# The association between market-determined and accounting-determined risk measures in the South African context

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A key problem in estimating the cost of capital for an unlisted company has been the determination of its beta coefficient. Market prices for such companies are not available, therefore the traditional regression methods for estimation are not possible. Thus, it is necessary for a proxy beta to be determined. In this article an attempt is made to develop such a proxy beta by using eight accounting variables. These accounting variables are shown to be significantly correlated to the market beta for individual companies. In addition, regression analyses are performed to develop an estimation model which will allow the individual company to obtain a proxy beta from its accounting variables. Satisfactory regression equations are developed for both the single share case and the portfolio case. The article is concluded with the presentation of a four-step procedure which will permit managers of unlisted companies to obtain a proxy for their beta and hence to estimate their overall cost of capital. In addition, it is shown that the procedure presented is consistent with the findings of modern portfolio theory.

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'n Baie belangrike probleem by die vasstelling van die koste van kapitaal vir 'n ongenoteerde maatskappy is die bepaling van sy beta-koëffisiënt. Die tradisionele regressiemetodes om skattings te maak is nie moontlik nie, aangesien geen markpryse vir sulke maatskappye bestaan nie. Dit is dus noodsaaklik dat 'n plaasvervanger-beta vasgestel word. In hierdie artikel word gepoog om so 'n plaasvervanger-beta te ontwikkel deur die gebruik van agt rekenkundige veranderlikes. Daar word bewys dat hierdie rekenkundige veranderlikes betekenisvol gekorreleer is met die mark-beta vir individuele maatskappye. Verder word 'n model ontwikkel wat individuele maatskappye in staat stel om 'n plaasvervanger-beta te ontwikkel aan die hand van regressie-analise. Bevredigende regressievergelykings word ontwikkel vir beide die enkelaandeel-geval sowel as die portefeulje-geval. Die artikel sluit af met die daarstelling van 'n prosedure bestaande uit vier stappe wat bestuurders van ongenoteerde maatskappye in staat sal stel om hul beta's te bereken en gevolglik hul koste van kapitaal te skat. Daar word verder ook aangetoon dat die voorgestelde prosedure in ooreenstemming is met die bevindings van moderne portefeulje-teorie.

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## Introduction

In recent years an increasing number of companies have been using modern capital budgeting techniques in evaluating their capital investment decisions. All of these techniques require that the company determine its cost of capital — i.e. the return it needs to earn from its investments to satisfy all of its providers of capital simultaneously. This cost of capital is then used either as the discount factor in the net present value (NPV) calculation or as the hurdle rate if an internal rate of return (IRR) approach is adopted.

Both academics and practitioners now agree that the weighted average cost of capital approach provides the most appropriate way of estimating the cost of capital for the individual firm. This approach requires the company to estimate the cost of each of its sources of capital (debt, equity, preference shares, etc) and to weight these by the proportion of each source in the company's target capital structure. In theory this is an extremely simple and appealing procedure. In practice, the costs of debentures, preference shares, and other debt instruments are usually determined by reference to current market rates for these types of instruments. They are therefore relatively easy to establish. However, the cost of equity is not as easily established. Even if the company is a listed company, a share price is quoted and not a return. Furthermore, there is almost universal agreement that the share price is fixed by investors' expectations of future dividends rather than by the history of past dividends. Therefore, the return required by the equity holders on their investment in the company is not easy to determine.

Several approaches to estimating the cost of equity have emerged in the literature. The early approaches were based on forecasts of future dividends and the discounting of these to produce the current share price (cf., for example, Gordon, 1955 and Gordon & Shapiro, 1956). In recent years the Capital Asset Pricing Model (Sharpe, 1964) has provided a means for companies to estimate their cost of capital without having to make forecasts of future dividends. This model can be stated as follows:

$$R_E = R_F + B.E(R_m - R_F)$$

where $R_E$ = the firm's cost of equity; $R_F$ = the risk-free rate; $E(R_m - R_F)$ = expected risk premium paid by market over and above the risk-free rate; and $B$ = a measure of the covariability of the share price with the market relative to the volatility of the market.

The parameter which is most difficult to estimate in the above equation is the $B$ parameter. The risk-free rate can be estimated by using either the treasury bill rate or the banker's acceptance rate whereas the expected market premium can be estimated by averaging the market premium over a large number of years. If the company is a listed company the $B$ parameter can be estimated using the market model (Fama, Fisher, Jensen & Roll, 1969):

$$R_i = a + BR_{mi} + e$$

where $R_i$ = the return on the share in period $i$; $R_{mi}$ = the return on the market in period $i$; $a$ and $B$ = the regression parameters which can be estimated using ordinary least squares (OLS) regression; and $e$ = the random error term which is assumed to obey the assumptions necessary for OLS regression.

Convention suggests that five years of monthly data yield reasonable estimates of the $B$ parameter.

Although the model has received some criticism in the literature (e.g. Roll, 1977) it remains popular in practice. This is probably due to its intuitive appeal and the simplicity of application. Consequently the CAPM has been used by many listed companies to estimate their cost of capital.

