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The income measurement properties of two crude inflation-accounting models

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Although the inflation rate in South Africa has been high over an extended period of time, accounting for the effect of inflation has not progressed further than Guideline AC201 of the South African Institute of Chartered Accountants. Research in the United States of America and the United Kingdom on the value of published inflation-accounting data has yielded little evidence of information content. Similar findings were obtained in South Africa based on estimated inflation-accounting data. Evidence of the income measurement properties of inflation-adjusted data in the USA has, however, been documented. In this article the income measurement properties of two simplified or crude inflation-accounting models are determined for industrial companies listed on the Johannesburg Stock Exchange (JSE). It is found that the historic cost income generally behaves as expected, but that the inflation adjustments to income contain little or no income measurement properties. The little positive evidence found points to the desirability of the disclosure of holding gains information.

Alhoewel die inflasiekoers in Suid-Afrika vir 'n uitgerekte tydperk hoog was, het die rekeningkundige verslagdoening oor die effek van inflasie nie verder gevorder as Riglyn RE201 van die Suid-Afrikaanse Instituut vir Geoktrooieerde Rekenmeesters nie. Navorsing in die Verenigde State van Amerika en die Verenigde Koninkryk oor die waarde van geopenbaarde inflasie-aangepaste rekeningkundige data het min bewyse van inligtingsinhoud gelewer. Soortgelyke resultate is in Suid-Afrika gerapporteer vir geskatte inflasie-aangepaste data. Metingseienskappe van inkomste gebaseer op inflasie-aangepaste data is egter wel in die VSA gedokumenteer. In hierdie artikel word die metingseienskappe van inkomste gebaseer op twee eenvoudige inflasie-rekeningkunde modelle vir nywerheidsmaatskappye wat op die Johannesburgse Effektebeurs (JE) genoteer is, bepaal. Daar is gevind dat die historiese koste-inkomste gewoonlik reageer soos verwag, maar dat die inflasie-aanpassings tot inkomste weinig of geen inkomste-metingseienskappe vertoon nie. Die geringe positiewe resultate wat verkry is, dui op die wenslikheid dat inligting oor hou-winst geopenbaar word.

Introduction

The inflation rate in South Africa has been at unacceptably high levels for more than 15 years, yet there is no formal statement of generally accepted accounting practice on the topic of inflation accounting. This contrasts with various western countries where such statements were published and made mandatory after only a few years of high inflation rates (Benatar & Fryer, 1987). The result was that in those countries where inflation-adjusted accounting numbers had to be published, a large amount of research has been conducted on the value of these data.

In South Africa, Guideline AC201 was published by the South African Institute of Chartered Accountants in 1978, but it was hardly used by companies listed on the Johannesburg Stock Exchange (JSE). The topic of inflation accounting has, however, received renewed attention of late. In September 1989 the South Africa Institute of Chartered Accountants published a new exposure draft, ED77, on this topic. Although this draft has since been withdrawn, the Institute is still working on new proposals (Singer, 1991). Jacobson (1991: 197) argued that it is essential for companies to disclose inflation-adjusted results in their annual financial statements, while Bhana (1992: 124) has highlighted the unwillingness of South African companies to disclose information regarding the effect of inflation on their financial results.

A number of studies have tested the association between the movement in share prices and inflation-adjusted accounting income numbers. Initial studies by Gheyara & Boatsman (1980), Beaver, Christie & Griffin (1980) and Ro (1980) focused on a single year's data and found no association. Later studies which used more than one year of data and used multivariate regression models such as the studies

by Beaver, Griffin & Landsman (1982), Beaver & Ryan (1985) also found no association, but others such as Bublitz, Frecka & McKeown (1985) and Murdoch (1986) found a weak association. Whereas the studies mentioned above generally followed an incremental information content approach, other research designs have also been used. Morris & McDonald (1986) used a valuation approach and found that the inflation-adjusted accounting variables did not contain any information useful in valuing stocks. Nuthirapakorn & Millar (1987) used an accounting beta approach and concluded that the inflation-adjusted accounting betas and historic cost accounting betas measured a common underlying phenomenon of share prices. Haw & Lustgarten (1988) used an income measurement perspective and found that the components of the inflation adjustments conformed to expectations in terms of sign and statistical significance. This relation is viewed as a necessary, but not sufficient, condition that the disclosures contain information that is useful to investors.

