The relevance of certain design elements on the association between accounting and market-based measures of risk on the JSE

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Received September 1994

In this article the association between accounting and market-based measures of risk on the JSE and the dependence of the association on a number of design elements are examined. The results obtained show that in the South African context a significant positive relationship exists between market beta and a variety of earnings and cash flow-based accounting betas. No evidence is found to validate the supposed superiority of cash flow-based betas over earnings-based betas. Furthermore, the results indicate that this relationship is sensitive to a number of experimental design considerations. The significance between market and accounting betas was improved when the sample size was increased, when longer time horizons were used and when the sample was restricted to companies in the same sector. The book value of equity was shown to be a better deflator than the market value.

In die artikel word die verwantskap tussen rekeningkundige en markbetas van risiko op die JE en die afhanklikheid van die verwantskap ten opsigte van 'n aantal ontwerpelemente ondersoek. Geen bewyse is gevind wat daarop dui dat kontantvloei betas beter resultate as inkomste-gebaseerde betas lewer nie. Die resultate dui daarop dat die verwantskap sensitief is vir 'n aantal eksperimentele oorwegings. Die betekenisvolheid van die verwantskap tussen rekeningkundige en markbetas het verbeter toe die steekproefgrootte toegeneem het, langer tydhorisonne gebruik is en toe steekproewe beperk is tot maatskappye in dieselfde sektor. Die boekwaarde van ekwiteit het 'n beter deflator blyk te wees as die markwaarde.

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Introduction

The purpose of this article is to explore the relationship between accounting-based and market-based measures of systematic risk; and to investigate the effect of certain elements of research design on the significance of the hypothesized relationship. It stems from and extends the results of Wessels, Smith & Gevers (1993) in a number of directions.

The ability of accounting risk measures to aid in explanations and predictions of systematic risk has been studied extensively. A number of these studies have reached conflicting results. In this article the association between market and accounting betas under a variety of specifications is investigated and the sensitivity of the association to certain elements of research design is examined especially with regard to the size of the sample; the length of the measurement period; the choice of the return deflator; and the homogeneity of companies in the sample in respect of financial year-end and sectoral characteristics. This flexibility is achieved through extensive automation of the research effort. The scope of the study is limited to the examination of the association between earnings and cash flow-based accounting betas and market betas of companies listed on the Johannesburg Stock Exchange.

The literature on the association between accounting betas and market beta is reviewed in the next section, whereafter the research design is discussed. Results of the analysis are presented in a subsequent section, while a summary is offered in the final section.

Literature review

The capital asset pricing model, as defined by Sharpe (1970) relates the *ex ante* expected return on a share to the *ex ante* expected return on the market portfolio. According to the capital asset pricing model the equilibrium expected one-period return on a share, R_i, is determined by the return on a riskless asset, R_f, and a return premium to reflect the risk inherent in the share.

The general form of the relationship is given by:

$$E(\tilde{R}_i) = R_f + \beta_m \times E((\tilde{R}_m) - R_f) \quad \dots (1)$$

where E is the expected value operator, R_m is the return on a market index of shares, tildes denote random variables, and β_m measures the sensitivity of return on share i to the market return. β_m is commonly referred to as market beta, and is arguably the most widely used market determined measure of risk. Market beta measures the co-movement of the return on a share with the return on an index of shares and represents the systematic or non-diversifiable risk of a share which arises from the underlying market-wide movements which affect all share prices.

Accounting beta is the term used to refer to the systematic sensitivity of some accounting return measure to a broad index of the same return. An accounting beta value measures the sensitivity of a firm's earnings to economy-wide changes. The relationship between accounting risk measures and market betas has been a popular subject of research in recent years. Two primary questions need to be answered in order to obtain an accounting beta. First, what is the appropriate accounting return? Second, how should the beta be calculated from the accounting returns? The second question is the easier to answer. Researchers have estimated beta from accounting returns using some form of the usual covariance formulas (i.e. linear regression). The majority of researchers have focused on finding the appropriate accounting return measure, that is, the one that exhibits a significant relationship with market beta.

Beaver, Kettler & Scholes (1970) empirically showed market beta to be associated with several variables, including leverage, earnings variability, dividend payout, growth, and an earnings beta. They also found that these accounting risk measures could be used to remove estimation error from the market betas. Both Beaver *et al.* (1970) and Rosenberg & McKibben (1973) found that accounting beta is not the most important predictor of market beta. According to Beaver & Manegold (1975: 235) this is due to the fact that the accounting betas are estimated with a large amount of error, as they are typically computed from nine or ten annual observations.

Brown & Ball (1967) showed that a market-index model of various income and income return measures has comparable explanatory power to the market-index model of stock returns. They also showed that an earnings-price beta has a significant correlation with the market beta. Hill & Stone (1980) developed a risk-composition model that expresses an accounting equity beta in terms of accounting measures of systematic operating risk and financial leverage. Their results indicate that both changes in financial structure and systematic operating risk are significant determinants of period-to-period changes in market betas. They found that changes in financial structure cause correlations between inter-period betas to decline, and are therefore a source of beta instability.

Ruland (1981) studied only six accounting risk measures and found that these measures explained differences in beta between firms about as well as the set of accounting risk measures used in previous studies.

