018	0.030	10.426	166.3	7.832	124.9	0.325	0.325	0.325	1.187	1.274
AECI	0.239	0.238	0.545	0.714	8.067	0.254	2.867	0.355	0.354	0.379	1.324	2.488
BOUMAT	0.190	0.190	0.760	0.748	6.175	0.533	4.404	0.043	0.043	0.043	1.065	1.082
ROMATEX	0.027	0.027	0.044	7.259	35.083	4.638	22.417	0.383	0.383	0.389	1.211	1.567
AFCOL	0.199	0.192	0.377	0.618	7.592	0.401	4.927	0.195	0.188	0.259	1.162	1.272
MOBILE	0.295	0.295	0.464	0.277	2.516	0.157	1.432	0.000	0.000	0.002	1.003	1.002
ANG-ALPH	0.097	0.097	0.119	1.155	8.200	0.921	6.539	0.812	0.812	0.864	1.235	1.417
O-K	0.186	0.186	0.498	0.215	2.618	0.360	4.397	0.268	0.268	0.285	1.283	1.263
BERZACK	0.187	0.186	0.432	0.946	5.638	0.995	5.928	0.253	0.251	0.256	1.177	1.181
FRAME	0.004	0.004	0.007	9.289	30.943	14.170	47.204	0.513	0.513	0.525	1.854	1.277
YORKCOR	0.171	0.159	0.304	0.989	6.910	1.231	8.603	0.572	0.530	0.612	1.180	1.079
ADCOCK	0.082	0.082	0.142	2.761	10.383	1.634	6.146	0.390	0.390	0.411	1.174	1.182
CEMENCO	0.198	0.198	0.562	0.525	3.969	0.243	1.832	0.360	0.360	0.360	1.682	2.641
HAGGIE	0.159	0.155	0.274	1.349	18.229	0.856	11.577	0.359	0.349	0.374	1.176	1.392
AFROX	0.153	0.153	0.241	1.112	15.217	0.969	13.268	0.672	0.672	0.721	1.225	1.137
COATES	0.137	0.137	0.310	1.527	33.290	-0.038	-0.839	0.155	0.155	0.155	1.131	-4.731
CAXTON	0.162	0.160	0.526	1.220	8.559	0.963	6.755	0.423	0.418	0.464	1.326	1.228
CROOKES	0.005	0.005	0.006	27.675	50.318	13.825	25.136	0.633	0.633	0.914	1.145	1.192
PROGRESS	0.288	0.284	0.576	0.638	7.969	0.364	4.552	0.479	0.472	0.479	1.106	1.259
CLAUDE-N	0.201	0.201	0.293	0.970	13.689	0.317	4.467	0.104	0.104	0.104	1.081	1.179
METAL-CL	0.076	0.076	0.113	3.627	33.136	1.703	15.559	0.455	0.455	0.455	1.359	1.675
OTIS	0.066	0.066	0.168	7.873	119.2	6.170	93.4	0.212	0.212	0.214	1.089	1.082
NEI-AFR	0.024	0.024	0.058	6.600	3.998	7.366	4.461	0.194	0.194	0.197	1.120	1.115
NINIAN	0.156	0.156	0.306	1.441	10.261	0.352	2.507	0.200	0.200	0.225	1.182	2.446
REX-TRUE	0.221	0.221	0.346	0.633	14.557	0.577	13.273	0.096	0.096	0.097	1.116	1.303
OCFISH	0.093	0.093	0.193	4.138	294.2	3.291	234.1	0.190	0.190	0.208	1.095	1.135
STATISTICS												
MAX VAL	0.442	0.396	187.1	126.1	3167.0	98.263	3188.0	0.812	0.812	0.914	2.396	3.736
2nd MAX VAL	0.385	0.385	4.901	27.675	294.2	14.560	234.1	0.689	0.689	0.865	2.270	3.650
MIN VAL	0.002	0.002	0.004	-0.230	-1.718	-0.262	-1.958	0.000	0.000	0.002	0.705	-4.731
2nd MIN VAL	0.004	0.004	0.006	0.094	0.743	-0.108	-0.944	0.029	0.029	0.043	1.003	0.266
MEAN	0.160	0.157	2.890	4.278	62.818	3.363	58.256	0.332	0.327	0.366	1.265	1.337
STD DEV	0.108	0.105	21.421	14.734	363.2	11.508	365.4	0.175	0.172	0.194	0.270	0.880

APPENDIX 9

AVERAGE RATIO SUMMARY

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST. C/FLOW		BAL. SHEET			INC. ST. C/FLOW	
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
POWTECH	0.631	0.425	0.631	1.737	0.204	0.143	0.562	0.356	1.540	3.168	0.158
GOLDSTEIN	0.731	0.701	0.697	2.798	-0.009	0.103	0.506	0.476	1.923	0.548	0.181
TRADGRO	0.933	0.784	0.868	14.811	0.098	0.020	0.676	0.526	10.854	1.485	0.026
GRINAKER	0.609	0.512	0.609	1.684	0.254	0.222	0.555	0.458	1.532	6.557	0.243
REUNERT	0.758	0.612	0.758	3.137	0.235	0.186	0.623	0.477	2.578	4.819	0.222
CHUBB	0.605	0.605	0.576	1.532	0.335	0.318	0.554	0.554	1.401	5.302	0.343
UNIHOLD	0.659	0.572	0.659	1.963	0.290	0.068	0.288	0.201	0.864	2.087	0.158
WINBEL	1.014	0.757	0.843	147.611	0.041	0.003	0.643	0.386	83.844	0.631	0.006
VALARD	0.658	0.637	0.658	1.933	0.070	0.192	0.260	0.239	0.762	0.430	0.470
SENTRCHE	0.602	0.565	0.599	1.564	0.177	0.196	0.212	0.176	0.537	1.448	0.530
MCARTHY	0.557	0.553	0.555	1.259	0.378	0.254	0.459	0.456	1.040	5.428	0.309
BLUE CIRC	0.422	0.395	0.402	0.731	0.514	0.374	0.211	0.184	0.365	3.786	0.783
TOYOTA	0.376	0.376	0.376	0.607	0.713	0.690	0.231	0.231	0.373	1.720	1.128
DELTA	0.450	0.403	0.450	0.826	0.618	0.434	0.431	0.384	0.788	24.604	0.452
USKO	0.550	0.477	0.550	1.236	0.246	0.043	0.181	0.108	0.404	1.904	0.096
FOSCHNI	0.527	0.526	0.527	1.113	0.530	0.282	0.374	0.373	0.790	6.899	0.398
ICS	0.509	0.500	0.509	1.039	0.180	0.145	0.360	0.350	0.734	2.913	0.205
ED-L-BAT	0.744	0.732	0.744	2.923	0.088	0.041	0.697	0.685	2.739	4.128	0.043
DORBYL	0.474	0.444	0.474	0.902	0.230	0.146	0.350	0.320	0.666	2.615	0.196
SEARDEL	0.692	0.658	0.672	2.254	0.222	0.060	0.332	0.298	1.082	1.720	0.115
PUTCO	0.234	0.234	0.232	0.310	0.512	0.560	0.168	0.168	0.220	570.2	0.556
WALTONS	0.721	0.651	0.703	2.759	0.390	0.155	0.413	0.343	1.499	5.226	0.252
HIVELD	0.358	0.253	0.357	0.575	0.762	0.652	0.240	0.135	0.371	21.126	0.820
ADONIS	0.429	0.429	0.429	0.768	0.744	0.451	0.269	0.269	0.477	7.701	0.719
FEDFOOD	0.545	0.531	0.544	1.211	0.323	0.303	0.314	0.299	0.688	2.478	0.527
CADSWEP	0.455	0.450	0.455	0.842	0.387	0.270	0.287	0.281	0.527	3.853	0.403
CNAGALO	0.527	0.503	0.509	1.114	0.395	0.371	0.487	0.463	1.030	16.554	0.402
PICKNPAY	0.689	0.688	0.689	2.219	0.230	0.202	0.674	0.673	2.171	31.489	0.206
TONGAAT	0.403	0.382	0.384	0.692	0.336	0.254	0.227	0.205	0.385	2.277	0.445
SUNCRUSH	0.403	0.350	0.397	0.678	0.621	0.547	0.297	0.244	0.500	7.867	0.741
TEGKOR	0.822	0.104	0.819	4.657	0.153	0.151	0.803	0.086	4.548	15.843	0.155
NAMPAK	0.541	0.479	0.541	1.177	0.385	0.260	0.389	0.328	0.848	5.929	0.366
PEPKOR	0.797	0.714	0.791	9.410	0.219	0.270	0.447	0.363	4.065	3.401	0.514
PREM-GRP	0.444	0.341	0.429	0.801	0.252	0.211	0.260	0.158	0.470	1.992	0.364
TRENCOR	0.472	0.406	0.455	0.897	0.468	0.366	0.291	0.226	0.554	6.145	0.592
GEN-OPTI	0.630	0.630	0.626	1.739	0.270	0.092	0.264	0.264	0.713	2.364	0.227
SAFICON	0.638	0.617	0.638	1.763	0.301	0.216	0.419	0.398	1.157	3.373	0.331
L-T-A	0.759	0.754	0.759	3.184	0.059	0.052	0.645	0.640	2.706	1.141	0.061
ALEXNDR	0.559	0.559	0.534	1.276	0.321	0.321	0.275	0.275	0.626	5.289	0.636
PPC	0.180	0.176	0.180	0.220	1.098	0.749	0.146	0.142	0.178	16.046	0.921
PORT	0.608	0.600	0.608	1.562	0.215	0.123	0.434	0.425	1.109	2.452	0.165
METAIR	0.275	0.264	0.275	0.383	0.658	0.499	0.245	0.234	0.340	9.311	0.567
TIGR-OAT	0.600	0.536	0.600	1.514	0.284	0.194	0.405	0.341	1.022	4.982	0.282