In the South African context Du Plessis, Archer & Affleck-Graves (1986) and Gevers (1991a) used the incremental information content approach as used by Beaver, *et al.* (1982) and found very little information content in the estimated inflation adjustments. Gevers (1992) also found that estimated AC201 inflation adjustments did not contain income measurement properties.

In comparing alternative models of inflation accounting, Gevers (1991b) showed that two simple or one-line inflation-adjustment models yielded income adjustments due to inflation that differed significantly from AC201. In this article these two crude models of inflation accounting are

used to generate the inflation adjustments to the reported accounting income numbers. Ensuingly, the income measurement properties of these crude inflation adjustments will be determined. If these adjustments are found to be significant in an income measurement perspective, then at least a necessary condition regarding the value of these adjustments has been established. This may then prove to be useful to those persons involved in drawing up new recommendations regarding accounting disclosures during periods of changing price levels.

In the next section the research design is discussed, including the details of the income measurement perspective as used by Haw & Lustgarten (1988) and adjusted for this study. Attention is also given to the treatment of the data for potential heteroscedasticity. The results are discussed subsequently and that is followed by the conclusions.

Research design

Relationship investigated

If markets existed for all the assets of a company, and the values of these assets were recorded, the value of the company reported on the balance sheet under current cost accounting would equal the market value of the company's shares, because both values would reflect the expected present value of the future cash flows to be generated by the company's assets (Haw & Lustgarten, 1988: 332). Under these circumstances the Rand-value of the return on the company's shares (dividends and capital appreciation) will be equal to current cost net income plus the holding gain. In turn the current cost net income is equal to the historic cost net income minus the realized holding gains. Thus under perfect and complete markets,

$$R_t = NI_t^h - RHG_t + HG_t \quad (1)$$

where

R_t = Return on share in year t ;
 NI_t^h = Historic cost net income in year t per share;
 RHG_t = Realized holding gains in year t per share; and
 HG_t = Holding gains in year t per share.

The left hand side of the equation indicates how investors perceive the change in the value of the assets between $t-1$ and t , whereas the right hand side of the equation indicates how accountants report the change in the company's value between $t-1$ and t under current cost accounting. Because the components on both sides are realizations, this equation holds under perfect and complete markets, regardless of investors' expectations.

Unfortunately the simplified inflation-accounting models used do not make provision for the separate estimation of realized and unrealized holding gains. If one assumes that the estimated inflation adjustments are correct, the realized and unrealized holding gains in Equation (1) are replaced by a single inflation adjustment. Thus, under perfect and complete markets,

$$R_t = NI_t^h - IA_t \quad (2)$$

where

IA_t = Current cost income adjustment in year t per share, and all other variables as defined before.

Using j and t as company and year subscripts, this leads to the following equation to be estimated using multiple linear regression:

$$R_{j,t} = \alpha_{0,t} + \alpha_{1,t} NI_{j,t}^h + \alpha_{2,t} IA_{j,t} + u_{j,t} \quad (3)$$

where $u_{j,t}$ represents the stochastic error which for an ordinary least squares (OLS) regression is assumed to be independent, normally distributed with a mean of zero and a constant variance. From the equation one would expect that $\alpha_{0,t} = 0$, $\alpha_{1,t} = 1$ and $\alpha_{2,t} = -1$.

Since the variables are all measured in Rand-values, the assumption of homoscedasticity may not be valid (Gujarati, 1978: 201). The procedures followed to eliminate heteroscedasticity are discussed further on.