The capital asset pricing model is a single-period model. Thus the model assumes that beta, and by implication its underlying determinants such as leverage and other operating characteristics, remain constant over the entire measurement period. In reality the determinants of beta do change over time. Eskew (1979) questioned the no-change assumption and performed a study using a model which assumed the accounting risk series to be mean-reverting (negative serial correlation). This model resulted in improved predictions over the no-change model for portfolios. In the case of single-securities, the mean-reverting assumption performed worse than the assumption of no-change.

De Jong & Collins (1985) found that highly leveraged firms exhibit greater equity beta instability than firms with lower leverage. Thus, when equity betas are estimated using constant parameter ordinary least squares techniques, larger residual variances should be expected for high-leverage firms. They also found that over time betas exhibit greater instability during periods of large unexpected changes in the risk-free rate.

One of the specification problems encountered when defining accounting betas is the choice of the deflator or denominator used to calculate the return series. Beaver *et al.* (1970) used market value as the common equity deflator. A number of researchers have calculated accounting betas using the book value of common equity as deflator, including Hill & Stone (1980). Gonedes (1973) used total assets, and suggested that the significant correlations achieved by Brown & Ball (1967) may be due to the share price being used as deflator of both the market return and the earnings ratio. Although the use of total assets as the deflator results in an accounting beta defined only by accounting variables, total assets pertain to the entire company, and not only to the common equity portion. This presents a problem in that market beta is a measure of the riskiness of common shares, and not of the complete company. The market-value deflated accounting beta used by Brown & Ball (1967) and Beaver *et al.* (1970) is not a true accounting beta and may reflect non-accounting events such as interest rate changes. Christie (Wessels, 1991: 8) concluded that the correct deflator is the market value of common equity at the beginning of the period, and that the use of any other deflator generates a problem with correlated omitted variables, which could cause biased and inconsistent estimators of the regression coefficients. Deflating an earnings measure by the *book value* of common equity yields a pure accounting beta, i.e. one defined entirely in terms of accounting variables, and one that pertains to only the common equity portion of a company.

Although an *ex ante* relationship, beta is typically measured using a time series of *ex post* returns. Consequently the measurements are subject to a degree of error. Beaver & Manegold (1975) state that measurement error in betas causes both the correlation between the measured accounting and market betas, and the slope coefficient of the implied linear regression between the two variables, to be downward biased. This view is supported by Hill & Stone (1980: 622) who state that measurement error is one of the causes of a downward bias in the correlation between accounting betas and market betas, and that the correlations obtained should be viewed as a conservative indication of what may be achieved with better data and more sophistication.

It is possible to distinguish between a general and company-specific transformation between accounting betas and market betas. Most researchers have used correlations that test for particular types of general transformations. The Spearman rank-order correlation, the standard product-moment correlation and simple linear regression are tests for general transformation. In contrast the Bayesian adjustment procedure suggested by Vasicek (1973: 1233–1239) is a company-specific transformation. Hill & Stone (1980: 607) suggest that its success in improving the association between accounting and market betas is empirical proof that the explanatory power of accounting information can be strengthened by using company-specific information on the relation between the accounting and market betas rather than relying only on the same general transformations for all companies. Vasicek (1973) suggests that Bayesian estimates are preferred to the classical sampling-theory estimates for the following reasons: first, Bayesian procedures provide estimates that minimize the loss due to misestimation, while sampling-theory estimates minimize the error of sampling. This is because Bayesian theory deals with the distribution of the parameters given the available information, while sampling theory deals with the properties of sample statistics given the true value of the parameters. Second, Bayesian theory weighs the expected losses by a prior distribution of the parameters, thus incorporating knowledge which is available in addition to the sample information.

Another method to improve the relationship is to adjust an individual share's beta. Blume (1971) has examined a procedure of adjusting observed betas using prior period beta estimates. He found that there is a tendency for the estimated values of beta to regress towards the mean over time, and that correcting for this tendency resulted in more accurate assessments of future values. Using this method the estimated values of beta in one period are regressed on the values estimated in a previous period. The resulting relationship is used in the assessment of future betas. Blume tested this method on portfolios ranging from one to one hundred shares in size, and found that for all the portfolio sizes, the adjusted betas were more accurate than the unadjusted betas.

A further method often employed is to perform correlation tests on a portfolio of shares. The formation of portfolios involves a trade-off between lost information from reduced sample size and possible aggregation bias and the aggregation benefits of reduced measurement and specification error. According to Theil (Hill & Stone, 1980) aggregation bias can be avoided if there was no measurement error. Similarly, Beaver & Manegold (1975: 239) state that aggregation of data makes no sense in the absence of measurement error, as it would result in discarding some information. For this reason Hill & Stone (1980: 613) formed portfolios by ranking on market betas, which can be measured with relatively less error than accounting betas. Beaver & Manegold (1975) also formed portfolios ranked on market beta, and warned that the results obtained from regressions on aggregated data should be interpreted with circumspection. Other studies have investigated the relationship between the inter-temporal stability of beta and the size of the portfolio. Blume (Alexander & Chervany, 1980: 131) found that the correlations increased with the portfolio size. Porter & Ezzel (Alexander & Chervany, 1980: 131) performed a similar study, but formed the portfolios randomly. Their results showed no distinguishable trend in the correlations, which led them to conclude that the stability of portfolio beta coefficients for randomly selected portfolios was unrelated to portfolio size. Alexander & Chervany (1980) examined the approaches of both Blume & Porter and Ezzel and concluded that the time stability of portfolio betas as measured by mean absolute deviation continues to be directly related to the number of shares in the portfolio and is significantly stable for portfolios of ten or more shares.