	DEFAULT FINANCIAL LEVERAGE 1						DEFAULT FINANCIAL LEVERAGE 2				
	BAL. SHEET				INC. ST. C/FLOW		BAL. SHEET			INC. ST. C/FLOW	
COMPANY	TLIA/ TASS	ATLIA / TASS	TLIA/ ATASS	TLIA/ EQUITY	EBIT/ TLIA	CASH2/ TLIA	NIBD/ TASS	ANIBD/ TASS	NIBD/ EQUITY	EBIT / NIBD	CASH2 / NIBD
WOOLTRU	0.554	0.550	0.518	1.247	0.388	0.375	0.395	0.391	0.891	4.386	0.508
PORTHLD	0.320	0.309	0.304	0.474	0.506	0.304	0.235	0.224	0.346	136.7	0.397
I-&-J	0.469	0.469	0.469	0.883	0.486	0.362	0.333	0.333	0.628	7.524	0.509
OMNIA	0.700	0.670	0.700	2.456	0.212	0.137	0.272	0.243	0.889	1.389	0.297
CONCOR	0.810	0.786	0.810	4.293	0.059	0.037	0.738	0.714	3.910	3.761	0.041
AMREL	0.589	0.589	0.586	1.450	0.116	0.162	0.214	0.214	0.522	0.861	0.414
SUTHSUN	0.486	0.260	0.467	0.964	0.057	0.040	0.294	0.068	0.582	1.198	0.065
UTICO	0.410	0.410	0.410	0.696	0.458	0.406	0.375	0.375	0.636	36.196	0.443
AECI	0.540	0.527	0.539	1.178	0.336	0.193	0.317	0.303	0.690	3.714	0.326
BOUMAT	0.752	0.737	0.752	3.046	0.167	0.119	0.563	0.547	2.271	2.631	0.157
ROMATEX	0.368	0.368	0.368	0.582	0.484	0.344	0.321	0.321	0.507	11.202	0.391
AFCOL	0.469	0.458	0.454	0.885	0.249	0.163	0.247	0.236	0.467	2.711	0.307
MOBILE	0.364	0.358	0.364	0.575	0.230	0.120	0.060	0.055	0.095	1.211	0.769
ANG-ALPH	0.198	0.193	0.198	0.248	0.543	0.390	0.082	0.077	0.101	4.244	0.962
O-K	0.611	0.599	0.611	1.588	0.075	0.040	0.419	0.407	1.094	1.341	0.052
BERZACK	0.556	0.513	0.553	1.278	0.344	0.303	0.334	0.290	0.748	2.780	0.495
FRAME	0.409	0.113	0.409	0.695	0.118	0.145	0.388	0.092	0.658	11.751	0.151
YORKCOR	0.500	0.494	0.463	1.035	0.252	0.348	0.235	0.229	0.473	2.775	0.683
ADCOCK	0.427	0.425	0.427	0.747	0.518	0.395	0.349	0.348	0.610	7.786	0.485
CEMENCO	0.643	0.641	0.643	1.824	0.152	0.054	0.433	0.431	1.228	1.807	0.080
HAGGIE	0.431	0.311	0.420	0.759	0.504	0.317	0.274	0.153	0.481	9.264	0.496
AFROX	0.376	0.360	0.376	0.611	0.478	0.471	0.212	0.195	0.340	6.083	0.808
COATES	0.531	0.525	0.531	1.140	0.405	0.240	0.421	0.415	0.903	12.081	0.295
CAXTON	0.757	0.510	0.746	3.286	0.251	0.132	0.539	0.292	2.311	3.485	0.185
CROOKES	0.067	0.067	0.066	0.072	1.817	1.482	0.047	0.047	0.050	22.857	2.142
PROGRESS	0.466	0.462	0.459	0.881	0.445	0.247	0.226	0.222	0.428	4.692	0.502
CLAUDE-N	0.336	0.324	0.336	0.523	0.579	0.227	0.110	0.097	0.165	4.897	0.410
METAL-CL	0.329	0.329	0.329	0.490	0.729	0.577	0.249	0.249	0.372	28.950	0.792
OTIS	0.593	0.593	0.593	1.499	0.916	0.880	0.491	0.491	1.223	34.641	1.012
NEI-AFR	0.577	0.577	0.576	1.375	0.299	0.270	0.546	0.545	1.303	2.493	0.285
NINIAN	0.493	0.491	0.493	0.975	0.408	0.011	0.309	0.307	0.611	3.933	0.014
REX-TRUE	0.356	0.222	0.356	0.558	0.438	0.307	0.137	0.002	0.213	8.223	0.810
OCFISH	0.506	0.474	0.506	1.027	0.663	0.541	0.439	0.407	0.891	100.2	0.626
STATISTICS											
MAX VAL	1.014	0.786	0.868	147.6	1.817	1.482	0.803	0.714	83.844	570.2	2.142
2nd MAX VAL	0.933	0.784	0.843	14.811	1.098	0.880	0.738	0.685	10.854	136.7	1.128
MIN VAL	0.067	0.067	0.066	0.072	-0.009	0.003	0.047	0.002	0.050	0.430	0.006
2nd MIN VAL	0.180	0.104	0.180	0.220	0.041	0.011	0.060	0.047	0.095	0.548	0.014
MEAN	0.534	0.482	0.526	3.562	0.375	0.281	0.362	0.309	2.206	17.328	0.424
STD DEV	0.171	0.167	0.163	16.863	0.272	0.230	0.164	0.156	9.598	67.258	0.329

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST.	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
POWTECH	0.069	0.069	0.197	2.148	6.011	1.669	4.253	0.326	0.326	0.329	1.274	1.568
GOLDSTEIN	0.225	0.209	0.875	0.112	0.789	0.268	1.091	0.319	0.307	0.394	1.362	1.735
TRADGRO	0.257	0.240	3.957	0.372	2.797	0.084	0.421	0.186	0.173	0.200	1.278	1.299
GRINAKER	0.054	0.054	0.151	2.974	12.888	2.549	10.513	0.227	0.227	0.264	1.271	1.382
REUNERT	0.135	0.135	0.559	1.359	9.369	1.152	7.151	0.270	0.270	0.290	1.241	1.346
CHUBB	0.051	0.049	0.130	5.822	10.344	6.833	9.755	0.272	0.259	0.274	1.206	1.189
UNIHOLD	0.371	0.371	1.099	0.513	3.747	0.120	0.774	0.427	0.427	0.431	1.241	7.777
WINBEL	0.372	0.312	63.766	0.147	1.060	-0.017	-1.314	0.241	0.202	0.247	1.034	0.923
VALARD	0.398	0.398	1.171	0.115	0.568	0.328	2.372	0.293	0.293	0.304	0.908	1.289
SENTRCHE	0.390	0.388	1.027	0.286	2.479	0.320	2.593	0.419	0.417	0.485	1.420	1.460
MCARTHY	0.098	0.097	0.219	2.311	10.717	1.518	7.114	0.139	0.138	0.155	1.027	1.027
BLUE CIRC	0.211	0.201	0.366	1.094	7.002	0.776	5.137	0.598	0.571	0.678	1.270	1.418
TOYOTA	0.145	0.145	0.234	1.851	2.979	1.810	2.895	0.460	0.460	0.479	1.310	1.106
DELTA	0.019	0.019	0.038	97.334	48.987	68.432	35.239	0.220	0.220	0.248	1.144	1.182
USKO	0.369	0.369	0.833	0.375	3.420	0.077	0.652	0.388	0.388	0.416	1.220	1.836
FOSCHNI	0.153	0.153	0.323	1.867	13.689	1.000	7.251	0.108	0.108	0.112	1.124	1.179
ICS	0.150	0.150	0.305	0.621	5.398	0.497	4.396	0.427	0.427	0.475	1.429	1.631
ED-L-BAT	0.047	0.047	0.184	1.369	8.138	0.727	4.748	0.119	0.119	0.121	1.382	1.016
DORBYL	0.124	0.124	0.236	0.911	4.849	0.592	3.049	0.381	0.381	0.385	1.330	1.803
SEARDEL	0.360	0.350	1.172	0.430	3.317	0.122	0.740	0.127	0.124	0.136	1.173	1.049
PUTCO	0.066	0.065	0.090	8.462	1139.8	13.272	1221.5	0.550	0.544	0.595	1.484	0.081
WALTONS	0.308	0.297	1.260	1.039	10.264	0.441	4.472	0.192	0.188	0.201	1.120	1.237
HIVELD	0.118	0.118	0.203	32.877	41.630	32.422	37.366	0.623	0.622	0.643	1.180	1.454
ADONIS	0.160	0.160	0.292	2.300	15.164	1.357	9.074	0.239	0.239	0.242	1.253	1.556
FEDFOOD	0.231	0.231	0.523	0.868	4.574	0.817	4.316	0.383	0.382	0.413	1.257	1.303
CADSWEP	0.168	0.168	0.315	1.174	7.386	0.906	5.097	0.320	0.320	0.375	1.174	1.193
CNAGALO	0.040	0.039	0.084	6.060	32.854	5.508	29.738	0.264	0.254	0.316	1.177	1.162
PICKNPAY	0.015	0.015	0.048	12.316	62.615	11.422	59.489	0.363	0.363	0.404	1.259	1.330
TONGAAT	0.177	0.168	0.307	0.846	3.967	0.624	3.018	0.615	0.587	0.622	1.226	1.497
SUNCRUSH	0.106	0.104	0.179	2.396	15.192	2.098	13.219	0.551	0.542	0.665	1.110	1.107
TEGKOR	0.019	0.019	0.109	7.282	31.640	7.658	33.541	0.047	0.047	0.176	1.035	1.054
NAMPAK	0.151	0.151	0.329	1.485	11.422	1.029	7.954	0.437	0.437	0.442	1.237	1.382
PEPKOR	0.351	0.349	5.345	0.647	6.693	0.697	6.497	0.110	0.109	0.134	1.137	1.071
PREM-GRP	0.184	0.178	0.331	0.633	3.734	0.515	3.194	0.259	0.251	0.483	1.165	1.209
TRENCOR	0.180	0.174	0.343	1.252	12.036	1.001	9.819	0.264	0.254	0.403	1.157	1.176
GEN-OPTI	0.365	0.363	1.026	0.494	4.475	0.163	1.541	0.255	0.253	0.256	1.189	1.694
SAFICON	0.219	0.219	0.607	0.951	6.572	0.668	4.770	0.173	0.173	0.216	1.077	1.050
L-T-A	0.114	0.114	0.478	0.391	2.060	0.348	1.859	0.222	0.222	0.236	2.339	2.490
ALEXNDR	0.284	0.271	0.650	0.645	10.060	0.652	10.672	0.545	0.519	0.567	1.569	1.308
PPC	0.034	0.034	0.041	9.515	31.391	6.545	21.610	0.700	0.700	0.735	1.182	1.535
PORT	0.174	0.174	0.453	0.793	4.704	0.521	2.527	0.200	0.200	0.200	1.105	1.968
METAIR	0.030	0.030	0.043	9.733	18.204	6.554	12.884	0.419	0.419	0.450	1.306	1.258
TIGR-OAT	0.194	0.194	0.492	0.885	9.678	0.621	6.148	0.287	0.287	0.321	1.202	1.465