Sample selection

This investigation is limited to companies listed in the industrial section of the JSE. The period over which the investigation was performed, stretched from 1975 to 1989. This period includes both upward and downward phases of the economy (as reflected by the annual change in Gross Domestic Product) and as such should be representative of the typical phases in the South African economy.

In addition, only companies that have an accounting year end of 30 June were included in the research. It was further decided to exclude the following companies in order to avoid possible confounding issues:

- foreign companies;
- pyramid holding companies;
- companies whose shares traded infrequently;
- companies whose capital structure changed significantly during the year; and
- companies that were moved to nonindustrial sections of the JSE.

This resulted in a sample which included a maximum of 117 companies in 1976, and a minimum of 55 companies in 1987.

Accounting data

The University of Stellenbosch Business School maintains a database of accounting information of industrial companies listed on the JSE. The database is standardized, resulting in income and other numbers that are comparable between the various companies. In terms of market capitalization these companies represent almost the full industrial section of the JSE.

As a result of the intricacies of many of the proposed models for inflation accounting world wide, there has been a demand for a model that would be easy to apply. Steele puts forward a well motivated case for a simplified adjustment. To quote him:

'It is this fundamental arbitrariness at the core of adjusting income for the effects of inflation, which suggests that for consistency (and sanity) a broadbrush approach is appropriate' (1985: 147).

The crudest of these adjustments requires the maintenance of shareholders' funds (Knights, 1986: 143). This single adjustment to income based on historic costs, is calculated by multiplying opening shareholders' funds by the change in the Consumer Price Index (CPI) over the reporting period. Although this adjustment is crude, and does not take into account the holding gains on fixed assets, Gevers (1988: 344) found that he could estimate AC201 adjusted income, using as an adjustment shareholders' funds multiplied by a percentage that did not differ much from the annual change in the CPI.

The first one-line adjustment model, which is called CRUDE/1 hereafter, is based on the maintenance of shareholders' funds. Shareholders' funds are considered to be equal to ordinary share capital, all distributable and non-distributable reserves, minority interest, convertible preference share capital, convertible long term loans and deferred taxation. In suggesting a one-line inflation adjustment Archer & Steele (1984: 484) proposed the use of the opening shareholders' funds adjusted for changes during the financial year. Thus the average of the opening and closing values of shareholders' funds were used for this model. The average shareholders' funds is multiplied by the increase in the CPI to yield the adjustment to income.

The second model, which resembles Archer & Steele's (1984: 484) proposal closer, is named CRUDE/2. They proposed an adjustment which consists of two parts. The first part is an adjustment to keep shareholders' equity intact in terms of an index. This part will cause a reduction in the stated income number. The second part is an adjustment in the opposite direction indicating the increase in nominal value of the non-monetary assets using the same index as in the first part. They also propose that the beginning of the year amounts of non-monetary assets should be restated at their historic cost adjusted for changes in a general index or at the current cost if the current cost is less. Shareholders' equity would be the restated amount for the assets minus the liabilities.

In model CRUDE/2 only the fixed assets were considered to be non-monetary, since it is possible to estimate their age, and hence their restated value, approximately using the method advanced by Ketz (1978) and Short (1985). In order to determine the restated value of equity, the liabilities were subtracted from the restated value of the assets (revalued fixed assets plus all other assets). Liabilities were determined by subtracting the historic cost value of equity (as used in model CRUDE/1) from the historic cost value of total assets. As for the CRUDE/1 model, the average of the opening and closing amounts of the revalued fixed assets and revalued equity were multiplied by the change in the CPI to determine the two parts of this adjustment. The difference of the two parts constituted the final adjustment. If the increase in the value of assets, however, exceeded the amount required to maintain shareholders' equity, the net adjustment was made equal to nil. This follows the recommendation of Archer & Steele (1984: 484).

Since the relationship between accounting income numbers and the movement of share prices is being investigated, it was deemed necessary to determine the historic cost income and the inflation adjustment to income attributable to ordinary shareholders. If the financial statements reflect the

consolidation of minority interests, the adjustment of income due to inflation is appropriated between the ordinary shareholders and the minorities.