Unfortunately, use of the model is not widespread among unlisted companies. This is because in the absence of a regular market price for the equity of the company, beta estimation is not possible in the conventional sense (i.e. using the market model). To overcome this problem many texts suggest that the unlisted company choose a listed company in the same type of business and estimate the beta for that company (say $B_L$). This beta can then be used as a first approximation for the beta of the unlisted company (Brealey & Myers, 1985:172). However, it has been shown that the beta is directly related to the leverage employed in the company (Hamada, 1972). Therefore, it is necessary to first unlever the beta of the listed company as follows.

$$B_A = \frac{E_L}{D_L + E_L} \cdot B_L$$

where $B_A$ = unlevered beta for the listed company; $B_L$ = levered (estimated) beta for the listed company; $E_L$ = the total value of equity in the listed company; and $D_L$ = the total value of debt in the listed company.

The beta for the unlisted company can then be estimated by re-levering this $B_A$ by the leverage employed by the unlisted company. That is,

$$B_{eq} = \frac{D_u + E_u}{E_u} \cdot B_A$$

where $B_{eq}$ = the equity beta of the unlisted company; $D_u$ = the total value of debt in the unlisted company; and $E_u$ = the total value of equity in the unlisted company.

Whilst this procedure might prove adequate in countries with very large exchanges it is inadequate for countries with relatively few listed companies. This is true in South Africa where, due to the increase in conglomeration over the last few years, it may prove difficult for an unlisted company to find an appropriate surrogate company. Additional problems are encountered when the listed company is thinly traded (Dimson, 1979) which is the case for many companies listed on the JSE (Strebel, 1977).

The problem arises as to how best to estimate beta for an unlisted company. One approach is to attempt to estimate the beta from accounting variables as such variables are readily available to the management of an unlisted company. If this is possible then added benefits will ensue. For example, if a relationship can be established between market beta and accounting variables this relationship could be used, *inter alia*, to assess the impact on the market's assessment of risk in changes in the accounting structure of the company and to assist in determining the rate of return which can justifiably be earned by companies in regulated industries.

In this article, an attempt is made to develop a relationship between market beta and eight accounting variables. A brief review of the relevant literature is presented in the second section and this is followed by a brief discussion of the data and methodology in Section 3. Section 4 presents initial results showing the correlation coefficients between market beta and each of the accounting variables examined. The regression models are presented and discussed in Section 5 and the article closes with a brief summary and conclusion.

## Review of past research

The research into the relationship between market beta and accounting variables can be divided into two distinct classes — a univariate approach which concentrates on attempts to find a single accounting surrogate for market beta and a multivariate approach in which the relationship between market beta and several accounting variables is examined. These will be discussed separately below.

In one of the first major univariate studies, Hamada (1972:449) showed that financial structure had an important influence on beta but he disagreed with certain other authors on whether beta varies directly with the level of financial leverage. This followed an earlier study (Hamada, 1969:19) in which he proved analytically that beta will increase as a company increases its leverage. He concluded that if the Modigliani & Miller (1958) corporate tax leverage propositions were correct, approximately 21–24% of the observed systematic risk of common shares (when averaged over 304 companies) could be explained merely by the added financial risk taken on by the underlying company with its use of debt and preference share capital. In other words, corporate leverage has a significant influence. In another study, Lev (1974:627) devised an operating leverage variable (the ratio of fixed to variable operating costs) which proved to have modest explanatory power.

In addition to these attempts to establish a relationship between market beta and a single traditional accounting variable, several researchers attempted to establish a relationship between market beta and an accounting-based beta. For example, Gonedes (1973:410) defined an accounting beta based on earnings divided by the book value of assets. The correlations between this accounting beta and market beta were insignificant except when first differences were used to compute the betas. Beaver & Manegold (1975) extended this work by conducting an extensive investigation employing three different measures of accounting beta. They found significant correlations (both Spearman rank-order and Pearson product-moment) with market betas for all the accounting betas examined (Beaver & Manegold, 1975:248). In addition, they found that the strength of the correlation increased with increasing portfolio size.

Hill & Stone (1980) devised a risk composition beta which they claimed to be an accounting analogue of the market beta. Their results indicated that the risk-composition beta was generally more highly correlated with the market beta than were the other accounting betas. In addition, the risk-composition beta was able to predict the magnitude of the future market beta with significantly less error than other accounting betas.

As far as South African companies are concerned, Retief, Affleck-Graves & Hamman (1984) showed that the Hill & Stone results did not hold for a sample of companies chosen from the JSE. In particular, they showed that the correlation between most of the accounting betas and the market beta was negative. They concluded that it was unlikely that a single accounting beta would prove an adequate surrogate for market beta in the South African context (Retief, Affleck-Graves & Hamman, 1984:210).

Other researchers have sought to forge multivariate links between beta and several corporate risk factors. For example, Logue & Merville (1972:42) regressed the betas of 287 industrial common shares on nine financial variables. Only return on assets, asset size, and financial leverage variables appeared significant, but correlations were low with $r^2$ equalling 0,25.

Breen & Lerner (1973:344) divided 1 400 companies into 12 groups according to the month in which 1969 financial results were announced. They then regressed the betas in each month grouping on seven financial variables. They found that most variables were not significant, and those that were, were not consistently significant over time.

Rosenberg & McKibben (1973:325) examined 32 variables derived from both accounting and share market data. They found 13 significant variables but the directions of their relationship with beta, as expressed by the signs of their regression coefficients, were generally unexpected. In addition, the variables had only 2% more explanatory power than the naive assumption that beta equalled one for all shares.

Lev & Kunitsky (1974:264) found beta to be significantly associated with dividend payout, indicators of smoothing in a company's capital expenditure, dividends, sales, and earnings. The regression coefficients had expected signs and the $r^2$ was 0,47.

