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Modelling systematic risk and return using accounting-based information

ABSTRACT

The study explored the linkages between the financial parameters of a firm derived from reported accounting data, and systematic risk as described by estimated market beta coefficients. The relationships between financial variables and risk proposed by previous theoretical and empirical research were tested for 135 JSE-listed Industrial companies, in each of three consecutive 5-year periods. Correlation analysis and stepwise multiple regression were used to establish significant explanatory beta models. Strong positive associations with risk were found for measures of firm growth, profitability, leverage and the variabilities of earnings and cashflows. Significant negative relationships emerged for liquidity, stock turnover and dividend yield.

Secondly, the linkages between the same financial parameters and observed equity returns were tested in a multifactor asset-pricing model for the same sample. Measures of firm growth, profitability and size were positively correlated to share returns, while the variabilities of earnings and cashflows as well as debtors' collection period were negatively related.

For both betas and equity returns, correlations with financial parameters improved for portfolios of shares. Several of the significant financial variables were derived from cashflow-based data, as opposed to standard accrual-accounting values. While significant regression models emerged for risk and return in each of the 5-year analysis periods, they were non-stationary across the periods. Consequently, fairly poor predictive performance was observed for the models over consecutive time intervals. Nevertheless, it was apparent that certain classes of fundamental financial data were strongly related to beta as a measure of systematic risk, and to *ex post* share returns.

INTRODUCTION

The pricing of financial assets is a key concern of finance research. In particular, much effort has been directed at incorporating the concept of risk into valuation models to reflect the variability of returns. The measurement of systematic risk as defined by beta has attracted criticism since the Capital Asset Pricing Model (CAPM) was originally postulated, with Fouse, Jahnke and Rosenberg (1974 p.70) summing up the controversy in likening beta to an imaginary substance called "phlogiston", a concept invented to explain the disappearance of matter during combustion and described as "a stepping stone between alchemy and modern chemistry". The analogy characterised beta as merely a technical signal with mysterious underpinnings and little association to any comprehensible characteristics of either the firm or the stock market.

Recently, the questioning of asset pricing based on beta estimates has intensified. A landmark paper by Fama & French (1992) cast doubts on the validity of the CAPM by finding no significant relationship between average return and systematic risk of common stocks. Instead, their research indicated that market capitalisation and the price-to-book ratio for a firm dominated return. A flood of commentary and counter-research has ensued. Bernstein (1992) claimed that by eliminating the traditional relationship between risk and return, the Fama-French research implied some kind of 'free lunch', while Amihud, Christensen and Mendelson (1992) repeated the Fama-French study using two novel econometric methods which improved estimation efficiency and provided more powerful test statistics, resulting in a highly significant relationship between average portfolio returns and systematic risk. However, their methods were controversial. Roll & Ross (1993) highlighted the sensitivity of the risk-return relationship to the choice of market proxy, which they claimed could produce spurious statistical results. As strong proponents of Arbitrage Pricing Theory, the CAPM's main rival, they have suggested that models based on macroeconomic variables such as inflation and interest rates offer better explanatory power and are less prone to estimation error.

Beta estimation has been criticised in similar vein to other time-series forecasting methods, namely that *ex post* returns are used to develop a model for forecasting *ex ante* returns. Marston and Harris (1993) stated that while the assumption of realised historical returns as a proxy for future expectations may be true over long sweeps of history, it was inappropriate for shorter time frames in a risky market. The authors studied the relationship between beta and *expected* returns, as derived from several analysts' forecasts, and showed a strong positive risk-return relationship.

In particular, while betas based on historical returns have been widely applied in asset pricing, researchers have noted that the beta estimation procedure is subject to the following statistical problems:

- Non-stationarity of estimated betas between different measurement periods. This has been highlighted by many authors (Levy 1971, Blume 1971). Non-stationarity has been ascribed in part to estimation errors, for which Vasicek (1973) offered a Bayesian approach to combining cross-sectional information in the estimation of betas which reduced such errors.
- The effect of thinly traded markets on beta estimation has also been extensively researched. Dimson (1979) observed that significant downward biases in estimates could result for securities that were thinly traded, and proposed an 'aggregated coefficients' method for providing an unbiased beta estimator. Bowie and Bradfield (1993a and b) showed that South African beta estimates could be further improved by using a trade-to-trade measurement technique.
- An inherent 'survivorship bias' exists in the market return, since market index performance is measured only on shares which are listed at a given point in time.

A further significant shortcoming of traditional beta estimation is that it cannot be applied to unlisted firms or business units of conglomerates for which no market return data is available. The 'similar firm' or 'pure play' approach has been suggested for these cases, whereby the beta for a listed firm wholly or largely engaged in the same type of business as the private firm is used as a proxy. The practicality of this method has been questioned (Ehrhardt & Bhagwat, 1991), and is particularly problematic in South Africa where very few single-activity firms are listed on the Johannesburg Stock Exchange (JSE) (Firer & Thompson, 1993). Baer (1993) showed empirically that neither financial categories nor industry groups provided good proxies for systematic risk classes.

The primary goal of this research has been to extend previous work done in the area of microeconomic modelling of systematic risk. In broad terms, several firm-specific factors have been tested for significance in determining measured betas. The choice of factors was based on the results of existing studies of the theoretical and empirical relationships between financial parameters of firms and their systematic risk.

A further objective was to examine the relationship between firm-specific parameters and the returns achieved by shareholders.

LITERATURE REVIEW

The empirical studies in this area have taken two broad directions, namely those that have sought to establish univariate relationships between systematic risk and a single explanatory variable, and multivariate studies using numerous independent variables.

Univariate Studies

Hamada (1972) combined his theoretical derivation of the positive impact of financial leverage on systematic risk with an empirical exercise, which explained up to 24% of systematic risk over 304 firms by using gearing levels. Lev (1974) also carried out a confirmatory study to demonstrate modest explanatory power for systematic risk using his theoretically postulated operating leverage measure. Research into Canadian firms (Belkaoui, 1978) found significance for both the current ratio and long-term debt ratio in explaining beta. A South African study by Retief, Affleck-Graves & Hamman (1984) used several definitions of financial leverage, finding the highest correlation with risk when gearing was defined as:

$$\textit{Financial Leverage} = \frac{\textit{Total Assets} - \textit{Equity}}{\textit{Total Assets}}$$

Mandelker & Rhee (1984) combined operating and financial leverage in a single model, and found significant joint impact for the two types of leverage on systematic risk. Huffman (1989) repeated this study on more recent data, with mixed results. Another study (Bhandari, 1988) concluded that financial leverage was a highly significant determinant of systematic risk, with the relationship being robust to variations in market proxy and estimation technique. Ro, Zavgren & Hsieh (1992) assessed the change in beta for firms approaching bankruptcy, observing a steady rise as gearing and financial distress increased.