Measurement error induced by sampling error may be reduced by increasing the number of observations. Although measurement error is present in both the accounting and the market betas, it is of special concern for the accounting betas as they are typically computed from fewer (annual) observations. Gonedes (1973) provided some evidence that long-term (e.g. twenty-year) rather than short-term (e.g. seven-year) accounting betas should be used in correlations with short-term market betas. From a statistical perspective, the longer the period (i.e. the more observations) the better. An adequate number of observations is required to enable statistically significant deductions to be made. However, the measurement period should not be so long as to include information that does not reflect current relationships. According to Retief (1984c: 84) the use of observations from a non-contemporaneous time period involves a trade-off between a potential reduction in sampling error *versus* drawing from a different population. Contrary to the assumption of beta-stationarity, the beta of a firm does change over time (Breen & Lerner, 1972 [Harrington, 1987: 109]).

In concept, beta reflects the expected covariance between the returns of a specific share and those of the market portfolio. The latter though, is not observable and empirical estimates of beta require the use of a suitable proxy. The conventional approach is to select a broadly based share market index and to estimate beta as the slope coefficient obtained by regressing returns of the share upon returns on the selected market index. Elgers & Murray (1982) studied the effect of the choice of market index on the observed relationships. They found that the stability of beta estimates over time is quite sensitive to the market index employed. The apparent ability of accounting risk measures to improve upon market-based forecasts of beta was also found to depend upon the choice of market index. They concluded that the prudent course for researchers concerned with the relationship between accounting risk measures and beta is to develop empirical results using a variety of market indices.

In recent years, managers and researchers alike have started to realise the value of cash flows in managing and measuring a firm's well-being. According to Pinches (1984: 82–83) the fundamental determinants of the value of a firm are the magnitude, timing, and riskiness of the cash flows expected by the firm and its shareholders. Chastain & Cianciolo (1986: 66) propose that cash is clearly superseding working capital as a measure of financial health. A major reason for this is that cash is often a better immediate indicator of solvency or liquidity than working capital. In other words cash is an indicator of the riskiness of the firm, and potentially superior to the more traditional accrual-based indicators. Ismail & Kim (1989: 134) came to the conclusion that cash flow data have the potential to supply additional information on a firm's risk beyond that available from earnings.

In South Africa Retief, Affleck-Graves & Hamman (1984a) addressed the impact and importance of leverage as a measure of market risk in the assessment of the perceived riskiness of a share. They found a high correlation between leverage and market measures of risk. As expected, correlations were found to increase with the size of the portfolio. Retief, Hamman & Affleck-Graves (1984b) investigated the correlation between market beta and a funds flow beta, (funds flow equals earnings after taxation plus depreciation of fixed assets) and found a surprisingly strong correlation in the single-share case. They calculated a number of accounting betas, including an operating beta and an income beta using total assets as the deflator, and an equity beta using book value of common equity as deflator. The most significant correlations were found between market beta and the equity beta, although the researchers concluded that pure accounting betas did not appear to be the sole determinants of risk within the South African market and could not be used as a substitute for market beta as a quantitative measure of a company's risk. Retief (1984c) suggested that a possible explanation for the inability of risk measurement models developed in America to be successfully applied in South Africa could be the higher level of inaccuracy present in the South African data owing to the use of fewer observations (only one period of 10 years). Another possible cause could be the fact that the rate of inflation in the USA, at the time of the research, was significantly lower than the South African inflation rate.

The impact of inflation within the South African context was investigated by Marais (1988) and Verwey (1988) in two separate but related studies. Verwey made use of guideline AC201, while Marais used Method 1-2-3-4 to adjust for inflation. Neither Verwey nor Marais found any indication that the use of inflation-adjusted values leads to improved correlation between market beta and accounting betas. Wessels, Smith & Gevers (1993) concluded that a significant portion of the variability in market risk could be explained by the variability in smoothed cash-flow based accounting betas. The present study extends this analysis.

Research design

In this article the focus is on the effect of differing research design elements. For example, whereas the typical study would select one sample of companies and perform all calculations on the one sample, this study calculates accounting and market return measures and betas and estimates the correlations between these variables using different sampling techniques. A computer system was designed to provide the required flexibility and to automate the following processes: generation of multiple samples of companies; generation of multiple accounting returns and accounting betas; generation of market returns and market betas; correlation between market betas and accounting betas; and the reporting of results.

The computer system was designed to extract the required data directly from the BFA-NET database. The data held within the BFA-NET database was provided by the Bureau for Financial Analysis of the University of Pretoria. The database contains accounting and market information on companies listed on the Johannesburg Stock Exchange. Annual accounting data and weekly share prices are available as far back as 1973. The database does not contain dividends; therefore dividends were not included in the calculation of market returns.