	INTEREST FINANCIAL LEVERAGE							OPERATING LEVERAGE				
	BAL. SHEET			INC. ST.		C/FLOW		BAL. SHEET			INC. ST.	C/FLOW
COMPANY	IBD/ TASS	IBD/ ATASS	IBD/ EQUITY	EBIT/ IBD	EBIT/ INT	CASH2/ IBD	CASH2/ INT	FASS/ TASS	FASS/ ATASS	FASS/ OASS	(EBIT+DEP)/ EBIT	CASH1/ CASH2
WOOLTRU	0.159	0.148	0.356	1.674	8.342	1.748	7.707	0.460	0.430	0.481	1.187	1.153
PORTHLD	0.085	0.081	0.128	2.496	272.9	1.639	203.3	0.442	0.420	0.485	1.202	1.428
I-&-J	0.135	0.135	0.255	1.687	14.707	1.258	11.013	0.341	0.341	0.345	1.200	1.331
OMNIA	0.427	0.427	1.566	0.389	2.338	0.265	1.332	0.440	0.440	0.504	1.263	1.970
CONCOR	0.072	0.072	0.383	0.657	7.323	0.416	6.360	0.198	0.198	0.205	2.045	2.674
AMREL	0.375	0.373	0.928	0.199	1.602	0.267	2.258	0.120	0.119	0.251	0.967	2.610
SUTHSUN	0.192	0.185	0.382	0.145	1.743	0.106	1.309	0.680	0.653	0.867	1.915	-4.890
UTICO	0.035	0.035	0.060	6.916	72.066	6.138	57.646	0.326	0.326	0.327	1.193	1.213
AECI	0.224	0.223	0.488	0.822	7.065	0.479	3.796	0.365	0.364	0.392	1.312	2.014
BOUMAT	0.190	0.190	0.775	0.718	5.215	0.516	3.738	0.048	0.048	0.048	1.095	1.116
ROMATEX	0.047	0.047	0.075	5.038	22.011	3.752	15.644	0.393	0.393	0.399	1.252	1.548
AFCOL	0.222	0.215	0.418	0.533	5.219	0.354	3.399	0.209	0.202	0.280	1.180	1.374
MOBILE	0.304	0.304	0.480	0.276	2.422	0.143	1.187	0.001	0.001	0.003	1.004	1.004
ANG-ALPH	0.116	0.116	0.147	1.048	7.675	0.738	5.463	0.814	0.814	0.862	1.259	1.506
O-K	0.192	0.192	0.494	0.244	2.401	0.160	1.504	0.282	0.282	0.298	1.294	1.055
BERZACK	0.223	0.221	0.530	1.151	5.304	0.977	4.752	0.256	0.255	0.259	1.194	1.233
FRAME	0.021	0.021	0.037	35.488	23.010	61.063	35.446	0.492	0.492	0.499	1.758	1.303
YORKCOR	0.265	0.245	0.562	0.555	5.035	0.755	7.049	0.556	0.515	0.595	1.401	1.114
ADCOCK	0.078	0.078	0.136	2.920	15.168	2.206	11.512	0.405	0.405	0.427	1.185	1.158
CEMENCO	0.210	0.210	0.596	0.468	3.253	0.164	1.373	0.360	0.360	0.360	1.773	1.339
HAGGIE	0.158	0.154	0.278	1.393	18.175	0.888	12.102	0.363	0.353	0.379	1.172	1.392
AFROX	0.164	0.164	0.271	1.235	11.505	1.255	11.155	0.662	0.662	0.704	1.222	1.116
COATES	0.110	0.110	0.237	1.993	24.008	1.287	11.895	0.153	0.153	0.154	1.138	-0.811
CAXTON	0.218	0.214	0.975	0.918	6.601	0.487	3.634	0.375	0.369	0.409	1.288	3.045
CROOKES	0.020	0.020	0.022	15.137	45.073	10.851	44.821	0.642	0.641	0.918	1.206	1.160
PROGRESS	0.239	0.236	0.453	0.880	8.914	0.500	4.477	0.477	0.470	0.477	1.100	1.294
CLAUDE-N	0.227	0.227	0.358	0.939	9.685	0.430	4.034	0.109	0.109	0.109	1.090	1.049
METAL-CL	0.080	0.080	0.118	4.080	57.431	3.371	50.122	0.470	0.470	0.471	1.424	1.477
OTIS	0.102	0.102	0.276	9.466	69.066	10.189	60.951	0.216	0.216	0.222	1.092	1.071
NEI-AFR	0.031	0.031	0.072	7.921	4.789	7.049	4.268	0.198	0.197	0.200	1.108	1.123
NINIAN	0.184	0.184	0.365	1.123	7.683	0.042	0.243	0.184	0.184	0.206	1.231	4.948
REX-TRUE	0.219	0.219	0.344	0.728	16.345	0.500	10.930	0.101	0.101	0.102	1.117	1.411
OCFISH	0.067	0.067	0.136	5.252	200.2	4.311	162.6	0.210	0.210	0.254	1.113	1.164
STATISTICS												
MAX VAL	0.427	0.427	63.766	97.334	1139.8	68.432	1221.5	0.814	0.814	0.918	2.339	7.777
2nd MAX VAL	0.398	0.398	5.345	35.488	272.9	61.063	203.3	0.700	0.700	0.867	2.045	4.948
MIN VAL	0.015	0.015	0.022	0.112	0.568	-0.017	-1.314	0.001	0.001	0.003	0.908	-4.890
2nd MIN VAL	0.019	0.019	0.037	0.115	0.789	0.042	0.243	0.047	0.047	0.048	0.967	-0.811
MEAN	0.172	0.169	1.356	4.468	34.329	4.066	31.396	0.333	0.328	0.369	1.257	1.401
STD DEV	0.110	0.107	7.295	12.340	134.5	11.039	141.8	0.174	0.171	0.193	0.228	1.216

APPENDIX 10

20-YEAR TIME SERIES MEASURES

Company	DOL/DFL	*r*	*t*-value	*df*	prob	Durbin-Watson *d*-stat	Chow *F*-value	prob of *F*-value
	DOL							
AECI	0.819	0.992	32.774	18	0.000	0.819	28.546	0.000
AFROX	1.306	0.986	24.993	18	0.000	0.958	21.680	0.000
ANG-ALPHA	1.012	0.980	20.891	18	0.000	0.758	32.065	0.000
BLUE-CIRC	0.939	0.965	15.610	18	0.000	0.663	16.509	0.000
CEMENCO	0.768	0.967	16.204	18	0.000	1.072	12.024	0.001
CNAGALO	1.038	0.981	21.493	18	0.000	1.336	7.922	0.004
DORBYL	0.941	0.986	25.046	18	0.000	1.968	18.209	0.000
HIVELD	1.190	0.919	9.860	18	0.000	0.893	2.666	0.094
METAL-CLO	1.029	0.992	34.413	18	0.000	0.859	24.898	0.000
NAMPAK	0.894	0.995	40.916	18	0.000	0.612	27.684	0.000
OTIS	0.962	0.930	10.708	18	0.000	0.399	14.684	0.000
PORT	1.003	0.919	9.868	18	0.000	1.267	20.138	0.000
O-K	0.406	0.775	5.210	18	0.000	0.614	18.178	0.000
PPC	0.973	0.994	37.200	18	0.000	1.155	32.506	0.000
PREM-GRP	1.098	0.996	49.246	18	0.000	1.017	23.577	0.000
PUTCO	0.968	0.946	12.393	18	0.000	0.812	23.044	0.000
REUNERT	0.999	0.846	6.722	18	0.000	0.942	9.209	0.003
SAFICON	0.903	0.971	17.379	18	0.000	0.903	27.650	0.000
SENTRCHEM	0.942	0.917	9.763	18	0.000	0.582	42.924	0.000
TOYOTA	1.022	0.957	14.035	18	0.000	1.250	5.449	0.014
USKO	0.761	0.799	5.642	18	0.000	1.617	7.210	0.006
SUNCRUSH	1.082	0.982	22.358	18	0.000	0.462	28.517	0.000
UTICO	0.706	0.843	6.643	18	0.000	0.787	8.085	0.004
WOOLTRU	0.875	0.987	25.703	18	0.000	0.387	22.890	0.000
	DFL							
AECI	1.015	0.988	27.024	18	0.000	1.617	29.680	0.000
AFROX	0.933	0.986	25.162	18	0.000	0.366	19.973	0.000
ANG-ALPHA	0.974	0.991	30.970	18	0.000	1.581	33.947	0.000
BLUE-CIRC	0.863	0.897	8.622	18	0.000	0.927	14.464	0.001
CEMENCO	1.042	0.956	13.895	18	0.000	1.034	11.606	0.001
CNAGALO	1.038	0.991	31.447	18	0.000	1.615	6.880	0.007
DORBYL	0.969	0.965	15.516	18	0.000	1.712	19.010	0.000
HIVELD	0.932	0.977	19.556	18	0.000	2.002	3.014	0.070
METAL-CLO	1.001	0.996	49.866	18	0.000	1.072	24.395	0.000
NAMPAK	0.998	0.999	101.494	18	0.000	0.909	27.337	0.000
OTIS	0.760	0.769	5.110	18	0.000	1.955	15.047	0.000
PORT	0.975	0.933	10.989	18	0.000	1.799	7.759	0.004
O-K	0.824	0.935	11.224	18	0.000	0.625	9.921	0.002
PPC	1.053	0.989	28.015	18	0.000	0.613	34.815	0.000
PREM-GRP	0.977	0.987	25.764	18	0.000	1.157	25.245	0.000
PUTCO	0.860	0.961	14.670	18	0.000	1.497	18.164	0.000
REUNERT	1.009	0.954	13.553	18	0.000	0.734	2.157	0.149
SAFICON	0.881	0.953	13.327	18	0.000	0.952	36.209	0.000
SENTRCHEM	0.865	0.809	5.833	18	0.000	0.514	1.933	0.185
TOYOTA	0.919	0.894	8.445	18	0.000	1.882	3.426	0.050
USKO	0.993	0.953	13.306	18	0.000	0.912	0.637	0.731
SUNCRUSH	0.973	0.996	50.236	18	0.000	1.790	29.466	0.000
UTICO	0.801	0.930	10.766	18	0.000	0.700	6.701	0.007
WOOLTRU	1.039	0.998	73.288	18	0.000	0.558	22.795	0.000