Several researchers have sought a relationship between market beta and an accounting-based beta. Gonedes (1973) defined an accounting beta based on earnings divided by book value of assets, but found no significant correlation between this measure and market beta. Beaver & Manegold (1975) tested three variants of accounting beta, and found significant correlations to market beta for all of them. The correlations were stronger for larger portfolios of securtities.

Moyer & Chatfield (1983) examined a composite measure of a firm's market power derived from asset size, total sales, proportion of industry sales and the industry's four firm concentration ratio. They demonstrated only a weak relationship between this market power measure and systematic risk, but found a significant negative relationship between risk and industry concentration. Sudarsanam (1992) demonstrated for a sample of UK firms that industry growth rate increased systematic risk, while capital intensity reduced it.

Multivariate Studies

The first significant multivariate study was undertaken by Beaver, Kettler & Scholes (1970), using dividend payout, growth in net book assets, financial leverage, liquidity, size, earnings variability and an accounting beta which attempted to measure cyclicality of earnings. Using a sample of 307 firms, both leverage and accounting beta showed strong positive correlations to systematic risk, and earnings variability together with dividend payout were also significant, with the expected signs.

Rosenberg & McKibben (1973) tried thirty-two variables, finding financial leverage, earnings volatility and growth in sales and earnings to be significantly positively related to beta. However, no significance was found for accounting beta or dividend payout. Some of the other significant variables had unexpected signs, and their model had only 2% more explanatory power than the naive assumption that beta equalled one for all firms.

Beta was found by Lev & Kunitzky (1974) to be significantly negatively related to dividend payout, as well as to indicators of 'smoothing' in a company's reported financial data, particularly smoothness of capital expenditure, dividends, sales and earnings. 'Smoothness' was defined effectively as the inverse of volatility, and thus this research confirmed earlier positive associations between earnings volatility and risk.

Melicher (1974) examined the electric utility industry, and found a significant multivariate model for beta incorporating dividend payout, ROE, market activity, plant to total capitalisation, and size. Although the pattern of signs was as expected, poor repeatability of results was found over different periods of measurement.

A study by Thompson (1976) used earlier research on corporate behaviour and characteristics to formulate 43 variables for explaining beta. Only three factors emerged as significant, stemming from fluctuations in earnings, dividends and an earnings multiple of the firm.

A South African study by Retief, Affleck-Graves & Hamman (1986) used eight variables, including financial and operating leverage, asset turnover, current ratio, return on assets, cash flow variability, an equity beta and a cashflow beta measure. They concluded that a share's market risk was sensitive to three classes of accounting data: financial structure, cash flow and liquidity. They also found that the correlation coefficients of their models improved as portfolios were formed, and suggested that this was due to a reduction in measurement errors through portfolio averaging.

METHODOLOGY

Population: This was defined simply as the South African traded equity market, focusing only on the Industrial sector. The rationale for excluding other sectors lay in the differences in accounting procedures applied in the other major sectors, notably Mining and Financials, which presented significant problems in standardisation of accounting variables.

Sample Selection: The sample was constrained by the period for which shares were continuously listed, and particularly by the availability of financial data for the firms represented by these share returns. A large sample was sought to allow for reliable statistical analysis. A total of 135 Industrial shares were continuously listed from January 1978 to January 1993, for which monthly share returns could be calculated to allow beta estimation, and online financial data was available for these shares for the same period.

Data Collection: Two online sources were used to capture financial data for firms. Since the basis for standardisation of the financial data differed between these two sources, one was used to gather all firm-specific financial variables, while the other was used only to provide share price and market index information. Annual beta estimates were provided by the UCT Department of Mathematical Statistics' Financial Risk Service, using their most recent trade-to-trade algorithm with Bayesian adjustment (Bowie & Bradfield 1993a & b), shown to minimise the statistical estimation problems mentioned earlier.

Data Analysis: The primary statistical tool used was correlation analysis followed by multiple regression. In the latter case, stepwise methods were employed to determine which variables added significant explanatory power to the model, and to detect any multicollinearity which may have existed.

Since the betas were estimated over a 5-year period, all annual financial data were aggregated over 5 years to match the dependent variable. This was consistent with the methodology described by Stewart (1991 p. 453). The data collected spanned a 15-year period, and was divided into three 5-year subperiods to be used in three separate beta analyses. This allowed each set of betas used as dependant variables to be estimated using 60 months' non-overlapping returns. The variable names and definitions are included as Appendix 1.

The individual propositions were explored as follows:

Proposition 1: The significance of gearing was examined by correlating the financial leverage variable with levered betas, ie. beta estimates derived using actual market returns.
Proposition 2: The components of business risk were examined firstly by finding correlations between financial variables and unlevered betas, derived from the Hamada (1972) degearing formula:

$$\beta_U = \frac{\beta_L}{(1 + \frac{D_L}{S_L})}$$

with

β_L = Beta of levered firm
β_U = Beta of unlevered firm (Business risk β)
D_L = total market value of firm L debt
S_L = total market value of firm L equity

Since leverage was shown to have a strong impact on systematic risk in previous studies, the unlevering procedure was used to expose significant residual business risk relationships, and followed previous research (Stewart 1991). Furthermore, Chung (1989) demonstrated a theoretical link between financial leverage and business risk itself, suggesting an inverse relationship between them. If this were found to occur in an empirical context, it would possibly obscure other significant correlations.

Secondly, propositions 1 and 2 were combined in a composite analysis of all financial variables including leverage as independent variables, against levered market betas. In this case, correlation analysis was used to highlight significant relationships, and these financial variables were used to develop regression models for levered betas in each of the three data periods.

The predictive power of the regression models was assessed by performing two forecasting exercises, which predicted betas for the second and third data intervals based on the models developed for the first and second intervals' data respectively. The forecasts were then compared with the actual measured betas for these latter two periods.

Finally, an overall regression model was produced using the full 15-year data set by row-wise combination of the three data blocks.

Proposition 3: Portfolio effects were implicitly explored in propositions 1 and 2, by ranking the full sample of firms by their betas and aggregating groups of adjacent firms into portfolios, using equally-weighted averages to find portfolio betas. This was done to avoid creating a set of random portfolios with all aggregate betas tending to the market average, which would defeat the objective of this study. Correlation and regression analysis was then performed on equally-weighted averages of the corresponding financial variables, with portfolio sizes of 3,5 and 7 shares being tested.

Proposition 4: A general multifactor form of the asset-pricing model was tested, as follows (after Sharpe, 1984):

$$R_a = R_f + b_m \beta_a (R_m - R_f) + \sum_{I=i}^{n} b_i X_i$$

where

R_a = Return on Security a
R_f = Risk Free Rate of Return
R_m = Market Rate of Return
β_a = Measured beta for security a
b_m = Regression
b_o = Intercept
X_i = Financial Variable i
b_i = Regression coefficient for X_i

This form was applied to a stepwise regression, preceded by correlation analysis, to indicate which financial variables contribued to determining share returns, either in addition to or in place of the return on the overall market. In effect, this analysis bypassed the traditional CAPM, making it possible to assess which financial parameters of the firm were significantly priced in total by investors in the shares of each firm.