Melicher (1974:239) found significant multivariate links between beta for electric utility shares during 1967–1971 and dividend payout, return on common equity, market activity, plant to total capitalization, and size. The pattern of signs was generally as expected and $r^2$ ranged from 0,33 to 0,41. Replication of the tests on the 1963–1967 period, however, produced very poor results.

In a follow-up study, Melicher & Rush (1974:541) sought to relate changes in betas from 1962–1966 to 1967–1971 to 11 financial variables. The results were discouraging. Only financial leverage, earnings growth, and plant to total capitalization proved significant with $r^2$ ranging from 0,22 to 0,26.

Thompson (1976:178–181) formulated 43 variables to explain the beta of a common share by using prior research on corporate behaviour and characteristics and by developing a model. His model, based on a widely used share evaluation technique revealed three major risk factors inherent in the beta of a share. These risks stem from fluctuations in the earnings, dividends, and an earnings multiple of the individual company.

Belkaoui (1978:5) concluded from evidence based on examining 55 Canadian companies that accounting-based measures of risk are impounded in the systematic risk of a common share. A significant positive relationship was found between both the current ratio and long-term debt to common equity and systematic risk. However, his results conflicted with those obtained in similar studies conducted in the USA. Pettit & Westerfield (1972:1662), on the other hand, did not find significant correlations between liquidity and leverage against market beta.

In South Africa very few studies have emerged in this area. However, Retief (1980:42) investigated five return measures, namely return on assets, return on equity, EBIT/average total assets, EBIT/selected liabilities, and return on book capitalization. However, he found no significant results.

The above refers to only a few of the numerous studies attempting to establish the underlying determinants of systematic risk. What seems to be clear is that systematic risk is related in some way to risk factors existing in the corporation. However, it is still far from clear which risk factors are important and these factors seem to vary between different markets, different economic climates and conditions, different time periods, and are even sample dependent.

## Data and sample selection

The companies chosen to comprise the sample for the study and the time period examined are identical to those selected for the study of Retief, Affleck-Graves & Hamman (1984). The sample consists of 63 companies quoted on the Johannesburg Stock Exchange (JSE), each of which had a June financial year-end for each year from 1973 to 1982. The companies are listed in Appendix 2. For additional details concerning the selection the reader is referred to Retief, *et al.* (1984:207).

An analysis of the previous attempts to establish a relationship between market beta and accounting variables has shown that the choice of variables depends on the researcher and that choices were usually made in an *ad hoc* manner. Measures, however, can be generally divided into the following classes: profitability; leverage; liquidity; and efficiency.

Rather than choosing a multitude of ratios (e.g. 40 or 50) and increasing the chances of obtaining a spurious relationship, it was decided to choose only one or two variables from each of the major classes of accounting variables. Accordingly, the following eight variables were selected:

Financial leverage ($F$)
Operating leverage ($OL$)
Asset turnover ($TATO$)
Current ratio ($CR$)
EBIT to total assets ($ROA$)
Equity beta ($B^E$)
Cash flow beta ($B^{CF}$)
Standard deviation of cash flow ($S_{CF}$).

The exact definition used for each of these ratios is presented in Table 1 and it is assumed that the definition used will not materially affect the results.

Five of these eight variables are traditional financial ratios and therefore will not be discussed further. Additional information concerning the applicability and relevance of these ratios can be formed from a number of sources as Weston & Brigham (1981); Keown, Scott, Martin & Petty (1985) and Halloran & Lanser (1985). The three remaining variables are, however, not standard ratios and therefore warrant some additional comment.

**Table 1** Definitions of ratios (variables)

| Symbol | Description | Definition |
|---|---|---|
| $F$ | Financial leverage | (Total assets – equity) ÷ (Total assets) |
| $OL$ | Operating leverage | (Fixed assets + goodwill (exclusive of investments)) ÷ (Total assets – current liabilities) |
| $TATO$ | Asset turnover | (Sales) ÷ (Total assets) |
| $CR$ | Current ratio | (Current assets) ÷ (Current liabilities) |
| $ROA$ | EBIT to total assets | (Net income before tax + interest) ÷ (Total assets) |
| $B^E$ | Equity beta | $Cov(ROE_i, ROE_m) \div Var(ROE_m)$<br>where:<br>Cov = covariance operator<br>Var = variance<br>$ROE_i$ = (earnings after taxation – minority interest in income – pref dividends) ÷ (Book value of common equity)<br>$ROE_m$ = a market index of accounting equity rate of returns |

Each of the above measures were calculated per company per year for 1973–1982. To establish the relationship with market beta, a single value for the time period studied was calculated as follows:

Example, in the case of the $F$ (financial leverage ratio); for company $i$, year $t$:

$$(F_i)_t = \frac{\text{(Fixed assets and all other non-current assets)} + \text{(Current assets)} - \text{(Equity)}}{\text{(Total assets)}}$$

then

$$F_i = \sum_{t=1}^{N} (F_i)_t / N \quad \text{for the total period}$$

where N = number of years in the time period studied

Firstly, equity beta was chosen to represent the class of accounting beta variables because it proved to be the best of the traditional accounting betas in the South African context (Retief, *et al.*, 1984). Secondly, cash flow beta was also included as it was argued (Retief, 1984:201) that this accounting beta might be more appropriate under conditions of high inflation. The method of estimating cash flow beta is presented in Appendix 1. Finally, the standard deviation of cash flow was incorporated to include some unsystematic component in the accounting variable measures.