Stock market data

The University of Stellenbosch Business School maintains a share price analysis system that contains the daily closing prices and dividend information of all industrial shares traded on the JSE. Annual share returns were calculated for each of the individual shares for each of the years 1975 to 1989 from 30 June of one year to 30 June of the next year. Since all shares do not necessarily trade every day, the actual return periods were from the last traded day closest to 30 June of each year to a similar date the next year. This is equivalent to using the prevailing trading price on 30 June, even if no actual trades took place on that particular day.

$$R_{j,t} = P_{j,t} - P_{j,t-1} + D_{j,t} \quad (4)$$

where

- $R_{j,t}$ = Annual return on share j in year t ;
- $P_{j,t}$ = Price of share j at the end of year t ;
- $P_{j,t-1}$ = Price of share j at the start of year t ; and
- $D_{j,t}$ = Dividends per share paid to shareholders of share j during year t .

Christie (1987) advocates the use of the opening market value of common equity as a deflator of the accounting variables. This may, however, not be the ideal number to use as deflator when the capital structure of the company has undergone a drastic change. Thus, the data for companies in the years where capital structure changes were reported in the *JSE Monthly Bulletin*, were removed from the study. In addition, wherever the issued share capital of a company increased by more than 10%, that particular company-year was also excluded from the research. As a result 91 data points in total were removed over the total period of 14 years, leaving 1 165 data points for the analysis.

Heteroscedasticity

Since Equation (3) is expressed in Rand-values, it has to be corrected for heteroscedasticity. In this study the standard econometric procedure followed by Haw & Lustgarten (1988) is also used. If undeflated variables were to be used in estimating Equation (3), the estimates of the regression coefficients would be unbiased, but inefficient and yielding overstated t -values since the variance of the stochastic error $[E(u_{j,t}^2)]$ would not be constant. If $E(u_{j,t}^2)$ is known, weighted least squares (WLS) regression may be used to estimate the regression coefficients (Gujarati, 1978: 207). Based on the recommendation of Christie (1987) it is assumed that $E(u_{j,t}^2)$ is related to the opening market value of equity, $V_{j,t-1}$. This leads to the estimation of a deflator related to $V_{j,t-1}$. Thus it is assumed that:

$$[E(u_{j,t}^2)]^{\frac{1}{2}} = \gamma_0 + \gamma_1 V_{j,t-1} \quad (5)$$

In previous studies which deflated the variables by $V_{j,t-1}$, it was implicitly assumed that $\gamma_0 = 0$ and $\gamma_1 = 1$. In order to estimate the correct deflator for the WLS regression, the

residuals from the undeflated regression of (3) are determined first. The absolute value of these residuals are then regressed on $V_{j,t-1}$ to determine γ_0 and γ_1 . The estimating equation is thus:

$$|\hat{u}_{j,t}| = \gamma_0 + \gamma_1 V_{j,t-1} + \varepsilon_{j,t} \quad (6)$$

The predicted value from (6) is:

$$|\hat{u}_{j,t}|^* = \gamma_0 + \gamma_1 V_{j,t-1} \quad (7)$$

γ_0 and γ_1 are the OLS estimates of equation (6). $|\hat{u}_{j,t}|^*$ is then used to deflate all the variables in equation (3) and the regression constant of that equation is replaced by the reciprocal of $|\hat{u}_{j,t}|^*$ as recommended by Gujarati (1978: 209). It was assumed that this treatment of the data was sufficient to ensure that possible heteroscedasticity had been accounted for.