APPENDIX 11

10-YEAR TIME SERIES MEASURES

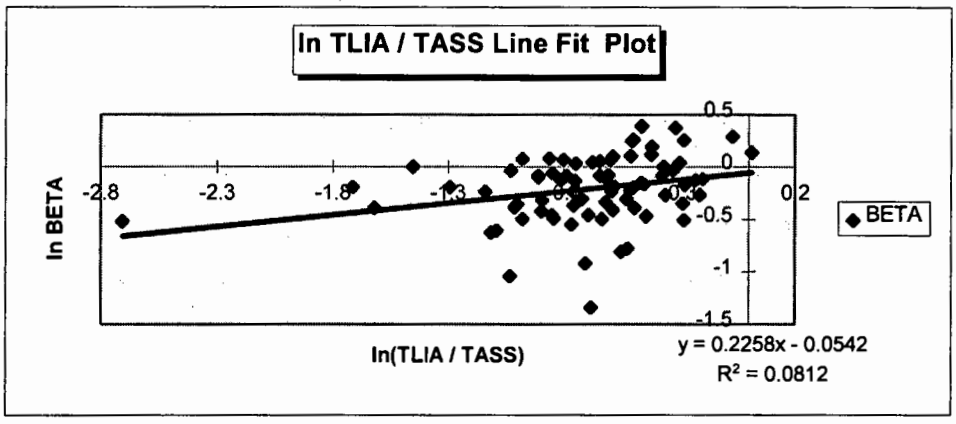
Company	DOL-10 yr	*r*	*t*-value	*df*	prob	Durbin-Watson *d*-stat	Chow *F*-value	prob of *F*-value
AECI	0.6850	0.8949	5.6731	8	0.0005	0.8049	2.0625	0.2836
AFROX	1.1605	0.9798	13.8590	8	0.0000	2.0959	9.1949	0.0506
ANG-ALPHA	1.0341	0.9916	21.6482	8	0.0000	2.1248	5.0107	0.1093
BLUE-CIRC	1.2800	0.8884	5.4722	8	0.0006	1.5239	2.1218	0.2763
BOUMAT	0.7610	0.8101	3.9079	8	0.0045	1.3497	0.7372	0.5960
CADSWEP	0.7579	0.9803	14.0253	8	0.0000	1.1471	3.7323	0.1540
CEMENCO	0.9389	0.8816	5.2841	8	0.0007	0.9806	5.3507	0.1009
CHUBB	1.0153	0.9490	8.5174	8	0.0000	0.8380	2.6697	0.2207
CNAGALO	0.9597	0.9683	10.9639	8	0.0000	1.6623	5.0961	0.1071
COATES	1.0105	0.9560	9.2133	8	0.0000	0.9367	7.3562	0.0677
CROOKES	0.7635	0.8148	3.9758	8	0.0041	2.7478	5.9402	0.0887
DORBYL	0.7979	0.9413	7.8874	8	0.0000	1.7940	5.5388	0.0967
ED-LBATE	0.5449	0.7287	3.0100	8	0.0168	2.2758	18.6147	0.0192
FOSCHINI	1.2972	0.9874	17.6274	8	0.0000	1.5157	3.8501	0.1487
GRINAKER	0.7971	0.8266	4.1537	8	0.0032	0.9812	0.4635	0.7280
HAGGIE	0.8036	0.9852	16.2838	8	0.0000	0.9393	12.8503	0.0322
HIVELD	1.1791	0.9174	6.5214	8	0.0002	0.9520	3.5466	0.1631
ICS	0.6833	0.7301	3.0223	8	0.0165	1.1531	0.7544	0.5888
I-&-J	1.3680	0.9894	19.2903	8	0.0000	1.2239	8.1974	0.0588
MCCARTHY	0.9793	0.9037	5.9697	8	0.0003	1.3975	0.8756	0.5422
METAIR	0.9459	0.9411	7.8701	8	0.0000	1.7714	1.4946	0.3746
METAL-CLO	0.8941	0.9862	16.8408	8	0.0000	1.9173	6.9163	0.0733
NAMPAK	0.8039	0.9813	14.4143	8	0.0000	0.9137	5.2066	0.1043
NEI-AFR	1.2454	0.9305	7.1866	8	0.0001	0.7136	3.5452	0.1631
PEPKOR	0.8333	0.7498	3.2054	8	0.0125	1.5900	1.1696	0.4503
PICKNPAY	0.8523	0.9909	20.8034	8	0.0000	0.8151	5.1427	0.1059
PORT	0.5991	0.7644	3.3531	8	0.0100	1.1801	1.3561	0.4042
PORTHLD	0.7088	0.9044	5.9933	8	0.0003	2.0474	0.3084	0.8201
POWTECH	0.9428	0.9844	15.8116	8	0.0000	0.7610	5.8236	0.0909
PPC	0.8899	0.9551	9.1198	8	0.0000	1.2742	2.0483	0.2855
PREM-GRP	1.2545	0.9913	21.3437	8	0.0000	1.8224	4.7667	0.1160
PROGRESS	0.9869	0.9663	10.6167	8	0.0000	0.7439	1.7249	0.3327
REUNERT	0.7388	0.7391	3.1034	8	0.0146	1.0026	4.9857	0.1099
ROMATEX	0.9816	0.6694	2.5485	8	0.0343	1.0516	1.4036	0.3936
SAFICON	1.0964	0.9673	10.7953	8	0.0000	1.2283	1.4710	0.3794
SEARDEL	0.8435	0.9207	6.6714	8	0.0002	0.9022	0.8638	0.5465
SENTRCHEM	0.6880	0.6524	2.4346	8	0.0409	0.8246	1.3738	0.4002
SUNCRUSH	1.2384	0.9903	20.1915	8	0.0000	2.0350	6.0046	0.0875
TONGAAT	0.6942	0.9523	8.8289	8	0.0000	1.6810	2.8800	0.2041
TOYOTA	0.9217	0.9432	8.0308	8	0.0000	1.4527	1.5804	0.3580
TRADGRO	0.9565	0.9111	6.2506	8	0.0002	1.4950	2.7365	0.2152
TRENCOR	1.6305	0.9809	14.2447	8	0.0000	2.0668	4.3202	0.1303
UNIHOLD	0.9286	0.8567	4.6971	8	0.0015	1.2926	1.3570	0.4039
USKO	0.6929	0.6677	2.5370	8	0.0349	1.6056	1.0480	0.4851
UTICO	1.3102	0.8631	4.8339	8	0.0013	1.1999	5.1397	0.1060
WALTONS	1.1197	0.9960	31.6302	8	0.0000	1.2072	9.3075	0.0498
WOOLTRU	0.7129	0.9751	12.4326	8	0.0000	1.1526	1.8684	0.3103
YORKCOR	0.8173	0.7888	3.6293	8	0.0067	1.2076	0.2948	0.8287

Company	DFL-10 yr	*r*	*t*-value	*df*	prob	Durbin-Watson *d*-stat	Chow *F*-value	prob of *F*-value
AECI	0.9514	0.8774	5.1720	8	0.0009	1.0938	1.6815	0.3400
AFROX	1.4429	0.9785	13.4230	8	0.0000	1.3667	8.4930	0.0562
ANG-ALPHA	1.1302	0.9177	6.5355	8	0.0002	1.6622	4.4031	0.1274
BLUE-CIRC	0.3937	0.7918	3.6672	8	0.0063	0.8654	1.3508	0.4053
BOUMAT	0.9273	0.9339	7.3872	8	0.0001	1.6786	0.1325	0.9345
CADSWEP	0.9877	0.9938	25.2144	8	0.0000	1.9080	3.8539	0.1485
CEMENCO	0.7893	0.9338	7.3829	8	0.0001	1.1603	3.8424	0.1490
CHUBB	0.7476	0.8286	4.1867	8	0.0031	1.3478	1.6964	0.3374
CNAGALO	0.9470	0.9806	14.1636	8	0.0000	1.6384	4.5810	0.1216
COATES	1.0524	0.9736	12.0679	8	0.0000	0.5368	7.4672	0.0664
CROOKES	0.8417	0.9909	20.8732	8	0.0000	0.8926	2.3556	0.2500
DORBYL	0.6102	0.7755	3.4737	8	0.0084	1.1303	4.2734	0.1319
ED-LBATE	0.5969	0.9396	7.7643	8	0.0001	2.3909	5.5428	0.0967
FOSCHINI	0.9162	0.9845	15.8653	8	0.0000	2.8128	4.1029	0.1383
GRINAKER	0.8232	0.9309	7.2065	8	0.0001	1.2639	0.0596	0.9777
HAGGIE	1.0901	0.9931	23.8682	8	0.0000	2.3756	12.4267	0.0337
HIVELD	0.8894	0.9627	10.0682	8	0.0000	1.1142	3.6161	0.1596
ICS	0.5230	0.9265	6.9646	8	0.0001	0.7974	0.5579	0.6782
I-&-J	1.0334	0.9797	13.8402	8	0.0000	2.0018	8.7683	0.0539
MCCARTHY	0.7967	0.9862	16.8448	8	0.0000	1.0815	1.0843	0.4743
METAIR	1.0019	0.9874	17.6718	8	0.0000	2.6888	1.3738	0.4002
METAL-CLO	1.1466	0.9859	16.6726	8	0.0000	1.3972	6.9488	0.0728
NAMPAK	1.0725	0.9992	72.6175	8	0.0000	2.9993	5.4470	0.0987
NEI-AFR	0.9736	0.9884	18.4438	8	0.0000	2.1036	4.0589	0.1400
PEPKOR	1.0361	0.9330	7.3306	8	0.0001	0.7466	0.2403	0.8640
PICKNPAY	1.0298	0.9970	36.5321	8	0.0000	1.1077	5.1377	0.1060
PORT	0.6472	0.8549	4.6606	8	0.0016	1.4400	2.5518	0.2310
PORTHLD	1.0181	0.9211	6.6935	8	0.0002	0.7968	0.2602	0.8510
POWTECH	1.0807	0.9971	37.3482	8	0.0000	1.5207	6.0250	0.0872
PPC	1.2255	0.9142	3.9871	8	0.0040	0.6400	0.8292	0.5594
PREM-GRP	0.8332	0.9142	6.3797	8	0.0002	0.8906	3.6892	0.1560
PROGRESS	0.9313	0.9780	13.2520	8	0.0000	2.3676	1.6875	0.3389
REUNERT	1.0075	0.9593	9.6035	8	0.0000	0.8605	0.4642	0.7277
ROMATEX	0.4941	0.8925	5.5958	8	0.0005	1.4298	0.2470	0.8596
SAFICON	0.8030	0.8944	5.6575	8	0.0005	0.8013	0.9025	0.5326
SEARDEL	0.5348	0.7531	3.2381	8	0.0119	1.2618	0.1263	0.9384
SENTRCHEM	0.8062	0.8373	4.3307	8	0.0025	0.5436	0.4286	0.7477
SUNCRUSH	1.0519	0.9886	18.5468	8	0.0000	1.2618	5.9886	0.0878
TONGAAT	0.7458	0.8119	3.9335	8	0.0043	0.5182	0.9773	0.5073
TOYOTA	0.9707	0.8608	4.7836	8	0.0014	1.8477	0.1129	0.9468
TRADGRO	0.9989	0.9216	6.7182	8	0.0001	1.2525	0.0108	0.9981
TRENCOR	0.9702	0.9986	53.1253	8	0.0000	2.4853	4.1689	0.1358
UNIHOLD	0.9340	0.9693	11.1507	8	0.0000	1.2672	0.6376	0.6397
USKO	0.9841	0.9796	13.7758	8	0.0000	1.1162	0.0597	0.9777
UTICO	0.8957	0.9640	10.2610	8	0.0000	0.7151	4.0836	0.1390
WALTONS	1.0132	0.9976	40.8805	8	0.0000	2.4924	9.4431	0.0488
WOOLTRU	1.1400	0.9946	27.1543	8	0.0000	1.2330	1.9955	0.2924
YORKCOR	1.0130	0.9711	11.5163	8	0.0000	1.3867	0.1254	0.9390