This analysis used the same 5-year aggregates of financial variables for the independent variables. The corresponding 5-year returns on individual shares as well as for the market portfolio were derived as follows:

- Firstly, the annual return on each share was measured using the year-on-year percentage gain in annual average share price, where annual average share price was calculated from the total value of shares traded divided by total number of shares traded during the financial year of each firm. Annual returns were found for each year of the 15 year period, and then three 5-year averages were taken to derive share returns for the three separate analyses.
- For the market return, annual average values for the All-Share Index were found by taking the arithmetic mean of twelve monthly values. An annual average market return was found using the year-on-year percentage gain in annual average value of the index, for each year of the 15-year analysis period. Finally, three sets of 5-year averages were taken as above. However, to match the return on the market with the individual share returns (which were measured during each firm's financial year), it was necessary to find 5-year average market returns for each month of the year and extract the 5-year value corresponding to each respective firm's financial year-end.

It was not considered necessary to dividend-adjust either the share returns or the market returns used in the regressions, since the averaging described above would limit the observable 5-year effects.

Once again, three separate analyses were conducted to derive individual regression models for each consecutive 5-year period. The predictive power of these models was tested by forecasting returns for the latter two data intervals as described for the beta analysis. Finally, an overall explanatory model for returns was developed using the full 15-year data set through row-wise combination of the sub-intervals. Portfolio analysis was also conducted throughout, as per the procedure described in Proposition 3, but ranking shares by their returns prior to aggregating into portfolios.

Limitations: The research was subject to a few limitations:

- The problems surrounding beta estimation were not addressed in this study. The betas used may thus have been subject to measurement errors for a number of reasons, as discussed. Furthermore, no attempt was made to constrain the sample to well-traded shares, and hence thin-trading bias may have had an effect on the results.
- The question of market segmentation was not addressed in this study. The betas used were derived from the covariances of share returns against the Actuaries' All-Share Index, and CAPM testing of multifactor models was done using the same index as market proxy.
- The macroeconomic approach to asset pricing, based on Arbitrage Pricing Theory, was not addressed at all. Only microeconomic variables specific to individual firms were tested for significance.

The study was limited to a sample and survivor bias may exist. The issue of beta stationarity could not be comprehesively addressed in this study, which may have an effect on the applicability of the results to other time periods. Furthermore, the research was restricted to using financial variables for which published financial information was available. For example, the international diversity factor proposed by Stewart (1991) could not be tested since South African firms do not generally report the percentage of their revenues derived from offshore sources.

RESULTS

Financial leverage was tested for significant correlation to measured market betas, to assess the contention that financial risk due to gearing is a significant component of systematic risk. The leverage ratio used was

$$\textit{Financial Leverage} = \frac{\textit{Total Assets} - \textit{Equity}}{\textit{Total Assets}}$$

Separate analyses were carried out for each of the three time periods, namely 1978-1982, 1983-1987 and 1988-1992 and the results are shown on table 1.

TABLE 1
Financial leverage correlations with market Betas

PORTFOLIO SIZE	1	3	5	7
TIME PERIOD	1978 TO 1982			
Correlation Coeff. (r)	0.13908	0.28680	0.40097	**0.49670**
Significance Prob. (S)	0.1331	0.0691	0.0522	0.0425
TIME PERIOD	1983 TO 1987			
Correlation Coeff. (r)	**0.25445**	**0.46583**	**0.51977**	**0.66089**
Significance Prob. (S)	0.0040	0.0019	0.0077	0.0028
TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.17874**	**0.32423**	**0.36594**	**0.47239**
Significance Prob. (S)	0.0452	0.0362	0.0420	0.0478

It is notable that significant positive correlations were found at the 5% probability level (shown in bold) in all cases except for the 1978-1982 sample. For each of the three sample periods, the correlations improved as portfolio size increased, and for the first sample period this resulted in a significant correlation for a portfolio size of 7 shares.

This result agreed with the theoretical relationship postulated by Hamada (1972), as well as with the numerous empirical studies cited earlier. Specifically, the results confirmed the previous South African work by Retief *et al.* (1984), although their correlations were much higher than those above. However, their sample size was approximately half of that used for this research, being restricted to firms with a June year-end.

A number of firm-specific financial parameters were tested for significant correlations to an unlevered beta measure, calculated by applying the Hamada degearing formula to measured market betas. The results of the correlation analysis are summarised in three separate tables, describing each 5-year time period respectively. Only significantly correlated variables are listed.

TABLE 2
Correlations between financial variables and unlevered Beta

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.35705**	**0.61803**	0.19765	0.19404
Significance Prob. (S)	0.0011	0.0000	0.3546	0.4555
FINANCIAL VARIABLE	STOCKTO: Turnover Rate of Stock			
Correlation Coeff. (r)	**-0.22999**	-0.27722	-0.19496	-0.35811
Significance Prob. (S)	0.0201	0.0793	0.3613	0.1581

Only two variables showed significant correlations for the first time period, and these became insignificant for larger portfolio sizes. Nevertheless, the relationships had the expected signs, with a growth measure being positively correlated to beta, agreeing with Fewings' (1975) theoretical model, as well as Stewart's (1991) 'strategic risk' factor. The negative relationship for stock turnover agreed with the risk-reduction effects of good asset management proposed by Stewart (1991). Examining the data for this variable, it became evident that a few firms in the sample, such as Pick 'n Pay, were strongly affecting the result. Excluding these as outliers rendered the correlations insignificant.

Numerous financial variables showed strong correlations with unlevered betas for the second time period, although some correlations were not significant for certain portfolio sizes. It must be noted that the online financial data collected was somewhat sparse for certain variables in particular time periods, and hence the degrees of freedom differed between individual pairwise correlations.

Nevertheless, growth in absolute turnover, operating profit, total assets and total available cashflow were positively related to beta, as well as year-on-year percentage growth in operating profit and total assets. The latter two were a more rigorous test of the relationship, since inflation effects were eliminated. Firm size measured by total assets was also positively correlated to beta, which was contrary to the negative relationship proposed by Stewart (1991). He claimed that this could be observed in the fact that larger firms had longer track record of managerial competence, and that the risk impact of decisions taken under uncertainty would be small relative to the firm's total assets. However, in this sample the *positive* correlation was attributed to the fact that larger firms on the JSE tended to be well-traded relative to the smaller ones, and the thin-trading effect (Dimson, 1979) caused a significant downward bias on the measured betas of the latter shares.