The computer program made it feasible to select a number of samples satisfying a variety of conditions. The samples are summarized in Table 1 and are commented upon below:

- Any empirical study is limited by data availability. This constraint is especially severe in the case of accounting data which are only available, in a suitable form, on an annual basis. By way of example: ten years of accounting data yield only ten observations, which, while spanning a fairly long time period (which may incidentally cause a violation of the assumption of beta stationarity), does not contribute towards statistically significant correlations. The longest period of continuous accounting data available from BFA-NET was 20 years.
- For the sake of relevancy the period of measurement should be as recent as the available data permits. At the time of this study, the most recent data available from BFA-NET was for 1992.
- The computation of the accounting betas investigated in this study involve the calculation of lagged returns. Consequently the first observation, is 'lost', i.e. given that observations are available from year t, returns can only be computed from year t+1.
- June was selected as the default year-end month, because it is the most frequently used. Previous researchers have typically selected only companies with year-ends in the same month, the rationale being that it avoids possible seasonality in the earnings pattern of the companies under consideration. This study investigates the effect of relaxing this criterion on the significance of the observed betas. Relaxation of the 'same year-end criterion' for samples selected from the Industrial Sector yielded Sample E which at 100 is substantially bigger than Sample A at 39.
- Decreasing the measurement period from 20 to 15 to 10 years does not lead to a significant increase in the sample size. Sample D, which spans a measurement period of 5 years, is considerably larger than Sample A, and is used to investigate the effect of the measurement period.
- Samples F and G were selected from a population consisting of all the companies listed on the Johannesburg Stock Exchange. Whereas Sample F consisted of companies with a June year-end, Sample G comprised all companies, irrespective of year-end, resulting a sample size of 130. Samples F and G are used to investigate the effect of using the entire Stock Exchange as population which is more heterogenous than a population consisting of only the industrial sector.
- Samples A through G only include companies that have continuous share and accounting data available for the periods under measurement. Sample H includes companies which have continuous share data available, but that do not necessarily have continuous accounting data available. No accounting betas are calculated for Sample H, only market betas.

A dispute exists over the choice of the deflator of the accounting return variables. In this study two different deflators are used to define and calculate each of the accounting return variables, namely the beginning of the period *market value* of common equity (m) and the beginning of the period *book value* of common equity (b).

The accounting return variables are defined in Table 2. The accounting betas are estimated from these return variables utilizing a time series regression process, with the accounting return variables as the dependent variable, and a market index as the independent variable.

In calculating the betas, the Bayesian adjustment procedure was used to reduce the amount of measurement error. The betas were adjusted using the following procedure (Beaver & Manegold, 1975: 247–248):

$$\beta_{adj} = k\beta_{prior} + (1 - k)\,\beta_{sample} \qquad \text{...(2)}$$

where

$$k = \frac{\frac{1}{S^2_{prior}}}{\frac{1}{S^2_{prior}} + \frac{1}{S^2_{sample}}} \qquad (1-k) = \frac{\frac{1}{S^2_{sample}}}{\frac{1}{S^2_{prior}} + \frac{1}{S^2_{sample}}} \qquad \text{...(3)}$$

Table 1 Samples

Sample ID	Population	Year-end	Start	End	# Years	Sample Size
A	Industrials	June	1973	1992	20	39
B	Industrials	June	1978	1992	15	42
C	Industrials	June	1983	1992	10	46
D	Industrials	June	1988	1992	5	86
E	Industrials	All months	1973	1992	20	100
F	All Share	June	1973	1992	20	54
G	All Share	All months	1973	1992	20	130
H	All Share	All months	1973	1992	20	228

where

β_{adj} = the Bayesian adjusted beta, which is the expected value of the posterior distribution;

β_{prior} = the expected value of the prior distribution;

β_{sample} = the beta estimated from the sample data;

s^2_{prior} = the variance of the prior beta distribution; and

s^2_{sample} = the variance of the sample beta.

For the lack of a better estimate, Vasicek's assumptions for the New York Stock Exchange were used as estimates for β_{prior} and s_{prior}, namely 1 and 0.5 respectively. The Bayesian adjustments were applied to both market and accounting betas, and all betas were calculated unadjusted as well as adjusted. No adjustments were made for thin trading and the effect of thin trading on the results are not analysed.

The underlying model is:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \quad (4)$$

where

$R_{i,t}$ = rate of return on share i in period t;

α_i = intercept;

β_i = market beta for share i;

$R_{m,t}$ = rate of return on market portfolio; and

$\varepsilon_{i,t}$ = residual return on share i in period t.

Market betas were calculated as the average return for the companies in each individual sample for the samples listed in Table 1 using this model. Weekly observations from the BFA-NET database were utilized. Summary statistics of the market betas are listed in Tables 3 and 4.

The accounting return variables as defined in Table 2 were used to estimate accounting betas, using the following time series regression:

Table 2 Accounting return variables

ID	Definition	Calculation
Earnings[b] (1)	Income available to common equity, divided by the beginning of the period *book value* of common equity.	$\frac{A_t}{B_{t-1}}$
Earnings[m] (2)	Income available to common equity, divided by the beginning of the period *market value* of common equity.	$\frac{A_t}{C_{t-1}}$
Fundflow[b1] (3)	Income available to common equity plus depreciation, divided by the beginning of the period *book value* of common equity.	$\frac{A^1_t}{B_{t-1}}$
Fundflow[m1] (4)	Income available to common equity plus depreciation, divided by the beginning of the period *market value* of common equity.	$\frac{A^1_t}{C_{t-1}}$
Fundflow[b2] (5)	Income available to common equity plus depreciation and deferred taxes, divided by the beginning of the period *book value* of common equity.	$\frac{A^2_t}{B_{t-1}}$
Fundflow[m2] (6)	Income available to common equity plus depreciation and deferred taxes, divided by the beginning of the period *market value* of common equity.	$\frac{A^2_t}{C_{t-1}}$
Fundflow[b3] (7)	Income available to common equity plus the total of all income and expenditure items included in the income statement which did not represent an actual flow of funds, divided by the beginning of the period *book value* of common equity.	$\frac{A^3_t}{B_{t-1}}$
Fundflow[m3] (8)	Income available to common equity plus the total of all income and expenditure items included in the income statement which did not represent an actual flow of funds, divided by the beginning of the period *market value* of common equity.	$\frac{A^3_t}{C_{t-1}}$
Cashflow[b] (9)	Income available to common equity plus depreciation, deferred taxes and the change in non-cash working capital, divided by the beginning of the period *book value* of common equity.	$\frac{A^2_t - ((A^4 - A^5)_t - (A^4 - A^5)_{t-1})}{B_{t-1}}$
Cashflow[m] (10)	Income available to common equity plus depreciation, deferred taxes and the change in non-cash working capital, divided by the beginning of the period *market value* of common equity.	$\frac{A^2_t - ((A^4 - A^5)_t - (A^4 - A^5)_{t-1})}{C_{t-1}}$

where:

A	Net profit for the year, including profits and losses of an extraordinary nature and including income from associated companies, after providing for the taxation for the year. In the case of consolidated accounts, this is the combined profit of all the companies in the group, before providing for the minority shareholders' interest in this profit.
A^1	A + Depreciation for the year written off on all fixed assets.
A^2	A^1 + Taxation deferred for the year.
A^3	A + The total of all income and expenditure items included in the income statement which did not represent an actual flow of funds (BFA-NET field 130).
A^4	Current assets - current liabilities.
A^5	Loans + deposits + cash - bank overdraft - short term loans - dividends payable.
B	Book value of common equity.
C	Market value of common equity = Number of shares × share price.

Table 3 Market betas – unadjusted – summarized by sample

ID	Population	Sample Size	# Years	Year-end	Average	Standard Deviation	# (%) significant at 0,10	# (%) significant at 0,05	#(%) significant at 0,01
A	Ind	39	20	June	1,0000	0,4764	39 (100%)	39 (100%)	39 (100%)
D	Ind	86	5	June	0,9999	0,7108	73 (85%)	69 (80%)	52 (61%)
E	Ind	100	20	All	1,0000	0,3841	98 (98%)	97 (97%)	97 (97%)
F	Alshr	54	20	June	0,9999	0,4810	54 (100%)	54 (100%)	53 (98%)
G	Alshr	130	20	All	0,9926	0,4089	126 (96%)	126 (96%)	125 (95%)
H	Alshr	228	20	All	0,9678	0,4396	215 (94%)	215 (94%)	214 (94%)

Table 4 Market betas – Bayesian adjusted – summarized by sample

ID	Population	Sample Size	# Years	Year-end	Average	Standard Deviation	# (%) significant at 0,10	# (%) significant at 0,05	#(%) significant at 0,01
A	Ind	39	20	June	0,9845	0,4312	39 (100%)	39 (100%)	39 (100%)
D	Ind	86	5	June	0,9333	0,4128	79 (92%)	78 (91%)	71 (83%)
E	Ind	100	20	All	0,9978	0,3647	98 (98%)	98 (98%)	97 (97%)
F	Alshr	54	20	June	0,9855	0,4337	53 (100%)	54 (100%)	53 (98%)
G	Alshr	130	20	All	0,9901	0,3899	127 (97%)	126 (96%)	126 (96%)
H	Alshr	228	20	All	0,9679	0,4138	219 (96%)	216 (95%)	214 (94%)

$$r_{i,t} = a_i + b_i\, r_{m,t} + e_{i,t} \qquad \text{...(5)}$$

where

$r_{i,t}$ = accounting return for company i in period t;

a_i = intercept for company i;

b_i = accounting betas for company i;

$r_{m,t}$ = market index for accounting returns, computed as the simple average or median of the sample accounting returns $r_{i,t}$ in period t; and

e^{it} = residual return on company i in period t.

Accounting betas were calculated twice, once using the average of the sample accounting returns as market index, and once using the median of the sample accounting returns. It was decided to use the median as well in the light of the large variances observed between company returns.

Correlations were performed between the market beta and the accounting betas for each of samples A to G. The correlation coefficients are tabulated in Tables 5 to 11. The accounting betas from Samples A, E, F, and G were also correlated with appropriate subsets of market betas from Sample H which at 228 is by far the largest sample and best representative of the 'market'. The sample average return used in the calculation of the Sample H market beta may therefore be regarded as the best proxy for the 'return on the market'. It was therefore reasoned that the Sample H market betas should provide better approximations of the true market betas. These correlation coefficients are contained in Tables 12 to 15.

Results

Market betas

Summary descriptive statistics of the market betas are shown in Tables 3 and 4. The average market betas are either equal to or very close to the expected market beta of 1. The cross-sectional standard deviations of the Bayesian-adjusted betas are lower than the unadjusted ones. The Bayesian adjustment therefore caused a reduction in the variability of the betas, especially so for Sample D which spanned five years of data compared to 20 years for the other samples. In the case of Sample D, the Bayesian adjustment procedure also led to an improvement in the significance of the betas.

As expected, the betas of the 20-year samples have a higher level of significance than the five-year betas of Sample D. This is in part due to the lower number of observations used to calculate the five-year betas. Interestingly enough the highest levels of significance were obtained for the betas from Samples A and F, both of which only include companies with year-ends in June.