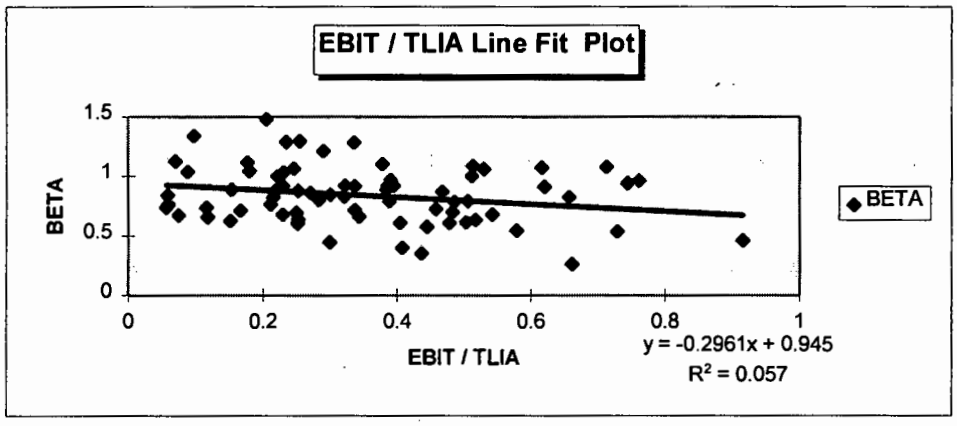
APPENDIX 12

CHAPTER 7 REGRESSION PLOTS

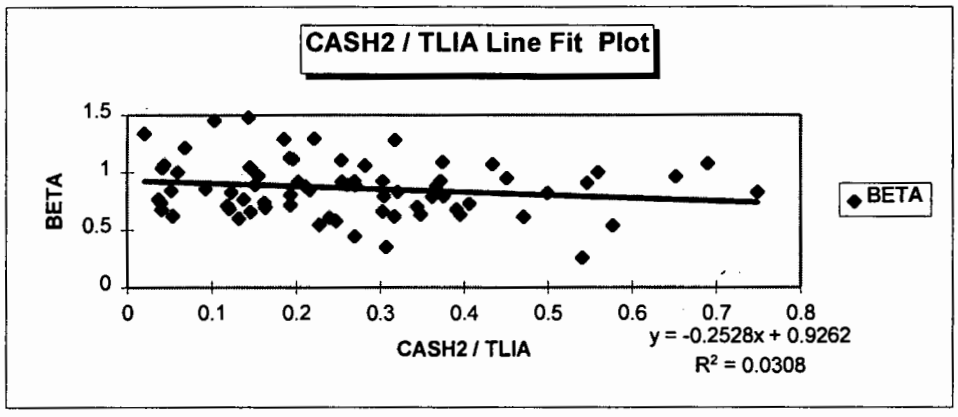
12.5: Beta vs. Balance Sheet Default Risk (I)



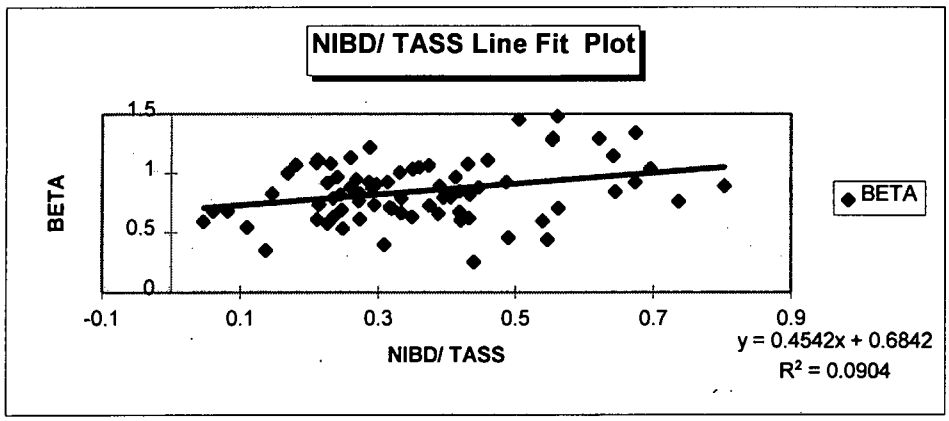
12.6: Beta vs. Income Statement Default Risk (I)



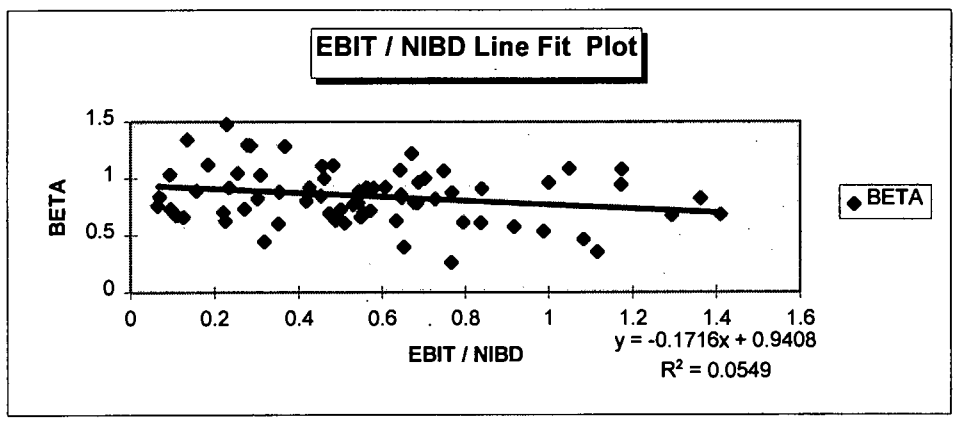
12.7: Beta vs.Cash Flow Default Risk (I)



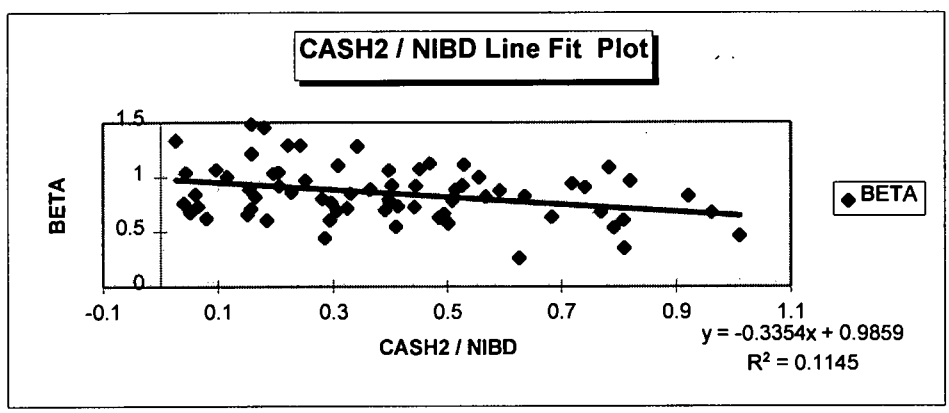
12.8: Beta vs. Balance Sheet Default Risk (II)



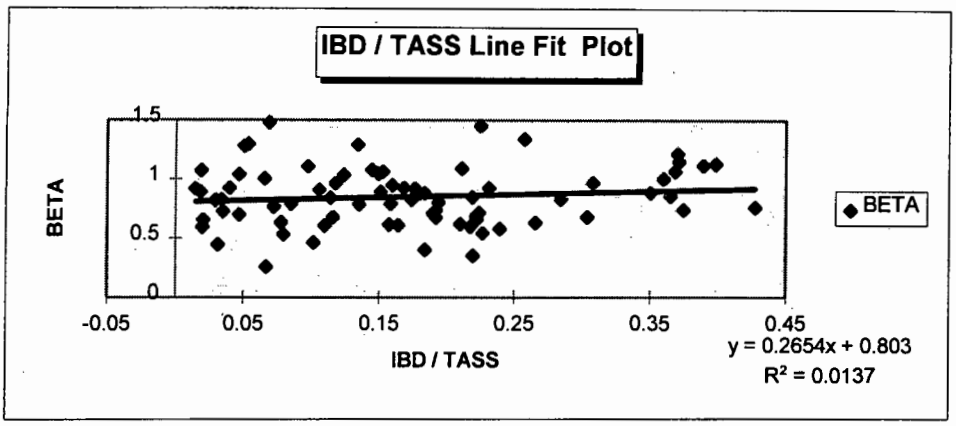
12.9: Beta vs. Income Statement Default Risk (II)