Each of the first five ratios were calculated for each of the years 1973–1982. These ten values were then averaged for each company to obtain an average value for the ratio for each company. The two accounting betas and the standard deviation of cash flow were estimated for each company using the ten years of available data, i.e. 1973–1982. Finally, the estimates for the market betas used in the subsequent correlation and regression analyses were estimated using monthly data over the entire period.

The results obtained for each variable were then averaged across the 63 companies comprising the sample. Some summary statistics for these variables are provided in Table 2.

## Simple correlation analysis

For each of the accounting variables discussed in the previous section the Pearson product-moment correlation coefficient with the market beta was calculated for (a) single shares; (b) portfolios consisting of three shares; (c) portfolios consisting of seven shares (except in the case of $S_{CF}$ and $B^{CF}$ where the portfolios consisted of six shares due to the reduction of the sample from 63 companies to 60 companies — cf. Appendix 1).

The portfolios were formed by grouping adjacent shares after ranking on market beta and portfolio variables were calculated as the arithmetic average of the variables for all companies included in the portfolio.

The results obtained are summarized in Table 3.

The empirical results presented in Table 3 indicate that with the exception of operating leverage in the three-share portfolio cases and both operating leverage and asset turnover in the seven and four-share portfolio cases (respectively), all the variables considered are significantly correlated (positively or negatively) at the 10% level of significance with the market measure of risk as captured by the market beta. It should be noted that the rankings in order of significance remain fairly consistent across the various

**Table 2** Sample characteristics of financial leverage ratios

| Variable | Arith mean | $SE$ of mean | Studentized mean | Unbiased variance | STD deviation | Coeff of variation | MAD | Min value | Max value | Range | Coeff of skewness | Coeff of kurtosis |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $F$ | 0,5061 | 0,2138 | 23,669 | 0,0288 | 0,1697 | 0,3354 | 0,1303 | 0,0700 | 0,8860 | 0,8160 | −0,5506 | 3,2225 |
| $OL$ | 0,4861 | 0,0307 | 15,854 | 0,0592 | 0,2434 | 0,5007 | 0,1856 | 0,0560 | 1,3340 | 1,2780 | 0,6029 | 4,1816 |
| $TATO$ | 1,6014 | 0,1119 | 14,3110 | 0,4508 | 0,6714 | 0,4193 | 0,4645 | 0,6700 | 3,6000 | 2,9300 | 1,0242 | 4,0238 |
| $CR$ | 2,1078 | 0,1801 | 11,7040 | 1,9459 | 1,3950 | 0,6618 | 0,8182 | 0,6000 | 8,5500 | 7,9500 | 2,9873 | 12,6420 |
| $ROA$ | 14,5500 | 0,4787 | 30,3940 | 13,7510 | 3,7082 | 0,2549 | 2,7505 | 6,5100 | 28,1000 | 21,5900 | 0,8666 | 4,8050 |
| $B^E$ | 0,9900 | 1,2243 | 8,0863 | 0,9443 | 0,9717 | 0,9815 | 0,6956 | −0,6451 | 4,0040 | 4,6491 | 1,2179 | 4,6162 |
| $\sigma_{CF}$ | 0,3350 | 0,0338 | 9,9220 | 0,0684 | 0,2615 | 0,7806 | 0,1928 | 0,0723 | 1,2539 | 1,1816 | 1,7497 | 5,4832 |
| $B^{CF}$ | 0,4542 | 0,2030 | 2,2375 | 2,4726 | 1,5724 | 3,4619 | 0,9643 | −4,3200 | 7,7680 | 12,0880 | 1,3557 | 10,6320 |

**Table 3** Summary of results of correlation tests between accounting variables and market beta

| Ratio | Symbol | Portfolio size | Correlation coefficient ($r$) | $t$ value | Degrees of freedom | Significance probability | Rank |
|---|---|---|---|---|---|---|---|
| Financial leverage | $F$ | 1 | 0,560 | 5,27 | 61 | 0,000 | 1 |
| Operating leverage | $OL$ | 1 | 0,209 | 1,67 | 61 | 0,099 | 8 |
| Asset turnover | $TATO$ | 1 | 0,317 | 1,95 | 34 | 0,059 | 7 |
| Current ratio | $CR$ | 1 | −0,320 | −2,58 | 58 | 0,013 | 4 |
| EBIT to total assets | $ROA$ | 1 | −0,273 | −2,17 | 58 | 0,035 | 6 |
| Equity beta | $B^E$ | 1 | 0,297 | 2,37 | 58 | 0,021 | 5 |
| Cash flow beta | $B^{CF}$ | 1 | 0,478 | 4,15 | 58 | 0,000 | 2 |
| Std. dev of $d$ (cash flow) | $\sigma_{CF}$ | 1 | 0,442 | 3,75 | 58 | 0,000 | 3 |
| Financial leverage | $F$ | 3 | 0,789 | 5,60 | 19 | 0,000 | 1 |
| Operating leverage | $OL$ | 3 | 0,286 | 1,30 | 19 | 0,208 | 8 |
| Asset turnover | $TATO$ | 2 | 0,426 | 1,89 | 16 | 0,078 | 7 |
| Current ratio | $CR$ | 3 | −0,493 | −2,41 | 18 | 0,027 | 5 |
| EBIT to total assets | $ROA$ | 3 | −0,486 | −2,36 | 18 | 0,030 | 6 |
| Equity beta | $B^E$ | 3 | 0,531 | 2,66 | 18 | 0,016 | 4 |
| Cash flow beta | $B^{CF}$ | 3 | 0,734 | 4,58 | 18 | 0,000 | 2 |
| Std. dev of $d$ (cash flow) | $\sigma_{CF}$ | 3 | 0,561 | 2,87 | 18 | 0,010 | 3 |
| Financial leverage | $F$ | 7 | 0,982 | 13,57 | 7 | 0,000 | 1 |
| Operating leverage | $OL$ | 7 | 0,325 | 0,91 | 7 | 0,393 | 8 |
| Asset turnover | $TATO$ | 4 | 0,432 | 1,27 | 7 | 0,246 | 7 |
| Current ratio | $CR$ | 6 | −0,783 | −3,57 | 8 | 0,007 | 3 |
| EBIT to total assets | $ROA$ | 6 | −0,624 | −2,26 | 8 | 0,054 | 6 |
| Equity beta | $B^E$ | 6 | 0,672 | 2,57 | 8 | 0,033 | 4 |
| Cash flow beta | $B^{CF}$ | 6 | 0,842 | 4,42 | 8 | 0,002 | 2 |
| Std. dev of $d$ (cash flow) | $\sigma_{CF}$ | 6 | 0,650 | 2,42 | 8 | 0,042 | 5 |