Accounting betas

Due to lack of space the twenty tables pertaining to accounting betas are not replicated here. As expected, the

Table 5 Correlation coefficients of market and accounting betas – accounting betas from sample A; market betas from sample A

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,4980***	0,3057*	0,5454***	0,4793***
Earnings^{m}	0,2267	0,0224	0,3048*	0,2002
Fundflow^{b1}	0,5188***	0,3236**	0,5447***	0,5263***
Fundflow^{m1}	0,2451	-0,0103	0,3030*	0,1666
Fundflow^{b2}	0,5181***	0,3656**	0,5539***	0,5371***
Fundflow^{m2}	0,2676*	0,0054	0,3196**	0,1880
Fundflow^{b3}	0,4431***	0,2889*	0,5386***	0,5201***
Fundflow^{m3}	0,2448	-0,0064	0,2996*	0,1490
Cashflow^{b}	0,4741***	0,2357	0,4387***	0,4724***
Cashflow^{m}	0,0760	-0,0146	0,1609	0,2542

* Significant at the ,10 level ** Significant at the ,05 level *** Significant at the ,01 level

Table 6 Correlation coefficients of market and accounting betas – accounting betas from sample B; market betas from sample B

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	-0,0974	0,1512	0,0312	0,0685
Earnings^{m}	0,3299**	0,0437	0,3828**	0,2087
Fundflow^{b1}	-0,1114	0,1786	-0,0409	0,1142
Fundflow^{m1}	0,3442**	0,0340	0,3873**	0,2009
Fundflow^{b2}	-0,1010	0,1784	-0,0323	0,1388
Fundflow^{m2}	0,3677**	0,0473	0,4004***	0,2071
Fundflow^{b3}	-0,1128	0,1490	-0,0620	0,1018
Fundflow^{m3}	0,3421**	0,0474	0,3813**	0,1909
Cashflow^{b1}	0,1214	0,0672	0,1644	0,1993
Cashflow^{m}	0,1507	-0,0725	0,1810	0,2395

* Significant at the ,10 level ** Significant at the ,05 level *** Significant at the ,01 level

Table 7 Correlation coefficients of market and accounting betas – accounting betas from sample C; market betas from sample C

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,0130	0,3100**	0,3057**	0,1803
Earnings^{m}	0,1806	0,2989**	0,3178**	0,3786***
Fundflow^{b1}	-0,0301	0,2954**	0,2761*	0,1997
Fundflow^{m1}	0,2641*	0,3400**	0,3888***	0,4192***
Fundflow^{b2}	0,0639	0,3168	0,2882*	0,2441
Fundflow^{m2}	0,2830*	0,3263**	0,4090***	0,4257***
Fundflow^{b3}	-0,0277	0,2533*	0,2300	0,1785
Fundflow^{m3}	0,2683*	0,3815***	0,3474**	0,4259***
Cashflow^{b}	0,1075	0,3365**	0,0849	0,3072**
Cashflow^{m}	-0,1827	0,3163**	-0,0306	0,3809***

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

cross-sectional standard deviations for the accounting betas are significantly higher than those of the market betas. This is in part due to the reduction in the number of observations used to calculate the accounting betas, which were calculated using annual observations compared to the market betas which were calculated using weekly observations over the same period. As with the market beta, the Bayesian adjustment procedure caused a significant decrease in the variability of the accounting betas. The Bayesian adjustment also led to a marked improvement in the significance levels of the accounting betas. Higher levels of significance were achieved for the betas calculated using the sample *median* return as compared to using the sample *average* return. The smallest percentage of significant betas were achieved for Sample D. When compared to the accounting betas calculated for Sample A, it would appear that the negative impact of the

Table 8 Correlation coefficients of market and accounting betas – accounting betas from sample D; market betas from sample D

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^b	-0,0305	0,0745	-0,0319	0,0726
Earnings^m	0,0249	0,0733	0,0545	0,1671
Fundflow^{b1}	-0,0496	0,0792	-0,0476	0,0705
Fundflow^{m1}	0,0171	0,1534	0,0637	0,1594
Fundflow^{b2}	-0,0476	0,0729	-0,0497	0,0742
Fundflow^{m2}	0,0046	0,0921	0,0592	0,1705
Fundflow^{b3}	-0,0402	0,0623	-0,0396	0,0397
Fundflow^{m3}	0,0468	0,1908*	0,0808	0,1591
Cashflow^b	-0,0122	0,1440	-0,0298	0,1302
Cashflow^m	0,0465	0,1651	-0,0412	0,0035

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

Table 9 Correlation coefficients of market and accounting – accounting betas from sample E; market betas from sample E

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^b	0,2149**	0,2663***	0,2802***	0,2222**
Earnings^m	0,1656*	0,1413	0,1884*	0,1228
Fundflow^{b1}	0,2411**	0,2591***	0,2782***	0,2333**
Fundflow^{m1}	0,1367	0,1240	0,1591	0,1104
Fundflow^{b2}	0,2560**	0,2670***	0,2896***	0,2534**
Fundflow^{m2}	0,1457	0,1347	0,1734*	0,1230
Fundflow^{b3}	0,2311**	0,2564**	0,2797***	0,2296**
Fundflow^{m3}	0,1332	0,1362	0,1484	0,1182
Cashflow^b	0,0013	0,1848*	0,1585	0,0695
Cashflow^m	0,1521	0,1153	0,1364	0,1605