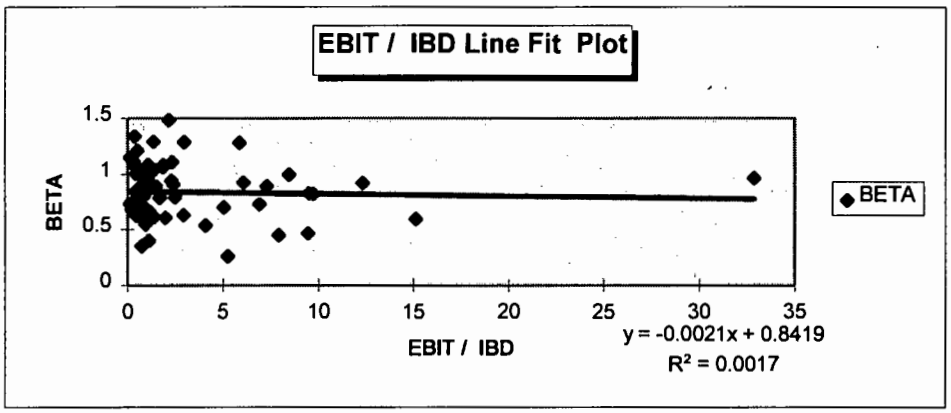
12.10: Beta vs.Cash Flow Default Risk (II)



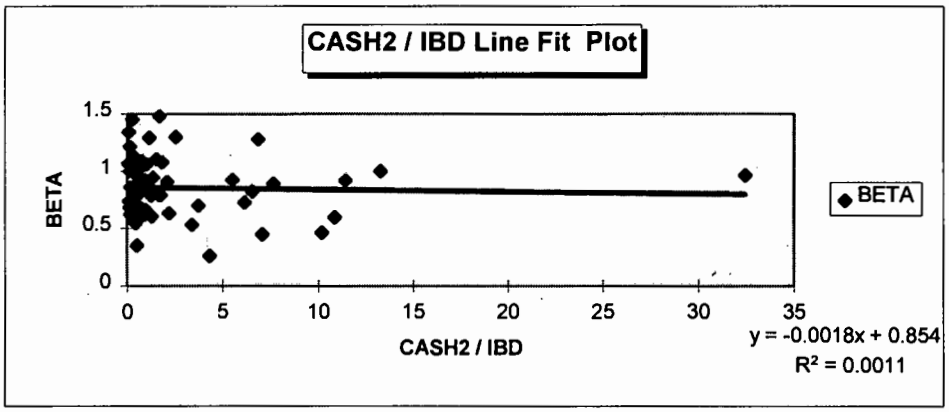
12.11: Beta vs. Balance Sheet Interest Risk



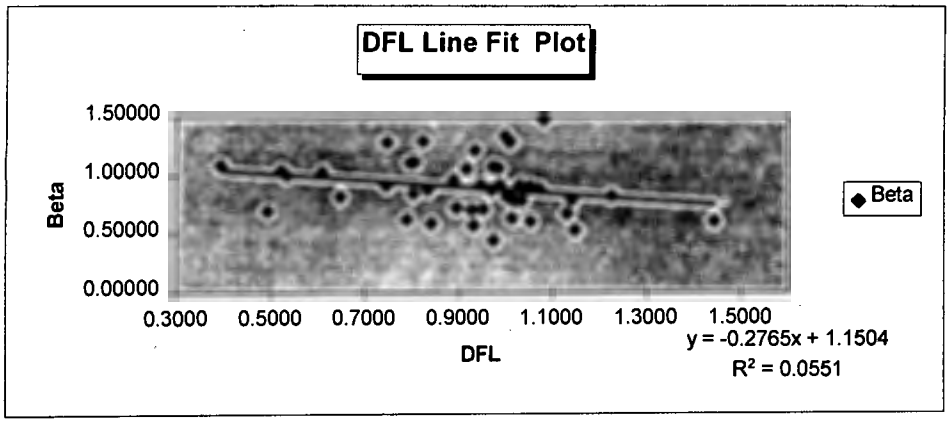
12.12: Beta vs. Income Statement Interest Risk



12.13: Beta vs.Cash Flow Interest Risk



12.14: Beta vs. DFL



APPENDIX 13

CHAPTER 7 FULL SAMPLE RESULTS

Table 13.1: Beta vs. Cash Flow Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL1									
Single Co									
first order	-0.122	-1.055	74	0.295	0.796	0.324			
lagged	-0.232	-2.048	74	0.044	0.773	0.397			
average	-0.237	-2.102	74	0.039	0.448	0.631			
Portfolio-B									
first order	-0.287	-1.078	13	0.301	0.702	0.200			
lagged	-0.426	-1.698	13	0.113	0.560	0.009		NO	
average	-0.500	-2.084	13	0.057	0.571	0.131		NO	
Portfolio-L									
first order	-0.313	-1.189	13	0.256	0.977	0.601		NO	
lagged	-0.461	-1.873	13	0.084	0.711	0.898			
average	-0.458	-1.855	13	0.086	0.943	0.405			

CFL1 = Cash2 / Tlia

Table 13.2: Beta vs. Income Statement Default Risk (I)

Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
IFL2									
Single co									
first order	-0.379	-3.528	74	0.001	0.273	0.202			
lagged	-0.305	-2.757	74	0.007	0.420	0.539			
average	-0.342	-3.129	74	0.003	0.202	0.364			
Portfolio-B									
first order	-0.667	-3.230	13	0.007	0.186	0.113			
lagged	-0.518	-2.183	13	0.048	0.902	0.034		NO	
average	-0.569	-2.494	13	0.027	0.551	0.070			
Portfolio-L									
first order	-0.580	-2.567	13	0.023	0.275	0.863		NO	
lagged	-0.682	-3.366	13	0.005	0.362	0.585			
average	-0.740	-3.969	13	0.002	0.043	0.925			

IFL2 = Ebit / Nibd

Table 13.3: Beta vs. Cash Flow Interest Risk

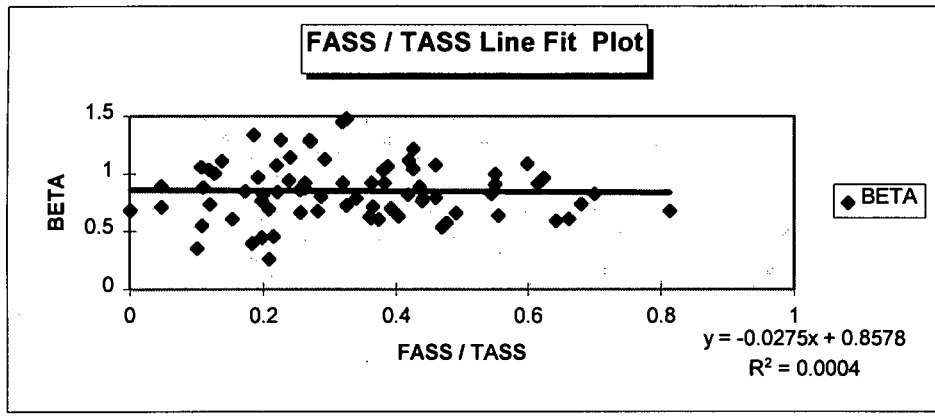
Grouping	Total				Upper	Lower	Residuals		
	r	t value	df	prob	prob	prob	homo	normal	indep
CFL3									
Single Co									
first order	0.032	0.276	74	0.783	0.678	0.132			
lagged	0.063	0.543	74	0.589	0.665	0.041			
average	0.006	0.050	74	0.960	0.805	0.119			
Portfolio-B									
first order	0.056	0.201	13	0.844	0.301	0.592			
lagged	0.154	0.564	13	0.583	0.173	0.954		NO	
average	0.008	0.029	13	0.978	0.235	0.681			
Portfolio-L									
first order	-0.047	-0.168	13	0.869	0.952	0.658		NO	
lagged	-0.106	-0.383	13	0.708	0.545	0.046		NO	
average	0.093	0.337	13	0.742	0.766	0.401			
CFL4									
Single Co									
first order	-0.007	-0.060	74	0.952	0.792	0.289			
lagged	0.044	0.381	74	0.705	0.544	0.027			
average	0.011	0.094	74	0.925	0.566	0.220			
Portfolio-B									
first order	0.077	0.280	13	0.784	0.361	0.625			
lagged	0.096	0.347	13	0.734	0.610	0.075			
average	0.049	0.177	13	0.862	0.234	0.150			
Portfolio-L									
first order	-0.302	-1.140	13	0.275	0.600	0.838			
lagged	-0.367	-1.423	13	0.178	0.350	0.109			
average	-0.449	-1.812	13	0.093	0.342	0.423		NO	

CFL3 = Cash2 / Ibd
CFL4 = Cash2 / Int

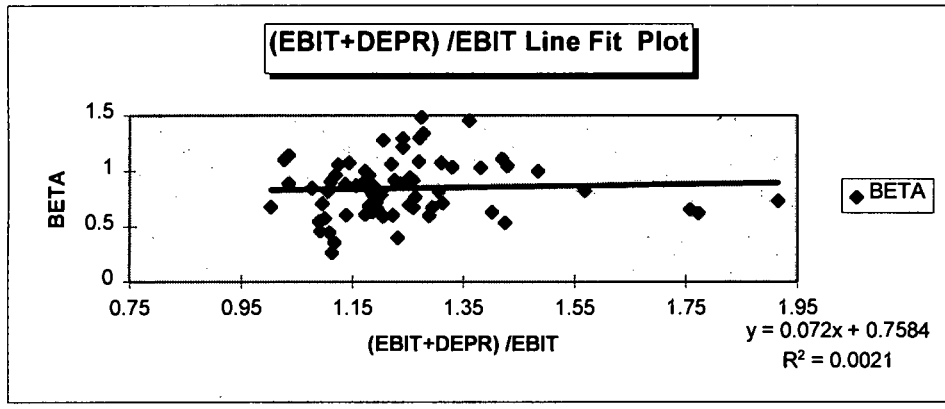
APPENDIX 14

CHAPTER 8 REGRESSION PLOTS

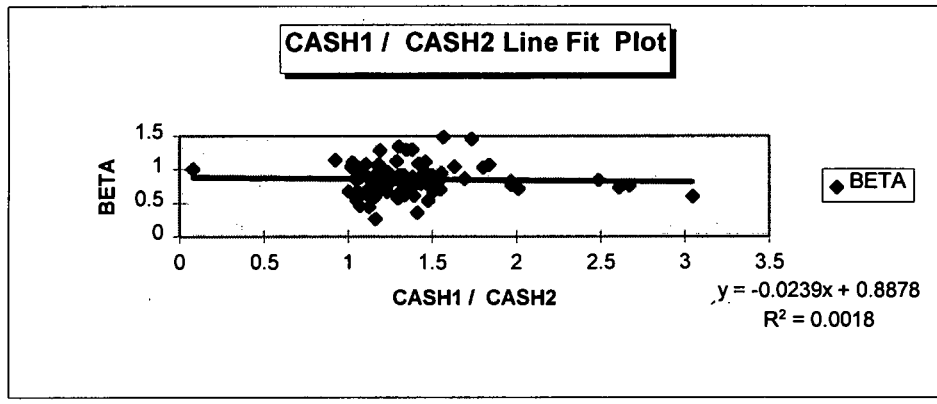
14.2: Beta vs. Balance Sheet Operating Leverage