Liquidity was negatively related to beta, corroborating the finding of Retief *et al.* (1986), as were both measures of dividend yield. The latter agreed with the theoretical relationship postulated by Gurney (1982), but contradicted the classical Miller & Modigliani (1961) proposition of dividend irrelevance. It is suggested that this was an 'information effect' due to the co-movement of dividends with earnings.

Two of the profitability ratios were positively correlated to beta, supporting the contention that a component of business risk is due to investor uncertainty that future earnings will be sustained by highly profitable firms (Stewart, 1991). In addition, the variabilities of total available cashflow and of one of the profitability ratios were positively related to beta, confirming the findings of

TABLE 3
Correlations between financial variables and unlevered Beta

TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.23133**	**0.49184**	**0.62383**	**0.68515**
Significance Prob. (S)	0.0137	0.0013	0.0011	0.0024
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.33919**	**0.59310**	**0.74321**	**0.77724**
Significance Prob. (S)	0.0001	0.0001	0.0000	0.0002
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.41456**	**0.54657**	**0.68306**	**0.69089**
Significance Prob. (S)	0.0000	0.0003	0.0002	0.0021
FINANCIAL VARIABLE	GTOTCASH: Y/Y Growth in Total Cashflow			
Correlation Coeff. (r)	0.14871	0.29598	**0.46851**	**0.57597**
Significance Prob. (S)	0.1035	0.0637	0.0209	0.0155
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.33489**	**0.51014**	**0.62339**	**0.70032**
Significance Prob. (S)	0.0002	0.0008	0.0011	0.0017
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	-0.14829	**-0.42651**	**-0.44528**	**-0.54623**
Significance Prob. (S)	0.1045	0.0061	0.0292	0.0233
FINANCIAL VARIABLE	DIV1: Dividend Yield Measure 1			
Correlation Coeff. (r)	-0.16457	-0.31101	**-0.40617**	**-0.48517**
Significance Prob. (S)	0.0713	0.0508	0.0489	0.0484
FINANCIAL VARIABLE	DIV2: Dividend Yield Measure 2			
Correlation Coeff. (r)	-0.16544	**-0.31235**	**-0.40767**	**-0.48757**
Significance Prob. (S)	0.0697	0.0497	0.0480	0.0471
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	**0.19508**	**0.33834**	0.38646	0.44310
Significance Prob. (S)	0.0393	0.0327	0.0621	0.0749
FINANCIAL VARIABLE	PROFIT 2: Profitability Ratio 2			
Correlation Coeff. (r)	**0.19782**	**0.33408**	0.32368	0.53359
Significance Prob. (S)	0.0374	0.0351	0.1228	0.0274
FINANCIAL VARIABLE	VARTOTCF: Variability of Total Cashflow			
Correlation Coeff. (r)	**0.34476**	**0.46865**	**0.54059**	**0.62838**
Significance Prob. (S)	0.0001	0.0023	0.0064	0.0069
FINANCIAL VARIABLE	VARPROF 2: Variability in Profit Ratio 2			
Correlation Coeff. (r)	**0.28874**	**0.37243**	**0.45422**	0.17366
Significance Prob. (S)	0.0013	0.0180	0.0258	0.5050
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Profit			
Correlation Coeff. (r)	**0.21791**	**0.36864**	**0.41701**	0.36594
Significance Prob. (S)	0.0438	0.0209	0.0426	0.1486
FINANCIAL VARIABLE	GROWAST%: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.22101**	**0.46313**	**0.56359**	**0.57400**
Significance Prob. (S)	0.0296	0.0026	0.0041	0.0160

Beaver *et al.* (1970), Rosenberg & McKibben (1973), Lev & Kunitzky (1974), Thompson (1976), Retief *et al.* (1986), and Stewart's (1991) 'operating risk' element. This was also intuitively logical, since beta as a convariance measure is intended to gauge risk as embodied in variability of return.

As for the previous time period, growth in turnover and total assets as well as year-on-year percentage growth in operating profit and total assets showed significant correlations in period 3, although not for every portfolio size tested. As before, firm size was positively correlated to beta, and liquidity showed negative correlations, although the latter was not significant at the 5% probability level. One variability measure, that of total available cashflow, was significantly positively correlated to beta.

The correlation analysis was repeated against market betas to expose significant relationships to allow for regression models to be constructed, with the levered beta as the dependent variable and those financial parameters found to be significant as independent variables. The summary regression statistics appear in Table 5.

It is apparent from Table 5 that while the regression models were fairly consistent for different portfolio sizes, they differed across the three time periods. This non-stationarity was due to changes in the relative significance of different financial variables over the time periods studied, and supported the notion that individual accounting parameters proxied for one another to some extent. Those with the greatest explanatory power in the stepwise regressions for each respective period contained the most risk information for that particular sample.

TABLE 4
Correlations between financial variables and unlevered Beta

TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.28214**	**0.47589**	**0.53839**	**0.56826**
Significance Prob. (S)	0.0032	0.0039	0.0118	0.0271
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.19554**	**0.34196**	0.40300	0.50124
Significance Prob. (S)	0.0435	0.0444	0.0701	0.0570
FINANCIAL VARAIBLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.23153**	**0.39900**	0.47589	0.59653
Significance Prob. (S)	0.0164	0.0176	0.0292	0.0189
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	-0.16500	-0.27870	-0.39823	-0.44989
Significance Prob. (S)	0.0894	0.1050	0.0738	0.0924
FINANCIAL VARIABLE	VARTOTCF: Variability in Total Cashflow			
Correlation Coeff. (r)	**0.23196**	**0.39576**	0.43031	0.48657
Significance Prob. (S)	0.0162	0.0186	0.0515	0.0659
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Proft			
Correlation Coeff. (r)	**0.32397**	**0.41200**	0.37147	**0.59056**
-Significance Prob. (S)	0.0032	0.0139	0.0973	0.0205
FINANCIAL VARIABLE	GROWAST%: Y/Y % Growth in Total Assets			
Correlation Coeff. (r)	**0.23088**	0.33015	0.28212	0.46539
Significance Prob. (S)	0.0286	0.0527	0.2153	0.0804