portfolio sizes. Therefore, for example, financial leverage is always the most significant of the accounting variables whereas the cash flow beta is always the second most significant variable. Also, operating leverage is consistently the least significant followed by asset turnover and return on assets.

The results presented in Table 3 thus indicate that the financial ratios traditionally employed are significantly related to market beta — i.e. the market measure of risk. In addition, the sign of the correlation is usually consistent with expectations. For example, financial leverage has a positive correlation with market risk supporting the widely held belief that increasing financial leverage increases risk. Similarly, the current ratio has a negative correlation with market risk indicating that, on average, the higher the current ratio, the lower the market risk and vice versa. Again, this is as expected.

However, despite the fact that the ratios are, in general, significantly correlated with market beta, it must be pointed out that the correlations are not particularly high in absolute terms. Even the financial leverage ratio has only a correlation of 0,56 with market beta in the single share case. This implies that only approximately 32% of the variability in market beta can be explained by financial leverage. Therefore, although the relationship is significant and useful, it is unlikely to be of great assistance to the individual company in attempting to assess its market beta.

Indeed, the results therefore indicate that for an investor analysing the riskiness of a company in isolation, leverage should clearly be an important consideration. But, it is not the only factor that influences market beta as other factors account for approximately 68% of the variability in the beta coefficient.

On the other hand, for an investor making portfolio decisions the leverage of the company is a crucial factor in assessing risk. At the portfolio level leverage explains as much as 96% of the variability in the market beta. In essence what appears to happen is that the other risk factors that affect the riskiness of an individual share (e.g. business risk) are diversified away at the portfolio level. However, the leverage factor is largely unaffected by the diversification and thus becomes the dominant risk factor.

## The regression approach

The results presented in the previous section indicated that, individually, the accounting variables examined are unlikely to enable the individual firm to estimate its market risk accurately. It is therefore necessary to examine whether these variables can be used collectively to provide a more accurate estimate of the company's market beta.

In order to examine this, stepwise regression with market beta as the dependent variable was used to determine which combination of the independent variables was most suitable for estimating market beta. The results for the single share case are summarized in Table 4.

An analysis of Table 4 reveals that financial leverage ($F$) alone explains 32,5% of the variation in $B_m$. The inclusion of $S_{CF}$ in addition to $F$ increases the coefficient of determination ($r^2$) by 11,12%. This represents a statistically significant increase. Likewise the inclusion of $B^{CF}$ and the current ratio ($CR$) also significantly increases the coefficient of determination (at the 10% level of significance). However, the further inclusion of $B^E$, $ROA$ or $OL$ does not significantly increase the coefficient of determination at the 10% level of significance.

The above discussion implies that only the variables $F$,

**Table 4** Summary of steps for the stepwise regression analysis: single share case

| Step no | Variable | Standard error of estimate | Coefficient of mult correlation ($r$) | Coefficient of deter-mination ($r^2$) | Change in coefficient of deter-mination | Significance level |
|---|---|---|---|---|---|---|
| 1 | $F$ | 0,3228 | 0,5701 | 0,3250 | 0,3250 | 0,000 |
| 2 | $\sigma_{CF}$ | 0,2976 | 0,6605 | 0,4362 | 0,1112 | 0,001 |
| 3 | $B^{CF}$ | 0,2910 | 0,6858 | 0,4703 | 0,0341 | 0,063 |
| 4 | $CR$ | 0,2849 | 0,7083 | 0,5016 | 0,0313 | 0,069 |
| 5 | $B^E$ | 0,2806 | 0,7247 | 0,5252 | 0,0236 | 0,108 |
| 6 | $ROA$ | 0,2812 | 0,7295 | 0,5321 | 0,0070 | 0,379 |
| 7 | $OL$ | 0,2815 | 0,7347 | 0,5399 | 0,0077 | 0,354 |

$B^{CF}$, $S_{CF}$ and $CR$ need to be considered in the estimation of $B_m$ in the single-share case (from the set of eight variables examined). The regression equation derived using these four variables is given by ($t$ values in parenthesis):

$$B_m = -0{,}30 + 1{,}457F + 0{,}404S_{CF} + 0{,}077B^{CF} + 0{,}073CR$$
$$(4{,}50) \quad (2{,}36) \quad (1{,}89) \quad (1{,}86)$$

This equation explains 50,16% of the variation in market beta.