Statistical analysis

In the regression analysis, the hypothesis testing concerns the significance of the coefficients of the explanatory variables. Haw & Lustgarten (1988) tested the null hypothesis which stated that the alpha coefficients were equal to nought, with the alternative hypothesis that the coefficients were not equal to nought. From the *a priori* model, however, the correct hypothesis test is to determine whether the coefficients are equal to their expected values as stated in a previous section. Stated symbolically:

$$\begin{aligned} H_0: \alpha_{1,t} &= 1 \\ H_1: \alpha_{1,t} &\neq 1 \\ \text{and} \\ H_0: \alpha_{2,t} &= -1 \\ H_1: \alpha_{3,t} &\neq -1 \end{aligned}$$

These hypotheses are referred to as the stated hypotheses and are structured in such a way that the non-rejection of the null hypothesis is the desired outcome. Although such a test is open to larger Type II errors than a test in which the rejection of the null hypothesis is the desired outcome, the structure of the model is such that this form of hypothesis statement is the only feasible one. If either of the two null hypotheses is rejected one can, additionally, test the two null hypotheses which state that the separate alpha-coefficients are equal to nought. These hypotheses are referred to as the additional hypotheses. If either or both of these additional null hypotheses are rejected, and the sign of the regression coefficient conforms to expectations, the result can be interpreted as an indication, albeit weak, of the income measurement properties of the data.

Results

Introduction

The estimation of the deflator was performed in a Lotus 1-2-3 environment for each year and both models. The final transformed regression model was estimated using Statgraphics. The results for the analysis of the single years are discussed first for both inflation-accounting models and is presented in the next section.

If the relationship established is not found to be very strong, one would expect to find a stronger relationship if years of data were to be combined. This was done for periods of two and three years (Haw & Lustgarten [1988] looked at all combinations up to 7 years.)

The Rand-values for the variables used in Equation (3) for each year were added, yielding on the left hand side of Equation (3) a two or three year return that the investor in the share would have received, and on the right hand side of the equation the two or three year inflation-adjusted income

Table 1 Regression results for individual years for Model CRUDE/1

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76	0.416	-4.444 ^a	3.168 ^a	0.024	4.990 ^a	0.114	0.177	8.180 ^a	117
77	0.601	-3.311 ^a	4.990 ^a	-0.731	1.517	-4.124 ^a	0.221	10.375 ^a	113
78	0.716	-1.668	4.216 ^a	-0.089	3.158 ^a	-0.307 ^a	0.519	37.426 ^a	107
79	1.044	0.327	7.672 ^a	0.222	8.984 ^a	1.632	0.715	79.343 ^a	98
80	1.789	2.880 ^a	6.526 ^a	-0.858	0.422	-2.542 ^a	0.729	79.835 ^a	92
81	-0.565	-5.148 ^a	-1.859 ^b	3.474	8.018 ^a	6.226 ^a	0.629	41.264 ^a	76
82	0.441	-3.993 ^a	3.150 ^a	0.056	4.853 ^a	0.258	0.210	6.660 ^a	78
83	1.825	2.260 ^a	5.003 ^a	0.436	2.730 ^a	0.829	0.631	43.950 ^a	80
84	0.599	-1.332	1.989 ^b	1.094	5.070 ^a	2.648 ^a	0.470	18.893 ^a	67
85	0.535	-2.672 ^a	3.076 ^a	0.200	9.597 ^a	1.600	0.613	35.939 ^a	71
86	0.962	-0.149	3.725 ^a	0.183	4.573 ^a	0.706	0.369	11.493 ^a	62
87	1.313	0.445	1.865 ^b	2.406	5.216 ^a	3.684 ^a	0.620	28.289 ^a	55
88	0.186	-1.777 ^b	0.405	0.758	2.540 ^a	1.095	0.164	4.055 ^a	65
89	1.680	2.159 ^a	5.330 ^a	0.009	2.801 ^a	0.024	0.446	21.726 ^a	84

The following key holds for all tables:

a. Denotes significance at the 5% level.

b. Denotes significance at the 10% level.

per share. After the values of the variables have been accumulated, the WLS regressions are repeated. The results for the extended periods are reported in the section on multiple year regressions.