TABLE 5
Regression models for market Beta using financial variables

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables	GROWTO	-STOCKTO	-STOCKTO	-STOCKTO
(Prob Level)	(0.0022)	(0.0345)	(0.0413)	(0.0598)
	-STOCKTO	LEVERAGE	LEVERAGE	LEVERAGE
	(0.0102)	(0.0273)	(0.0349)	(0.0674)
R^2	0.1798	0.1856	0.3149	0.4204
Adjusted R^2	0.1574	0.1416	0.2497	0.3376
Total D.O.F.	75	39	23	16
F-test Model Prob. Level	0.001	0.022	0.019	0.022
TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables	SIZE	GROWPROF	SIZE	SIZE
(Prob Level)	(0.0013)	(0.0003)	(0.0006)	(0.0000)
	-LIQUID	PLNTLIFE	PLNTLIFE	-LIQUID
	(0.0007)	(0.0179)	(0.0074)	(0.0010)
	VARPROF 2	PROFIT 2	LEVERAGE	
	(0.0299)	(0.0076)	(0.0733)	
		VARPROF 2		
		(0.0082)		
R^2	0.3024	0.6075	0.6845	0.7678
Adjusted R^2	0.2711	0.5626	0.6394	0.7368
Total D.O.F.	70	39	24	17
F-test Model Prob. Level	0.000	0.000	0.000	0.000
TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables	VARTOTCF	VARTOTCF	VARTOTCF	GROWTO
(Prob Level)	(0.0185)	(0.0000)	(0.0544)	(0.0003)
	GROWPRF%	GROWPRF%	PROFIT 4	PROFIT 4
	(0.0367)	(0.0113)	(0.0568)	(0.0629)
			GROWTO	
			(0.0697)	
R^2	0.1534	0.4478	0.5856	0.7170
Adjusted R^2	0.1299	0.4195	0.5264	0.6793
Total D.O.F.	74	41	24	17
F-test Model Prob. Level	0.002	0.000	0.000	0.000

Despite the non-stationarity, the usefulness of these beta models was tested in a predictive sense as follows:

- The regression models produced using the first period's data (1978-1982) were used to generate beta forecasts for firms based on the values of the relevant financial independent variables in the next period (1983-1987). This was done for each portfolio size individually. The actual beta estimates for the second period were then compared with these forecasts.
- The above procedure was repeated for the second two data intervals, ie. predicted betas were generated using the regression models from the second period with actual financial data for the third period, for comparison with actual betas for the third period.

The residuals for these forecasting exercises were too poor to allow meaningful error analysis. However, the correlations between forecasts and actual beta values appear in Table 6.

TABLE 6
Correlations between forecast and actual Betas

PERIOD FORECAST	1983 TO 1987			
PERIOD OF MODEL BUILT	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	0.02528	0.17796	0.07043	0.03039
Significance Prob. (S)	0.8162	0.2656	0.7437	0.9078
PERIOD FORECAST	1988 TO 1992			
PERIOD OF MODEL BUILT	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.35718**	**0.42673**	**0.54965**	**0.70272**
Significance Prob. (S)	0.0000	0.0073	0.0044	0.0011

It was clear that there was no meaningful correlation between forecast and actual betas over the first two periods. However, significant correlations emerged over the second two periods. While the latter would not be particularly useful in a forecasting context, the result offered some support to the continuity of the relationships between financial parameters and beta over multiple time periods.

To further explore this, a combined model was sought for the total 15-year data sample. This overall regression simply attempted to extract those financial variables which appeared to be significant determinants of beta over a longer time frame. Table 7 lists the significant financial variable correlations, and the overall model is described in Table 8.

TABLE 7
Correlations between financial variables and market Beta

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.30194**	**0.40332**	**0.44371**	**0.49165**
Significance Prob. (S)	0.0000	0.0000	0.0001	0.0002
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.24173**	**0.39893**	**0.50582**	**0.58854**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.23884**	**0.39795**	**0.49013**	**0.56363**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.30475**	**0.40147**	**0.48776**	**0.57368**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	**-0.12596**	**-0.18797**	**-0.25676**	**-0.37477**
Significance Prob. (S)	0.0146	0.0358	0.0272	0.0062
FINANCIAL VARIABLE	LEVERAGE: Financial Leverage			
Correlation Coeff. (r)	**0.18632**	**0.33938**	**0.40797**	**0.50662**
Significance Prob. (S)	0.0003	0.0001	0.0003	0.0001

Only the measures of growth, firm size, liquidity and financial leverage were significant in total over the full period. Each had the expected signs, in accordance with the research cited earlier.

The regressions were reasonably stable for different portfolio sizes, with all of the significantly correlated variables except for liquidity appearing in the models. The R^2-values were lower than those for the subperiod models, but highly significant nevertheless.

To test proposition four, the product of the overall market return with each share's beta was included as an independent variable in the regressions, and by applying stepwise methods, it was hoped to assess the relative explanatory power of the financial variables in determining asset prices in the presence of the classical CAPM's market return variable. The individual correlations between share returns and each variable are summarised in

TABLE 8 Combined regression models for market Beta using financial variables

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	SIZE (0.0000) GROWTO (0.0001) LEVERAGE (0.0141)	GROWASST (0.0071) GROWTO (0.0047) LEVERAGE (0.0541)	GROWASST (0.0148) GROWTO (0.0274) LEVERAGE (0.0168)	SIZE (0.0007) LEVERAGE (0.0045)
R^2	0.1764	0.2554	0.3523	0.4347
Adjusted R^2	0.1687	0.2368	0.3245	0.4117
Total D.O.F.	322	123	73	51
F-test Model Prob. Level	0.000	0.000	0.000	0.000

Tables 9,10 and 11, followed by a summary of the corresponding regression models in Table 12.

TABLE 9
Correlations between financial variables and share returns

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GOPCASH: Y/Y Growth in Op. Cashflow			
Correlation Coeff. (r)	0.12405	0.29159	**0.46413**	**0.53169**
Significance Prob. (S)	0.1946	0.0799	0.0296	0.0340
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	**-0.23665**	**-0.46255**	**-0.57505**	**-0.62889**
Significance Prob. (S)	0.0120	0.0039	0.0051	0.0091
FINANCIAL VARIABLE	VARPROF 2: Variability of Profit Ratio 2			
Correlation Coeff. (r)	**-0.28560**	**-0.53669**	**-0.69824**	**-0.74857**
Significance Prob. (S)	0.0023	0.0006	0.0003	0.0008
FINANCIAL VARIABLE	VARPROF 3: Variability of Profit Ratio 3			
Correlation Coeff. (r)	**-0.34940**	**-0.43673**	**-0.52926**	**-0.61247**
Significance Prob. (S)	0.0014	0.0069	0.0113	0.0117
FINANCIAL VARIABLE	VARPROF 4: Variability of Profit Ratio 4			
Correlation Coeff. (r)	**-0.39290**	**-0.51251**	**-0.68258**	**-0.75425**
Significance Prob. (S)	0.0003	0.0012	0.0005	0.0007
FINANCIAL VARIABLE	VARPROF 5: Variability of Profit Ratio 5			
Correlation Coeff. (r)	**-0.23776**	**-0.46472**	**-0.57792**	**-0.63155**
Significance Prob. (S)	0.0116	0.0038	0.0048	0.0087
FINANCIAL VARIABLE	VARPROF 6: Variability of Profit Ratio 6			
Correlation Coeff. (r)	**-0.31211**	**-0.42588**	**-0.50256**	**-0.59943**
Significance Prob. (S)	0.0046	0.0086	0.0171	0.0141

In the first time period (1978-1982), a single measure of growth was significantly positively correlated with share returns, namely operating cashflow growth. This was attributed to the presence of firms offering strong growth prospects, with the promise of superior returns in future periods being incorporated into share prices. Given that 5-year average data was used, the share price returns probably also reflected some realised performance due to growth opportunities. This was consistent with the market reality of high-growth firms typically trading at high P/E ratios. In addition, several measures of variation in profitability were significantly negatively correlated to returns. This was also as expected, since variability was shown to be correlated with risk and has been discounted in share prices for such firms.