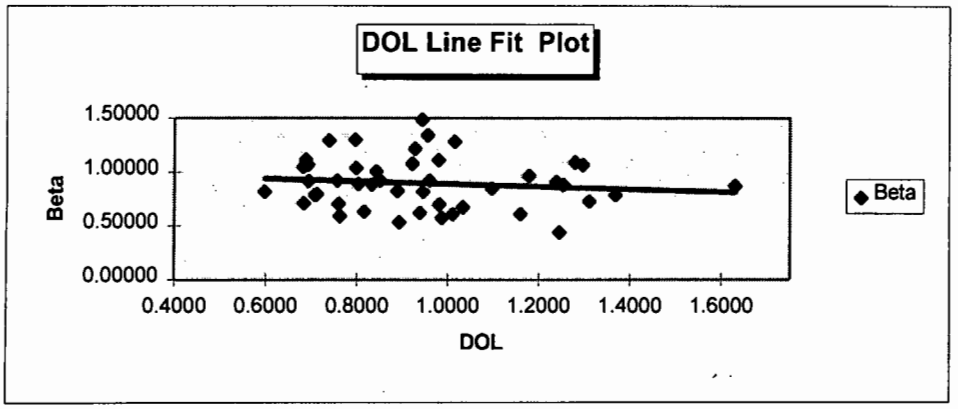
14.3: Beta vs. Income Statement Operating Leverage



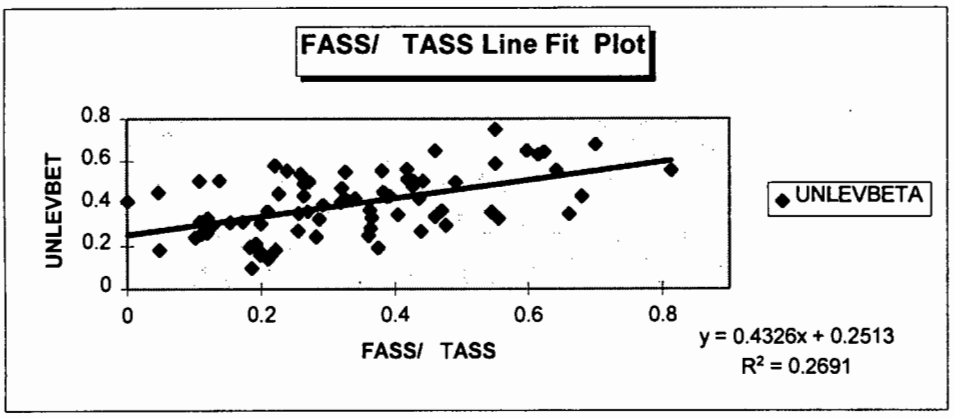
14.4: Beta vs. Cash Flow Operating Leverage



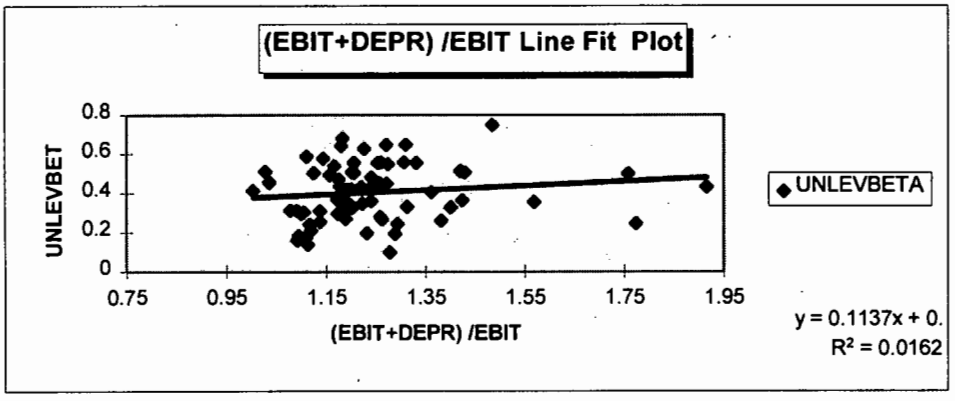
14.5: Beta vs. Time Series Operating Leverage



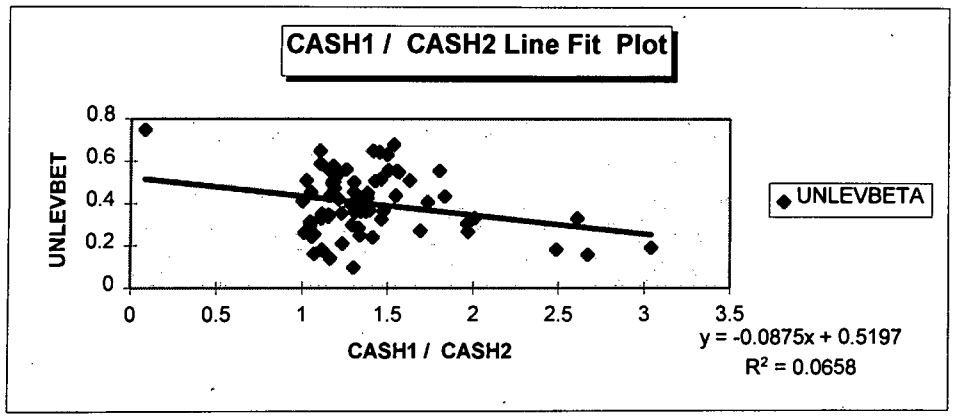
14.6: Unlevered Beta vs. Balance Sheet Operating Leverage



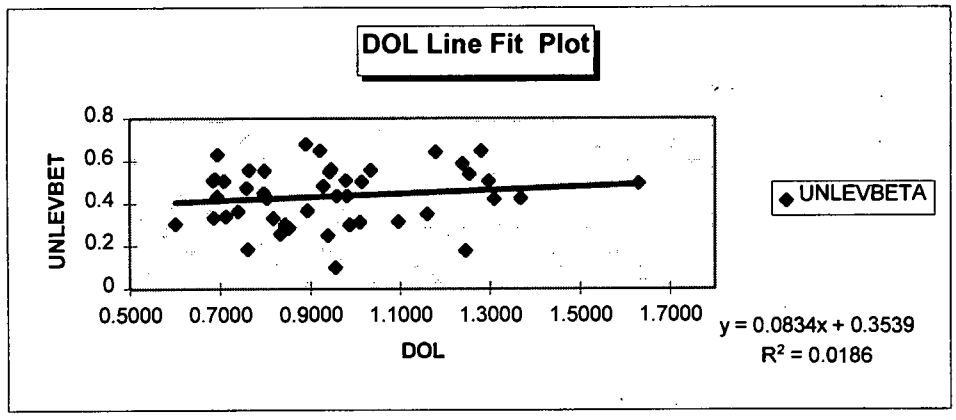
14.7: Unlevered Beta vs. Income Statement Operating Leverage



14.7: Unlevered Beta vs.Cash Flow Operating Leverage



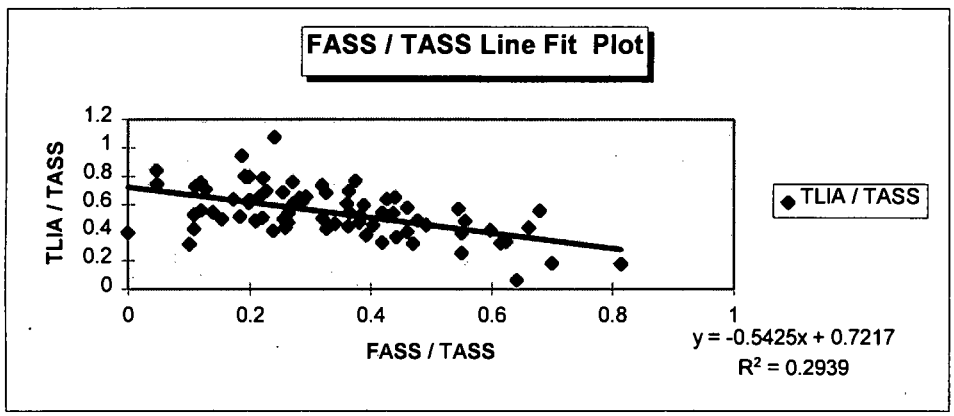
14.8: Unlevered Beta vs. Time Series Operating Leverage