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

Table 10 Correlation coefficients of market and accounting betas – accounting betas from sample F; market betas from sample F

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^b	0,5021***	0,3714***	0,5198***	0,5200***
Earnings^m	0,1694	-0,0278	0,1972	0,0359
Fundflow^{b1}	0,5515***	0,3964***	0,5025***	0,5453***
Fundflow^{m1}	0,1530	-0,0581	0,1845	0,0106
Fundflow^{b2}	0,5344***	0,4143***	0,5069***	0,5433***
Fundflow^{m2}	0,1607	-0,0564	0,1922	0,0210
Fundflow^{b3}	0,5546***	0,3839***	0,4910***	0,5339***
Fundflow^{m3}	0,1621	-0,0591	0,1830	0,0012
Cashflow^b	0,2825**	0,3309**	0,2656*	0,3079**
Cashflow^m	0,1412	-0,0702	0,1107	0,0672

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

shorter period (i.e. fewer regression points) far outweighs the positive impact of the larger sample size. The highest percentages of significant betas were achieved for Samples E and A, which may be attributable to the market index used. As expected the percentage of significant betas are slightly lower for Sample G, which was selected from all the shares listed on the JSE, when compared to Sample E, the latter containing industrial companies only. The financial results as stored in the database are not comparable across all companies listed on the JSE, for example the mining

Table 11 Correlation coefficients of market and accounting betas – accounting betas from sample G; market betas from sample G

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,0251	0,2522***	0,0217	0,2006**
Earnings^{m}	0,0938	0,0431	0,1041	-0,0193
Fundflow^{b1}	0,0322	0,2533***	0,0284	0,2143**
Fundflow^{m1}	0,0838	0,0142	0,0962	-0,0131
Fundflow^{b2}	0,0390	0,2539***	0,0375	0,2397***
Fundflow^{m2}	0,0976	0,0309	0,1010	-0,0019
Fundflow^{b3}	0,0281	0,2452***	0,0262	0,2060**
Fundflow^{m3}	0,0862	0,0202	0,0958	-0,0066
Cashflow^{b}	-0,0581	0,2451***	0,0962	0,1225
Cashflow^{m}	0,1234	0,0397	0,0942	0,0042

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

Table 12 Correlation coefficients of market betas and accounting betas – accounting betas from sample A; market betas from sample H

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,3247**	0,3745**	0,2480	0,3224**
Earnings^{m}	0,1094	0,0247	0,1367	0,0562
Fundflow^{b1}	0,3235**	0,3897**	0,2631	0,3705**
Fundflow^{m1}	0,1286	0,0475	0,1539	0,0789
Fundflow^{b2}	0,3291**	0,4107***	0,2749*	0,3997**
Fundflow^{m2}	0,1446	0,0624	0,1682	0,0952
Fundflow^{b3}	0,3016*	0,3631**	0,2622	0,3752**
Fundflow^{m3}	0,1387	0,0524	0,1638	0,0821
Cashflow^{b}	0,2260	0,3235**	0,1722	0,1456
Cashflow^{m}	0,0883	0,0621	0,0247	0,1174

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

Table 13 Correlation coefficients of market and accounting betas – accounting betas from sample E; market betas from sample H

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,1947	0,2414**	0,2055**	0,1670*
Earnings^{m}	0,1097	0,1120	0,1283	0,0604
Fundflow^{b1}	0,2024**	0,2199**	0,2002**	0,1765*
Fundflow^{m1}	0,0816	0,0960	0,0965	0,0563
Fundflow^{b2}	0,2166**	0,2317**	0,2105**	0,1979**
Fundflow^{m2}	0,0939	0,1127	0,1096	0,0713
Fundflow^{b3}	0,1976**	0,2147**	0,2017**	0,1717*
Fundflow^{m3}	0,0788	0,1099	0,0852	0,0659
Cashflow^{b}	0,0018	0,1675*	0,0830	-0,0134
Cashflow^{m}	0,1358	0,0916	0,0784	0,0862

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

company results are not comparable to the results of the industrial companies due to accounting conventions. The same does not hold as clearly for Sample F when compared to Sample A.

Correlation results

Correlation coefficients are reflected in Tables 5 to 15. Positive correlations between accounting betas and market beta were achieved. The most significant correlations were

Table 14 Correlation coefficients of market and accounting betas – accounting betas from sample F; market betas from sample H

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,1992	0,3719***	0,1798	0,3686***
Earnings^{m}	-0,0181	-0,1504	-0,0167	-0,1764
Fundflow^{b1}	0,1835	0,3826***	0,1938	0,3957***
Fundflow^{m1}	0,0049	-0,1750	0,0219	-0,1632
Fundflow^{b2}	0,1869	0,3919***	0,1975	0,3973***
Fundflow^{m2}	0,0144	-0,1651	0,0336	-0,1547
Fundflow^{b3}	0,1772	0,3633***	0,1909	0,3857***
Fundflow^{m3}	0,0130	-0,1771	0,0291	-0,1615
Cashflow^{b}	0,0335	0,2859**	0,1038	-0,0063
Cashflow^{m}	0,0171	-0,2172	-0,0554	-0,1597

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

Table 15 Correlation coefficients of market and accounting betas – accounting betas from sample G; market betas from sample H