For the second sample interval (1983-1987), the growth measures of turnover, operating profit and operating cashflow were significantly positively correlated, along with useful plant life. Once again, in explaining the latter result, it is believed that firms enjoying strong growth were undertaking capital expansion or replacement such that the plant life ratio was high, and thus the short-term negative effect of capital expenditure on reported accounting profits was not discounted for these firms in share prices. A working capital management ratio, namely debtors collection period, was significantly negatively correlated with returns. This was as expected, with firms employing superior working capital management enjoying better revenue performance and higher stock market ratings.

In addition, three of the profitability ratios were significantly positively correlated to returns, which although being a fairly obvious result indicated that such profitability measures offered useful pricing information to investors. It is notable that the three measures which were significant, closely approximated the free cash flow-based profitability formulations proposed by Stewart (1991) to better reflect real economic operating performance. Lastly two measures of variation in profitablility were significantly negatively correlated with returns in the second period, as expected.

TABLE 10
Correlations between financial variables and share returns

TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.22145**	**0.41890**	**0.64268**	**0.71658**
Significance Prob. (S)	0.0179	0.0071	0.0007	0.0012
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.32675**	**0.52249**	**0.65053**	**0.67197**
Significance Prob. (S)	0.0002	0.0005	0.0006	0.0031
FINANCIAL VARIABLE	GOPCASH: Y/Y Growth in Op. Cashflow			
Correlation Coeff. (r)	**0.24773**	**0.49700**	**0.63861**	**0.67420**
Significance Prob. (S)	0.0059	0.0011	0.0008	0.0030
FINANCIAL VARIABLE	PLNTLIFE: Useful Plant Life			
Correlation Coeff. (r)	0.15503	0.28264	**0.42308**	**0.50538**
Significance Prob. (S)	0.1255	0.0772	0.0394	0.0385
FINANCIAL VARIABLE	DBTRDAYS: Days in Debtors			
Correlation Coeff. (r)	-0.17293	-0.30357	**-0.49332**	**-0.55922**
Significance Prob. (S)	0.0646	0.0569	0.0143	0.0196
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	0.17808	**0.35285**	**0.44120**	**0.51451**
Significance Prob. (S)	0.0580	0.0255	0.0309	0.0346
FINANCIAL VARIABLE	PROFIT 2: Profitability Ratio 2			
Correlation Coeff. (r)	**0.19370**	**0.33639**	**0.46961**	**0.48351**
Significance Prob. (S)	0.0389	0.0338	0.0206	0.0493
FINANCIAL VARIABLE	PROFITS 5: Profitability Ratio 5			
Correlation Coeff. (r)	**0.20978**	**0.38664**	**0.47704**	**0.59353**
Significance Prob. (S)	0.0251	0.0137	0.0184	0.0120
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	-0.16621	**-0.34645**	-0.39531	**-0.60806**
Significance Prob. (S)	0.0673	0.0285	0.0559	0.0096
FINANCIAL VARIABLE	VARPPROF 5: Variability of Profit Ratio 5			
Correlation Coeff. (r)	-0.17053	**-0.35347**	**-0.40111**	**-0.61797**
Significance Prob. (S)	0.0604	0.0253	0.0521	0.0082

TABLE 11
Correlations between financial variables and share returns

TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.21700**	**0.47496**	**0.52916**	**0.56908**
Significance Prob. (S)	0.0118	0.0017	0.0065	0.0137
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.17351**	**0.41482**	**0.49412**	**0.59829**
Significance Prob. (S)	0.0450	0.0070	0.0121	0.0087
FINANCIAL VARIABLE	GOPCASH: Growth in Operating Cashflow			
Correlation Coeff. (r)	**0.19917**	0.29101	0.39005	**0.48812**
Significance Prob. (S)	0.0210	0.0649	0.0539	0.0399
FINANCIAL VARIABLE	GTOTCASH: Growth in Total Cashflow			
Correlation Coeff. (r)	**0.18834**	**0.33670**	**0.41469**	**0.53977**
Significance Prob. (S)	0.0293	0.0314	0.0393	0.0208
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.17044**	**0.47001**	**0.50134**	**0.53864**
Significance Prob. (S)	0.0490	0.0019	0.0107	0.0211
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	**0.43578**	**0.40940**	**0.51012**	**0.56334**
Significance Prob. (S)	0.0000	0.0079	0.0092	0.0149
FINANCIAL VARIABLE	PROFIT 5: Profitability Ratio 5			
Correlation Coeff. (r)	**0.42345**	0.28910	0.39498	**0.53801**
Significance Prob. (S)	0.0000	0.0668	0.0507	0.0213
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	**-0.18117**	**-0.48519**	**-0.58667**	**-0.69336**
Significance Prob. (S)	0.0362	0.0013	0.0021	0.0014
FINANCIAL VARIABLE	VARPROF 2: Variability of Profit Ratio 2			
Correlation Coeff. (r)	**-0.20626**	**-0.45382**	**-0.58523**	**-0.68013**
Significance Prob. (S)	0.0168	0.0029	0.0021	0.0019
FINANCIAL VARIABLE	VARPROF 4: Variability of Profit Ratio 4			
Correlation Coeff. (r)	**-0.24691**	-0.27960	**-0.46481**	-0.46243
Significance Prob. (S)	0.0084	0.0766	0.0192	0.0533
FINANCIAL VARIABLE	VARPROF 5: Variability in Profit Ratio 5			
Correlation Coeff. (r)	**-0.17782**	**-0.47932**	**-0.57917**	**-0.68073**
Significance Prob. (S)	0.0389	0.0015	0.0024	0.0019
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Profit			
Correlation Coeff. (r)	**0.19500**	**0.49057**	**0.54375**	**0.65957**
Significance Prob. (S)	0.0484	0.0013	0.0050	0.0029

In the final analysis period (1988-1992), once again measures of growth in operating profit, total assets, operating cashflow and total cashflow were significantly positively correlated to returns. Firm size was also positively correlated, which ran completely contrary to the controversial small-firm effect discussed earlier. However, the JSE appears to be subject to a 'blue is beautiful' effect whereby major institutional investors seek and tightly hold the shares of larger firms, with the consequent bidding up of share prices. This is done at the expense of smaller second-tier stocks which are often less sought after despite their value-creation potential. It is possible that the politically volatile South African business environment has led investors to prefer larger firms in the belief that they may be more robust to variations in business circumstances.
As in the second sample period, profitability was positively related to return for this analysis. It is notable that only those measures closely approximating Stewart's (1991) cash-based formulations were again highly correlated. Lastly, several measures of variability in the profit ratios were negatively related to return as before. The regression models developed for each time period appear in Table 12.