This procedure was repeated for the three-share portfolio case. The stepwise table is shown in Table 5. An analysis of the results (along the same lines as previously) shows that only three variables, namely $F$, $B^{CF}$, $CR$, should be included in the final regression equation. The variable $F$ alone explains 62,13% of the variation in $B_m$. The inclusion of $B^{CF}$ increases the coefficient of determination by 15,12%, which once again represents a statistically significant increase. Likewise the inclusion of $CR$ also significantly increases the coefficient of determination (by 7,68%). However, the further inclusion of $ROA$, $B^E$, $OL$, $TATO$, or $S_{CF}$ does not significantly increase the coefficient of determination (at the 10% level). It is therefore not recommended that these variables be included in the final regression equation.

Using only these three variables the following regression equation is obtained:

$$B_m = -1{,}387 + 2{,}980F + 0{,}247B^{CF} + 0{,}222CR$$
$$(5{,}26) \quad (3{,}80) \quad (2{,}85)$$

This equation explains 84,93% of the variation in $B_m$. An identical procedure was repeated for the six-share portfolio case. The stepwise regression results are summarized in Table 6. An analysis of this table shows that the variable $F$ on its own explains 94,07% of the variation in $B_m$. The inclusion of $OL$ in addition to $F$ only increases the coefficient of determination by 2,3% whereas the further inclusion of $S_{CF}$ is responsible for an increase of an additional 2,08%.

**Table 5** Summary of steps for the stepwise regression analysis: three-share portfolio case

| Step no | Variable | Standard error of estimate | Coefficient of mult correlation ($r$) | Coefficient of deter-mination ($r^2$) | Change in coefficient of deter-mination | Significance level |
|---|---|---|---|---|---|---|
| 1 | $F$ | 0,2440 | 0,7883 | 0,6213 | 0,6213 | 0,000 |
| 2 | $B^{CF}$ | 0,1946 | 0,8789 | 0,7725 | 0,1512 | 0,004 |
| 3 | $CR$ | 0,1633 | 0,9216 | 0,8493 | 0,0768 | 0,011 |
| 4 | $ROA$ | 0,1619 | 0,9279 | 0,8611 | 0,0118 | 0,277 |
| 5 | $B^E$ | 0,1643 | 0,9309 | 0,8665 | 0,0054 | 0,463 |
| 6 | $OL$ | 0,1629 | 0,9371 | 0,8781 | 0,0116 | 0,287 |
| 7 | $\sigma_{CF}$ | 0,1693 | 0,9372 | 0,8784 | 0,0003 | 0,856 |

**Table 6** Summary of steps for the stepwise regression analysis: six-share portfolio case

| Step no | Variable | Standard error of estimate | Coefficient of mult correlation ($r$) | Coefficient of deter-mination ($r^2$) | Change in coefficient of deter-mination | Significance level |
|---|---|---|---|---|---|---|
| 1 | $F1$ | 0,1003 | 0,9699 | 0,9407 | 0,9407 | 0,000 |
| 2 | $J22$ | 0,0840 | 0,9817 | 0,9637 | 0,0230 | 0,073 |
| 3 | $\sigma^{CF}$ | 0,0592 | 0,9922 | 0,9845 | 0,0208 | 0,029 |
| 4 | $RO1$ | 0,0491 | 0,9956 | 0,9911 | 0,0066 | 0,111 |
| 5 | $B^{CF}$ | 0,0496 | 0,9964 | 0,9928 | 0,0016 | 0,398 |
| 6 | $R42$ | 0,0549 | 0,9967 | 0,9933 | 0,0006 | 0,645 |
| 7 | $B^E$ | 0,0659 | 0,9968 | 0,9936 | 0,0003 | 0,795 |

Further inclusion of any other variables does not significantly increase the coefficient of determination at any acceptable level of significance.

However, even though both $OL$ and $S_{CF}$ cause significant increases in the coefficient of determination the increase is small in magnitude and hence it is not recommended that these two variables be included in the final regression equation. It is therefore recommended that only the $F$ variable be included in the multi-share portfolio case. This yields the following regression equation:

$$B_m = -0{,}930 + 3{,}456F$$
$$(11{,}26)$$

This equation explains 94,07% of the variability in $B_m$.

In concluding this section, it is worth noting some overall trends in the results. Firstly, the correlation coefficients ($r$) improve in all cases as portfolios are formed, possibly indicating a reduction in the measurement error or the occurrence of non-random grouping.

Secondly, the financial leverage ratio ($F$) is the most significant variable in all the regression models. It not only explains the highest portion of the variability of the beta coefficient individually, but it also displays the highest $t$ values throughout.

Thirdly, in all the cases cited above, the models indicate that the riskiness of a share, as perceived by the market, tends to be most sensitive to the following classes of accounting data: financial structure; cash flow; and liquidity.

Finally, the regression approach confirms the argument that other accounting variables need to be included in the individual share case if a suitable explanation of $B_m$ is to be obtained. Of the variation in $B_m$, 32% was explained when only leverage was taken into account and 23% was explained when only $B^{CF}$ was taken into account. However, when other variables were included, this improved to 50% — a significant improvement.

## Conclusion

In this article the relationship between market beta and eight accounting variables has been examined. The results obtained indicate that each of the eight accounting variables is individually significantly correlated with the market's assessment of the systematic risk inherent in the individual company. As such, the results indicate some support for the value of accounting information from an investor's point of view. However, it must be stressed that the evidence of a significant correlation only indicates the presence of a linear relationship between the two variables. It does not enable one to conclude that a causal relationship exists. The latter can only be established by means of a thorough theoretical study which is not the aim of this article.