Accounting beta	Median unadjusted	Median Bayesian	Average unadjusted	Average Bayesian
Earnings^{b}	0,0024	0,2340***	0,0125	0,1716*
Earnings^{m}	0,0552	0,0157	0,0607	-0,0651
Fundflow^{b1}	0,0000	0,2312***	0,0170	0,1838**
Fundflow^{m1}	0,0473	-0,0173	0,0599	-0,0543
Fundflow^{b2}	0,0031	0,2309***	0,0269	0,2088**
Fundflow^{m2}	0,0603	0,0008	0,0651	-0,0425
Fundflow^{b3}	-0,0025	0,2221**	0,0156	0,1734**
Fundflow^{m3}	0,0481	-0,0134	0,0575	-0,0481
Cashflow^{b}	-0,0701	0,2299***	0,0553	0,0887
Cashflow^{m}	0,0997	0,0033	0,0637	-0,0514

* Significant at the ,10 level
** Significant at the ,05 level
*** Significant at the ,01 level

achieved for Sample A, the smallest sample, selected from June year-end industrial companies closely followed by Sample F, a similar sample selected from all companies. Compared with the correlation results for samples E and G, the correlations for samples A and F indicate that the sample selection criterion of the same financial year-end is important.

Sample D had the lowest correlations as well as the lowest significance levels. This indicates clearly the effect of the length of the measurement period, i.e. the number of observations. The accounting betas for Sample D were calculated using time series regression on only five observations, compared with 20 observations for some of the other samples.

The sample *average* return and the sample *median* return were alternatively used as proxy for the return on the market in the calculation of the accounting betas. It would appear that the correlations are insensitive to the choice of accounting 'market' return. This is despite the fact that the accounting betas calculated using the median were generally more significant than those using the average. The Bayesian adjustment procedure influenced the correlations inconsistently. In some cases, such as Sample A, both correlations and significance levels were reduced, while in others the effect of the Bayesian adjustment was in the opposite direction.

Each accounting return was calculated twice, first using the *book value* of common equity as deflator, and then using the *market value* of common equity. Substantially stronger and more significant correlations were achieved, across all the samples, for accounting betas derived from the book value deflated return measures. This indicates that the pure accounting betas are superior to those using market value as deflator. This result is inconsistent with the conclusion of Christie (Wessels, 1991: 8), but agrees with the findings of *inter alia* Gonedes (1973) and Hill & Stone (1980).

Stronger and more significant correlations were achieved for the earnings and funds flow betas compared to the cash flow betas (although one may argue that Fundflow$^{b3 \,\&\, m3}$ betas are cash flow betas). These results provide no support for the notion that the cash flow beta is superior to the more traditional earnings beta in predicting market beta. The results are inconsistent with the findings of Ismail & Kim (1989: 131). Nevertheless the correlation coefficient of 0.4741 (significant at 0.01) achieved for the Cashflow^{b} beta (Sample A) is still relatively high.

Accounting betas from Samples A, E, F, and G were also correlated with appropriate subsets of the market betas of Sample H. This was done to determine whether or not the large size of Sample H (i.e. better approximation of the return on the market) has any effect on the correlations. Contrary to the expectation the correlation results were lower than correlations using accounting and market betas from the same samples.

Summary

In this article the association between market and accounting betas under a variety of research designs is investigated, namely: the size of the sample; the length of the measurement period; the accounting sample market return measure; the choice of the return deflator; and the homogeneity of sample companies in respect of financial year-end and sectoral characteristics.

Results obtained from this analysis showed that in the South African context a significant positive relationship exists between market beta and a variety of earnings and cash flow-based accounting betas, although no evidence was found to validate the supposed superiority of cash flow based betas over earnings based-betas. The results furthermore indicated that this relationship is sensitive to a number of the above design elements.

The Bayesian adjustment procedure as developed by Vasicek (1973) was successful in improving the significance of both the market and accounting betas, despite the use of Bayesian parameters which are approximations by Vasicek (1973) for the New York Stock Exchange. If Sample H (20 years of weekly data on 228 companies selected from the entire JSE) may be regarded as a good approximation of the 'market', then it would appear that Vasicek's (1973) parameters of $\beta_{prior} = 1$ and $s_{prior} = 0.5$ compare favourably with Sample H's average beta of 0.9678 and cross-sectional standard deviation of 0.4396.

Although the small size of the typical South African sample is of concern, the analyses showed that bigger was not always better. The results indicated that increasing the length of the measurement period and restricting the sample to companies with the same sectoral characteristics are more successful in improving the significance of the betas and the correlations. The results showed that it is possible to achieve significant relationships despite the relatively small size of the sample (relative to sample sizes used in American research), provided the measurement period is long enough. Based on the results obtained in this study, at least twenty years of continuous data is recommended.

The accounting betas were more significant when calculated using the sample median return as proxy for the return on the market, as opposed to using the simple average return of the sample. This is possibly caused by large variances between calculated company values in a given time period which may have impacted significantly on the average. Despite the fact that no clear pattern emerged from the correlations in this regard, it is recommended that the median be used in future research in order to obtain a higher level of significance.

The analyses clearly showed that the appropriate deflator for the accounting return measures is the book value of common equity. The true accounting betas calculated using the book value as deflator resulted in stronger correlations with market beta than those calculated using the market value of common equity.

Acknowledgement

The comments of an anonymous referee, which significantly improved the article, are gratefully acknowledged. The usual disclaimer, however, applies.

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