It is important to note that although the product of each share's beta and the overall market return was tested in each of the above analyses, this variable was not found to be significant in any of the measurement periods, or for any size of portfolio. This was of some concern, since the indication given was that the classical CAPM was unsuccessful in describing share returns for this data.

The regressions indicated reasonably stable models for different portfolio sizes, with only minor differences in the most significant financial variables extracted by the stepwise regression procedure. However, some differences emerged between the models across the three time periods. Despite this, a forecasting exercise was again carried out for share returns to assess the predictive performance of the models over consecutive time periods. This followed the same procedure as described for beta forecasting. The residuals were once again too large to allow for meaningful error analysis. However, the correlations between the forecast and actual share returns are given in Table 13.

The results for the first two periods indicated only one significant correlation, for portfolios of 5 shares, while the second two data intervals yielded forecasts which were quite strongly correlated to actual returns for each size of portfolio. These results did not indicate particularly successful predictive performance, but again offered some support to the underlying continuity of relationships between financial variables and returns.

Finally, an overall model was again sought for the entire 15-year analysis period, and it was notable that only two variables were significantly correlated to returns, as shown in table 14.

It appeared from this result that the non-stationarity of the relationships between individual time periods was sufficient to render almost all of the financial variables insignificant in determining returns over the total period, with the exception of financial leverage and the product of a firm's beta with return on the overall market portfolio. These relationships were themselves very weak, with significant correlations occurring for only one size of portfolio in each case. For example, an explanatory regression model using the product of beta and market return as the independent variable would have an R^2-value of only 0.075 in the very best case, for a portfolio size of 7 shares. Although this was extremely inconclusive, the emergence of the market return variable in this analysis gave some renewed support to the classical CAPM.

TABLE 12
Regression models for share returns using financial variables

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	-VARPROF 2 (0.0025)	-VARPROF 2 (0.0007)	GOPCASH (0.0012) -VARPROF 1 (0.0211) -VARPROF 2 (0.0003) -VARPROF 5 (0.0180)	-VARPROF 4 (0.0007)
R^2	0.0806	0.2929	0.7437	0.5689
Adjusted R^2	0.0722	0.2721	0.6867	0.5381
Total D.O.F.	110	35	22	15
F-test Model Prob. Level	0.003	0.001	0.000	0.001
TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	GROWPROF (0.0039) GOPCASH (0.0137) -DBTRDAYS (0.0386)	GROWPROF (0.0023) GOPCASH (0.0040) -DBTRDAYS (0.0268)	GROWPROF (0.0110) GOPCASH (0.0205) -DBTRDAYS (0.0009)	GROWPROF (0.0025) GOPCASH (0.0211) -DBTRDAYS (0.0005)
R^2	0.1862	0.4864	0.7270	0.8443
Adjusted R^2	0.1622	0.4436	0.6861	0.8083
Total D.O.F.	105	39	23	16
F-test Model Prob. Level	0.000	0.000	0.000	0.000
TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	PROFIT 1 (0.0000) -VARPROF 1 (0.0043)	PROFIT 1 (0.0077) -VARPROF 1 (0.0030) GROWPRF% (0.0093)	PROFIT 1 (0.0063) -VARPROF 1 (0.0015)	GROWASST (0.0109) -VARPROF 1 (0.0020)
R^2	0.2714	0.4943	0.5361	0.6677
Adjusted R^2	0.2592	0.4522	0.4940	0.6234
Total D.O.F.	121	39	24	17
F-test Model Prob. Level	0.000	0.000	0.000	0.000

TABLE 13
Correlations between forecast and actual share returns

PERIOD FORECAST	1983 TO 1987			
PERIOD OF MODEL BUILT	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	0.14361	0.27855	**0.56924**	0.32594
Significance Prob. (S)	0.1161	0.0860	0.0046	0.2179
PERIOD FORECAST	1988 TO 1992			
PERIOD OF MODEL BUILT	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.26150**	**0.42535**	**0.44315**	**0.48378**
Significance Prob. (S)	0.0041	0.0056	0.0265	0.0419

TABLE 14
Correlations between financial variables and share returns

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	LEVERAGE: Financial Leverage			
Correlation Coeff. (r)	-0.09556	**-0.18415**	-0.20356	-0.22554
Significance Prob. (S)	0.0689	0.0459	0.0863	0.1153
FINANCIAL VARIABLE	MRP: Product of Market Beta & Return on Market Portfolio			
Correlation Coeff. (r)	0.09600	0.17555	0.22015	**0.27411**
Significance Prob. (S)	0.0802	0.0562	0.0631	0.0492

Furthermore, the result suggested that of all the financial variables, only a firm's financial leverage added significant asset pricing information to that contained in the return on the market over the total period under review. Retief *et al.* (1986) contended that financial leverage was the only firm-specific parameter for which the effects could not be diversified away in a portfolio of shares, since the portfolio would always assume the weighted average value of the gearing of its constituent firms. They suggested that the emergence of leverage as a primary determinant of risk in an asset-pricing context was evidence of the separation theorem (Sharpe, 1964) at work.

CONCLUSIONS

The primary objective of this research was to explore the linkages between financial variables and systematic risk as embodied in estimated beta coefficients. It was found that highly significant models could be produced over individual 5-year periods, which in general followed the theoretical propositions offered in the literature. Unfortunately, these models were not stationary over consecutive time periods, which prevented meaningful predictive modelling of betas. This result was consistent with the contention of Marston & Harris (1993) that studies based on realised historical returns required extremely long time series to produce meaningful results, and that those over shorter time frames would be highly sensitive to the data for individual subperiods. However, it remained apparent that certain classes of fundamental financial data were strongly related to both beta and return, offering some useful insights to company management and investors.

In particular, beta risk estimates were strongly positively associated with measures of firm growth and profitability, supporting the notion of a 'strategic risk' element (Stewart 1991) existing for rapidly growing and/or highly profitable firms. Measures of short-term managerial performance such as liquidity ratios and stock turnover were negatively correlated to beta, in agreement with intuitive propositions as well as previous empirical work documented in the literature. Dividend yield was negatively related to unlevered beta risk estimates, in agreement with Gurney (1982) but in contradiction to the classical dividend irrelevance proposition of Miller & Modigliani (1961). However, it was suggested that this was an information effect due to the co-movement of dividends with earnings, and the correlations became insignificant with levered betas. Although firm size was positively correlated with beta, this was contrary to the findings of previous empirical research, and was attributed to the downward bias of thin trading (Dimson, 1979) which affected the typically thinly-traded shares of smaller firms on the JSE. Several measures of variability of profit ratios as well as of cashflow were strongly positively correlated to beta, in agreement with past research and logical expectations, given that beta estimates seek to encapsulate investment risk due to variability of returns.