From the regression analyses it was found that for an individual company the eight accounting variables examined can provide a reasonable estimate of the market beta. Thus, managers of unlisted companies can estimate their cost of equity using the following four-step procedure:

(i) From their historic annual financial statements and their future target structure, estimate the leverage ($F$), the current ratio ($CR$), the standard deviation of their cash flow ($S_{CF}$), and the beta cash flow ($B_{CF}$).

(ii) Use these estimates in the following equation to obtain an estimate of their market beta.

$$B_m = -0{,}30+1{,}45F+0{,}404S_{CF}+0{,}077B_{CF}+0{,}073CR$$

(iii) Use this estimate of $B_m$ to obtain an estimate of their cost of equity from the Capital Asset Pricing Model:

$$R_{eq} = R_F + B_m.E(R_m - R_F).$$

(iv) This estimate of the cost of equity ($R_{eq}$) can be used in the weighted average cost of capital calculation to obtain their overall cost of capital ($k_o$):

$$k_o = \sum_{i=1}^{n} w_i.R_i$$

where $w_i$ = the proportion of total funds provided by source $i$; and $R_i$ = the estimate of the return required by the providers of the $i^{th}$ source of funds.

The results presented in this article indicate that the above procedure will result in a statistically significant estimate of $B_m$ and hence of the weighted average cost of capital. However, it must be remembered that this regression equation was established using listed companies. This was necessary because a market estimate of $B_m$ was required to determine the regression relationship. On using the $B_m$ in the CAPM to obtain the return required by equity holders it is implicity assumed that such equity is easily marketable. Because this is not valid for unlisted companies, it is possible that a premium should be paid for this lack of liquidity. Examination of the fixed interest markets indicates that a premium of between 1% and 3% is evident in the yield to maturity of non-liquid assets. Thus it is tentatively suggested that in stage (iii) above, a 2% premium be added to $R_{eq}$ to allow for the lack of liquidity. Of course, this is merely a tentative recommendation and additional research is necessary to determine the exact premium, if any, which should be earned by unlisted companies.

Finally, it is interesting to note that the regression analyses indicate that as portfolios are formed, fewer of the accounting variables are necessary to produce a reasonable estimate of the market beta. Indeed with portfolios of size six, the leverage ratio on its own enables management to estimate the market beta with a high degree of accuracy. On reflection, this is not a strange result. It merely reflects the benefits of diversification. Therefore, when six companies are combined, there is a diversification effect which reduces the sensitivity of the portfolio to changes in the individual companies' cash flows and current ratios. For example, one company may have unexpectedly low cash flow in a particular year but this may be compensated for by another company which has unexpectedly high cash flow in that year. The effects of cash flow variations are thus diversified away in the portfolio. However, the leverage factor, or degree of financial risk, is not as easily diversified. The portfolio will certainly reflect the average leverage of its constituent companies, but there is no compensation within an individual year. For this reason it is not surprising that the leverage factor remains a significant variable at the portfolio level. Indeed, the results presented indicate that as far as investors are concerned, as opposed to managers, leverage is the only significant accounting variable to consider as they would be expected to hold diversified portfolios in an efficient market. This in turn provides support for the separation theorem (Sharpe, 1964) which indicates that the major decision facing an investor is the amount of assets he wishes to place at risk and the amount he holds in the risk-free asset. This is nothing more than saying that his major decision is the degree of leverage he personally wishes to have. He can obtain such leverage either by himself or through the companies whose shares he holds. Our results merely confirm this by showing that the leverage of the portfolio is the key accounting variable for the individual investor.

In conclusion, therefore, the results presented in this article provided a practical method for the unlisted company to estimate its cost of capital. The method presented is simple to use and is supported by the fact that the results obtained have been shown to be consistent with the teachings of modern financial theory.

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## Appendix 1 Cash flow beta

Traditionally the financial risk of a company has been associated with the company's ability to service its fixed charges, such as principal and interest repayments on debt, lease payments, and dividends on preferred shares. However, it has been suggested that in assessing the financial risk of a company the investor cannot rely on debt ratios alone but must also take congnizance of the payment schedule of the debt and the average interest rate. Therefore, in addition to the usage of debt ratios, it has been suggested that investors should also analyse the cash flow ability of the company to service the debt. Consequently, the greater and more stable the cash flows of the company, the smaller the risk of insolvency and consequently the less risky the company from the market's point of view. Moreover, it is generally accepted that under conditions of high inflation, cash flow becomes an important variable whilst traditional measures of earnings become less important. It was therefore decided to define a cash flow beta in a similar way to that in which other accounting betas have been defined (e.g. Hill & Stone, 1980).

To do this, it was necessary to define cash flow. Cognizance was taken of the debate in the literature concerning the appropriate definition of cash flow, but this study does not attempt to address the issue. Rather, a simplistic definition of cash flow was used, namely

cash flow = earnings after taxation plus depreciation of fixed assets.

Irrespective of the definition used, it would be incorrect to simply calculate the absolute cash flow values for each company for each year and regress those values against a market index of cash flows in order to obtain a 'cash flow' beta coefficient. This follows because the beta concept is a return concept and not an absolute level concept. In addition, inflation causes a reduction in the purchasing power of money, and hence an 'increase' in the cash flow figure tends to occur each year.