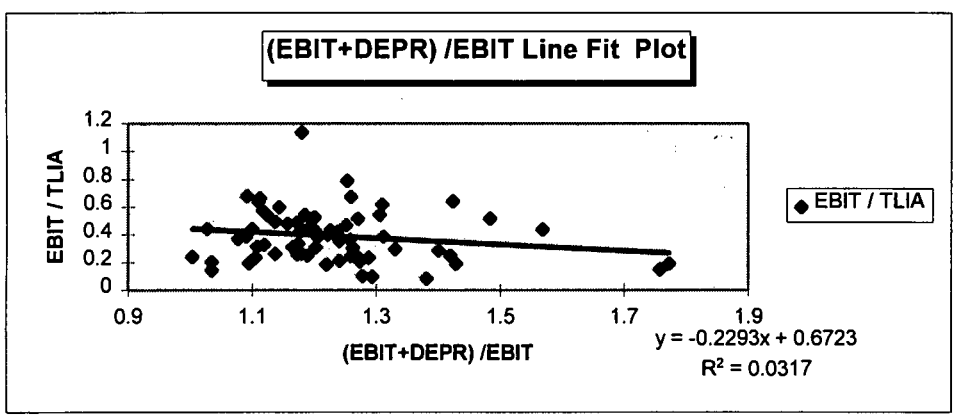
APPENDIX 15

CHAPTER 9 REGRESSION PLOTS

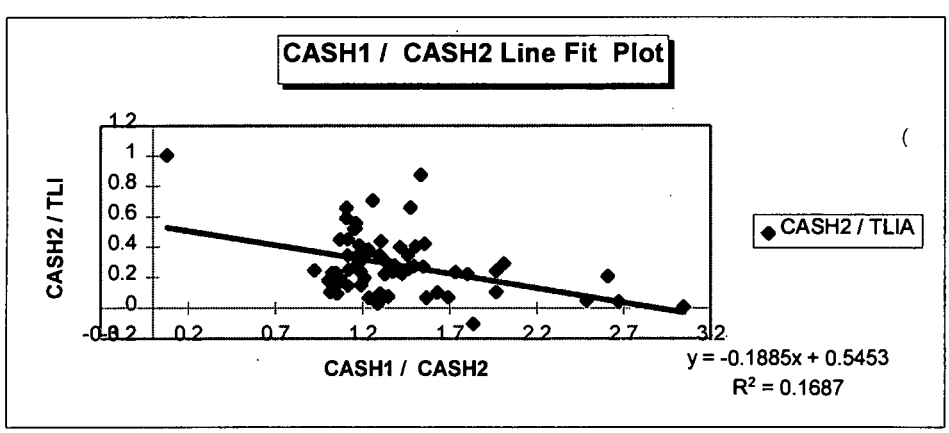
15.2: Operating Leverage vs. Balance Sheet Default Risk (I)



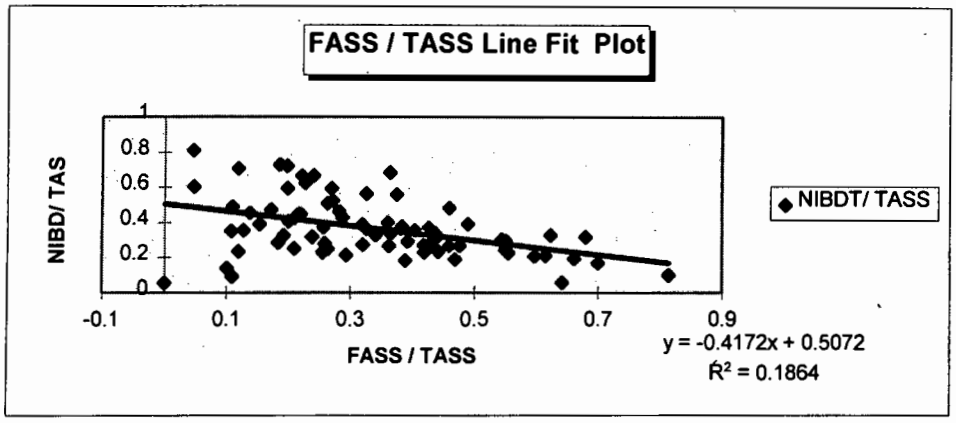
15.3: Operating Leverage vs. Income Statement Default Risk (I)



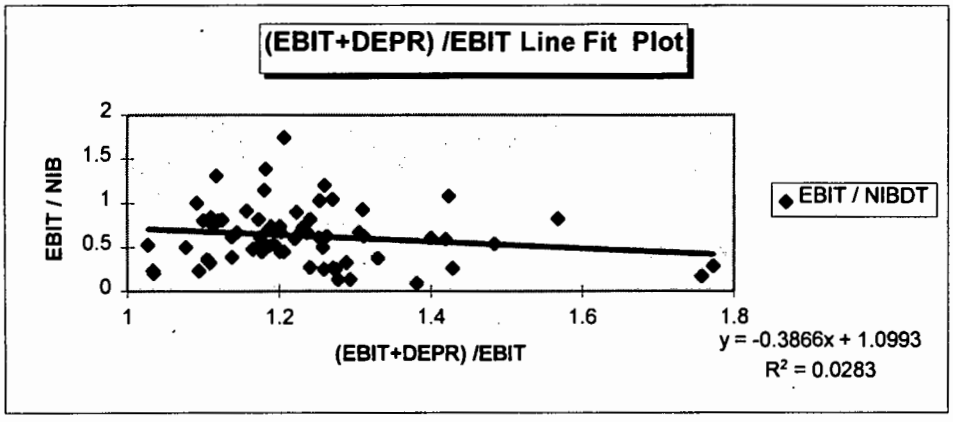
15.3: Operating Leverage vs.Cash flow Default Risk (I)



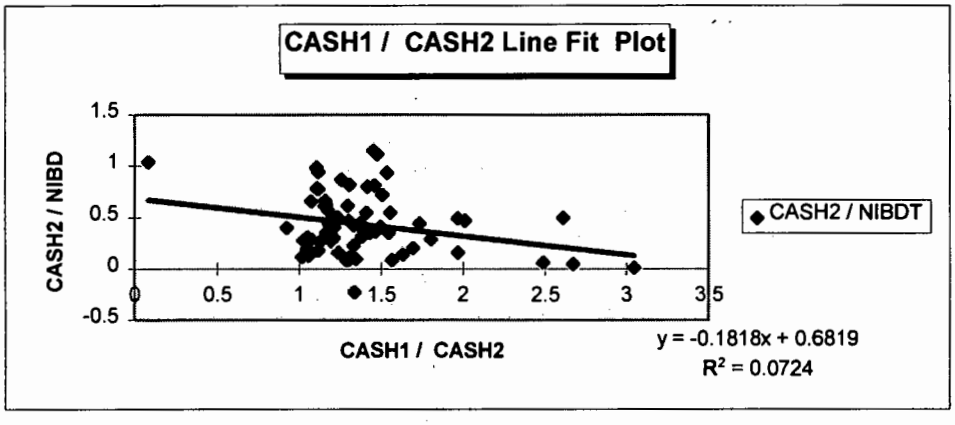
15.5: Operating Leverage vs. Balance Sheet Default Risk (II)



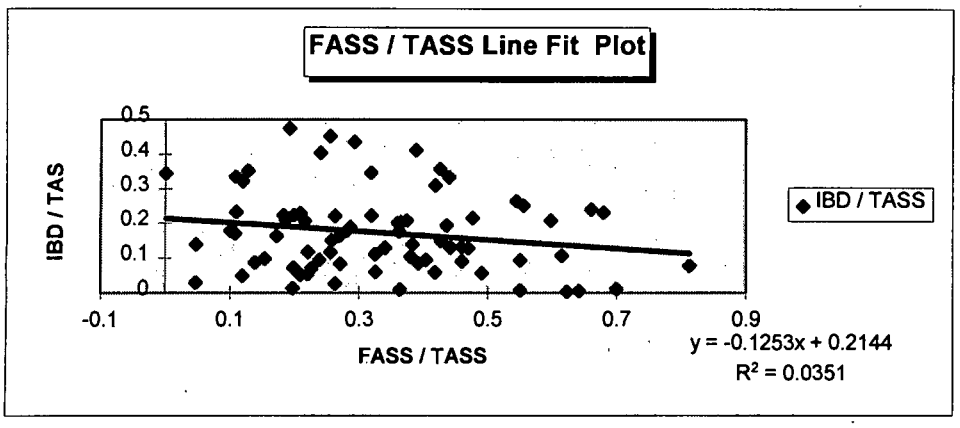
15.6: Operating Leverage vs. Income Statement Default Risk (II)



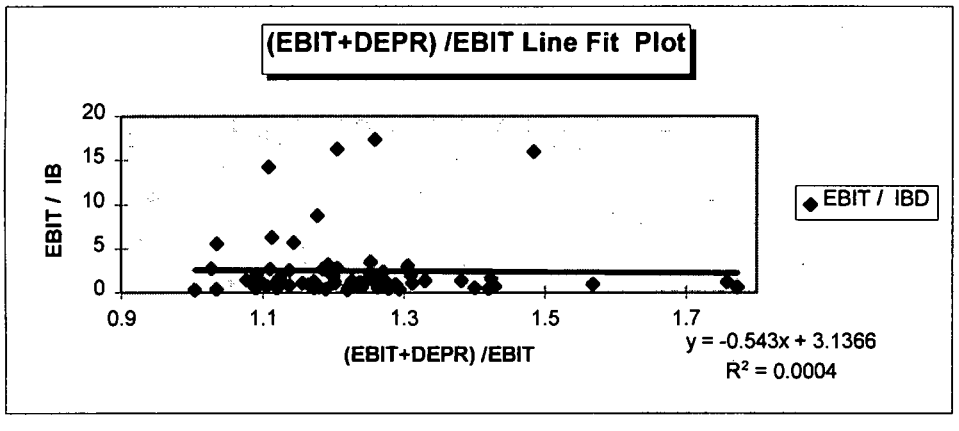
15.7: Operating Leverage vs. Cash Flow Default Risk (II)



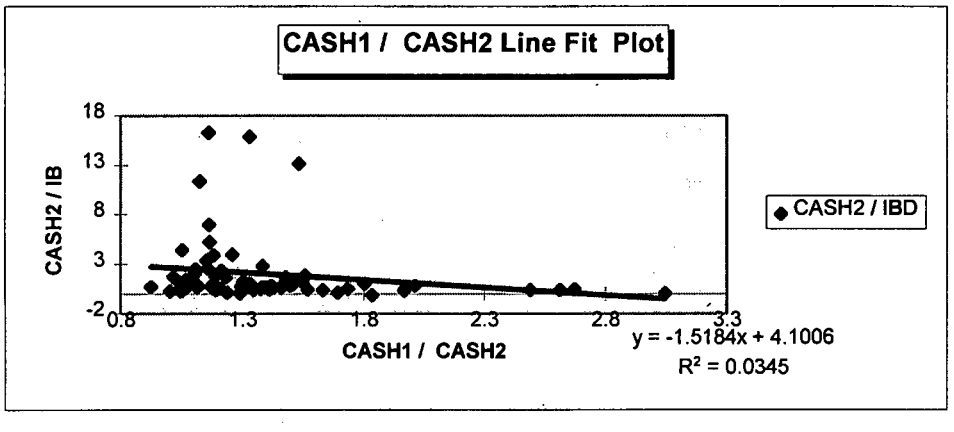
15.8: Operating Leverage vs. Balance Sheet Interest Risk



15.9: Operating Leverage vs. Income Statement Interest Risk



15.10: Operating Leverage vs.Cash Flow Interest Risk



15.11: DOL vs. DFL