Lastly, it was found that both unlevered betas and levered market betas were significantly correlated to the same classes of financial variables, except for financial leverage which was only significant against levered betas. This was as expected, and supported the theoretical contention that beta could be viewed as a composite of financial risk due to gearing , and the residual business risk inherent in the firm. This also gave some support to the validity of Hamada's theoretical deleveraging formula in stripping out financial risk while leaving the business risk component largely intact. The strong correlations between financial leverage and market betas also corroborated the earlier work of Retief *et al.* (1984) on South African stocks, although their contention that this was the only significant explanatory variable was refuted by the results of this study.

An important result in nearly all analyses was the marked improvement in correlations and regression models for portfolios of shares. This offered strong support for the contention that portfolio formation eliminated much measurement error in the various parameters through averaging. In the context of microeconomic modelling of systematic risk, this has been described as an emulation of the benefits of diversification understood in classical portfolio theory (Retief *et al.*, 1986).

A further notable result was the significance of several of the cashflow-based variables in all analyses, supporting the contention that these measures contained risk and asset-pricing information superior to that in ordinary accrual accounting variables. This was in agreement with Rayburn (1986), Ismail & Kim (1989) and Stewart (1991). However, the cashflow beta measure was not significant in any of the analyses. It is suggested that this may have been due in part to errors in the approximation used for cashflow calculations.

Throughout the analysis, neither of the operating leverage variables were significant, nor were the capital intensity and 'market power' measures. The latter variable was defined as the ratio of market value to book value of the firm, and its lack of significance in the study was in direct contradiction to the surprising and controversial result produced by Fama & French (1992) who found that this ratio was the major determinant of returns over the long term.

APPENDIX 1
Variable names and definitions

VAR. NAME	DESCRIPTION	DEFINITION
LEVERAGE	Financial Leverage	$\frac{\text{Total Assets} - \text{Equity}}{\text{Total Assets}}$
OPLEV 1	Operating Leverage 1	$\frac{\text{Fixed Assets excluding investments}}{\text{Total Assets} - \text{Current Liabilities}}$
OPLEV 2	Operating Leverage 2	$\frac{\triangle EBIT}{EBIT} \text{ X } \frac{Sales}{\triangle Sales}$
GROWTO	Y/Y Turnover Growth	$\text{Turnover}_t - \text{Turnover}_{t-l}$
GROWTO%	Y/Y % Turnover Growth	$\frac{\text{Turnover}_t - \text{Turnover}_{t-l}}{\text{Profit}_{t-l}}$
GROWFRO F	Y/Y Profit Growth	$\text{Profit}_t - \text{Profit}_{t-l}$
GROWPRF %	Y/Y % Profit Growth	$\frac{\text{Profit}_t - \text{Profit}_{t-l}}{\text{Turnover}_{t-l}}$
GROWASS T	Y/Y Asset Growth	$\text{Tot. Assets}_t - \text{Tot. Assets}_{t-l}$
GROWAST %	Y/Y % Asset Growth	$\frac{\text{Tot. Assets}_t - \text{Tot. Assets}_{t-l}}{\text{TTot. Assets}_{t-l}}$
GTOTCASH	Tot. Cashflow Growth	$\text{Tot. Cashflow}_t - \text{Tot. Cashflow}_{t-l}$
GOPCASH	Op. Cashflow Growth	$\text{Op. Cashflow}_t - \text{Op. Cashflow}_{t-l}$

Appendix 1 continued

VAR. NAME	DESCRIPTION	DEFINITION
SIZE	Firm Size	*Total Assets*
DIV 1	Dividend Yield 1	*Total Dividends Paid / Average Ordinary Shareholders Interest*
DIV 2	Dividend Yield 2	*Total Dividends Paid / Average Real Ordinary Shareholders Int.*
MKTPOWR	Market-to-Book Ratio	*Average share price x shares in issue / Total Assets less accumulated depreciation*
CAPINT	Capital Intensity	*Fixed Assets excluding Investments / Total Assets*
PROFIT 1	Profitability Ratio 1	*Operating Profit / Average Operating Assets*
PROFIT 2	Profitability Ratio 2	*Profit before inv.income, int. & tax / Ave. total assets excl. total investments*
PROFIT 3	Profitability Ratio 3	*Operating Profit / Turnover*
PROFIT 4	Profitability Ratio 4	*Profit before inv. income, int. & tax / Turnover*
PROFIT 5	Profitability Ratio 5	*Op. Profit before depr,inv.income, int & tax / Ave. Total Assets excl. Total Investments*
PROFIT 6	Profitability Ratio 6	*Profit before interest and tax / Turnover*
VARPROF 1	Variability in Profit Ratio 1	$SD(PROFIT\,1_{t-4} : PROFIT\,1_t)$
VARPROF 2	Variability in Profit Ratio 2	$SD(PROFIT\,2_{t-4} : PROFIT\,2_t)$
VARPROF 3	Variability in Profit Ratio 3	$SD(PROFIT\,3_{t-4} : PROFIT\,3_t)$
VARPROF 4	Variability in Profit Ratio 4	$SD(PROFIT\,4_{t-4} : PROFIT\,4_t)$
VARPROF 5	Variability in Profit Ratio 5	$SD(PROFIT5_{t-4} : PROFIT\,5_t)$
VARPROF 6	Variability in Profit Ratio 6	$SD(PROFIT6_{t-4} : PROFIT\,6_t)$
VAROPCF	Variability in Operating Cashflow	$SD(Op.Cashflow_{t-4} : Op.Cashflow_t$
VARTOTCF	Variability in Total Cashflow	$SD(Tot.\ Cashflow_{t-4} : Tot.\ Cashflow_t)$
DBTRDAYS	Debtors' Collection Period	*Average total debtors x 12 / Turnover*
STOCKTO	Turnover Rate of Stock	*Average total Stock x 12 / Turnover*
PLNTNEW	Plant Newness	*Fixed Assets – Accum. Depreciation / Fixed Assets*
PLNTLIFE	Useful Plant Life	*Fixed Assets excl. land, buildings / Accumulated Depreciation*
LIQUID	Current Ratio Liquidity	*Current Assets / Current Liabilities*
OPCBETA 1	Operating Cashflow Beta	$\frac{Cov(Op.Cashflow_i, Op.Cashflow_{Market})}{\sigma^2(Op.Cashflow_{Market})}$

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