This would result in correlation results being biased in the sense that a positive correlation would emerge due to a common inflation effect. For this reason, the relative change in the value of cash flow from year $(t-1)$ to year $(t)$ was used for the calculation of the cash flow beta. Thus cash flow beta ($B^{CF}$) was estimated using the following time series regression:

$$R_{it} = a + B^{CF}.R_{mt} + U_{it}$$

where $R_{it}$ = the relative change in the value of cash flow for company $i$ from year $(t-1)$ to year $(t)$; $R_{mt}$ = a market-wide index of the relative change in cash flow for the market from year $(t-1)$ to year $(t)$; $U_{it}$ = the stochastic individualistic component of $R_{it}$; and $a$, $B^{CF}$ = the intercept and slope parameters respectively of the assumed linear relationship between $R_{it}$ and $R_{mt}$.

The calculation of the relative change in cash flow ($d(CF)$) posed a problem due to the occurrence of negative values or values close to zero. For example, for company $i$:

$$d(CF)_{i,\,\text{year}\,(t-1)\,\text{to year}\,(t)} = \frac{(CF)_{i,t} - (CF)_{i,t-1}}{(CF)_{i,t-1}}$$

In cases where $(CF)_{i,t-1}$ was negative or was close to zero, the above calculation would lead to an incorrect interpretation of the meaning of $d(CF)$. To overcome this problem the following procedure was adopted:
(i) Values for $d(CF_i)$ obtained by dividing by a negative value, were omitted. Out of a total of 567 $d(CF)$ values, 10 were omitted in this way, resulting in 557 $d(CF)$ values used for subsequent calculations. In addition, three companies had too many values close to zero which resulted in exceptionally high $d(CF)$ values after dividing by the values close to zero. These three companies were omitted for all tests using either $S_{CF}$ or $B^{CF}$.
(ii) The market index of $d(CF)$ was determined by omitting those cash flow values which caused $d(CF_i)$ to be less than zero (as in (i)).

The average cash flow calculated for all companies for year $t$ was then determined as:

$$(CF_m) = \sum_{i=1}^{N} (CF)_i / N$$

where $N$ = number of companies in the sample.

This was repeated for values of $t$ from 1 to 10 (1973–1982) and thus resulted in values for the cash flow of the market for each year $(CF_m)_t$.
(iii) $d(CF_m)$ was then calculated as follows:

$$d(CF_m) = \frac{(CF_m)_t - (CF_m)_{t-1}}{(CF_m)_{t-1}}$$

Finally, the standard deviation of cash ($S_{CF}$) flow was calculated for each company as

$$S_{CF} = \left( \sum_{i=1}^{N} (CF_{i;t} - M)/(N-1) \right)^{1/2}$$

where $CF_{i;t}$ = the cash flow for company $i$ in year $t$; and $M$ = the average cash flow for company $i$ in the $N$ years.

## Appendix 2 The final sample

| Sector | Company name | No |
|---|---|---|
| Industrial Holding | Anglo Transvaal Industries | 10 |
| | Industrial and Commercial Holdings Group | |
| | Industrial Investments | |
| | Metje & Ziegler | |
| | Micor Holdings | |
| | Picardi Beleggings | |
| | Protea Holdings | |
| | Rentmeester | |
| | South Atlantic Corporation | |
| | Tollgate Holdings | |
| Beverage and Hotels | Picardi Hotelle | 3 |
| | Suncrush | |
| | Uniewyn | |
| Building | Everite | 5 |
| | Good Hope Concrete Pipes | |
| | Grinaker Holdings | |
| | Gypsum Industries | |
| | Murray & Roberts Holdings | |

## Appendix 2 Continued

| Sector | Company name | No |
|---|---|---|
| Chemical | Natal Chemical Syndicate | 2 |
| | Sentrachem | |
| Clothing | Consolidated Textile Mills | 9 |
| | Gubb & Inggs | |
| | Natal Consolidated Industrial Investments | |
| | Natal Canvas & Rubber Manufacturers | |
| | Rex Trueform Clothing Co | |
| | The South African Woollen Mills | |
| | Seardel Investment Corporation | |
| | Silverton Tannery | |
| | Towles, Edgar Jacobs | |
| Food | TW Beckett & Co | 2 |
| | Irvin & Johnson | |
| Furniture | Beares | 2 |
| | Montays | |
| Engineering | Abercom Group | 6 |
| | Berzack Brothers (Holdings) | |
| | Claude Neon Lights SA | |
| | Globe Engineering Works | |
| | National Bolts | |
| | Steelmetals | |
| Electronics | Central African Cables | 1 |
| Motors | Alderson & Flitton Holdings | 7 |
| | Currie Motors (1946) | |
| | Eureka | |
| | McCarthy Group | |
| | Northern Free State Motors | |
| | Brian Porter Holdings | |
| | Welfit Oddy Holdings | |
| Paper | Consol | 3 |
| | Copi | |
| | Press Supplies Holdings | |
| Pharmaceutic | Amalgamated Medical Services | 3 |
| | General Optical Co | |
| | The Union Cold Storage of SA | |
| Printing | Afrikaanse Pers | 2 |
| | Mathieson & Ashley | |
| Steel | Cullinan Holdings | 1 |
| Transport | Putco | 3 |
| | SA Marine Corporation | |
| | Trencor | |
| Stores | Garlicks | 4 |
| | Greatermans | |
| | Gresham Industries | |
| | M & S Spitz Footwear Holdings | |
| | Total | 63 |