Since the number of data points per year were not sufficient to perform any other subdivisions per year to possibly glean more information from the analysis, it was decided to pool all the data in a single cross-section over all the years and subdivide the pooled data into separate portfolios and repeat the regression analysis. The results for the pooled data are presented in the section on pooled regressions.

Single year regressions

The single year regression results for Models CRUDE/1 and CRUDE/2 are presented in Tables 1 and 2 respectively.

The results in Tables 1 and 2 are similar. The coefficient of NI^h does not differ significantly (at the 5% level) from its hypothesized value of +1 in approximately half the number of years. It is significantly different from zero in all but two of the 14 years. It has the correct sign (except for one year), but its value, however, varies considerably from a low of 0.186 for Model CRUDE/1 in 1988 to a high of 2.450 for Model CRUDE/2 in 1987.

The results for the coefficient of IA are disappointing. For Model CRUDE/1 the coefficient of IA is not significantly different (at the 5% level) from its hypothesized value of -1 in 2 of the 14 years, while for Model CRUDE/2 this number improves to 6 out of the 14 years. Model CRUDE/1 displays an unexpected negative sign for the coefficient of NI^h in 1981. The r^2 -values, which indicate the strength of the relationship, also vary from a low 0.146 for Model CRUDE/2 in 1977 to a high of 0.729 for Model CRUDE/1 in 1980.

In terms of the stated null hypothesis regarding the coefficient of the inflation adjustment, it seems as if Model CRUDE/2 displays the better income measuring properties. It should, however, be noted that the standard error of the coefficient sometimes displays such a large value that a positive coefficient is not found to be significantly different from -1. In terms of an overall fit of the model, Model

CRUDE/2 displays coefficients for both explanatory variables that do not differ from their hypothesized values (at the 5% level of significance) in the three years 1987 to 1989. Thus, although limited, some indication of the appropriateness of the models is established.

Haw & Lustgarten (1988: 342) only reported whether the coefficients of the two explanatory variables differed significantly from zero. As such their results differ from those in this study. They found that the coefficients of the inflation-adjustment components were usually statistically significant and of the correct sign. The remainder of the results are similar since they reported a range of values for α_1 of 0.39 to 2.61 while their r^2 -values varied between 0.123 and 0.561. They did mention testing whether the coefficients of the explanatory variables were significantly different from their hypothesized values of +1 and -1, but details of the test were not supplied, except in most cases they had to reject the hypotheses.

Multiple year regressions

The results for the two-year regressions are shown in Tables 3 and 4 and those for the three-year regressions in Tables 5 and 6 for models CRUDE/1 and CRUDE/2 respectively.

For the two-year regressions the coefficient of NI^h does not differ significantly (at the 5% level) from its hypothesized value of +1 in more than half the periods analyzed. In addition it is always positive and usually significantly different from zero at the 1% level. The coefficient of IA does, however, not improve. For Model CRUDE/1 the coefficient of IA does not differ significantly from its hypothesized value of -1 in only one period, while for Model CRUDE/2 this occurs in three periods. In the periods 1987-1988 and 1988-1989 Model CRUDE/2 displays coefficients for both explanatory variables that do not differ significantly from their respective hypothesized values. This seems to indicate that Model CRUDE/2 contains the better income measurement properties of the inflation-accounting models investigated.

Table 2 Regression results for individual years for Model CRUDE/2

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76	0.508	-4.529*	4.670*	-0.323	2.584*	-1.233	0.182	8.447*	117
77	0.399	-5.509*	3.662*	-0.613	1.565	-2.484*	0.146	6.224*	113
78	0.670	-2.166*	5.053*	-0.097	2.715*	-0.292	0.518	37.277*	107
79	1.143	1.042	8.324*	0.247	5.538*	1.096	0.718	80.739*	98
80	1.343	1.593	6.243*	-0.227	1.860*	-0.545	0.704	70.490*	92
81	0.259	-2.808*	0.984	2.670	4.984*	3.982*	0.513	25.600*	76
82	0.425	-4.353*	3.214*	0.173	3.727*	0.569	0.216	6.880*	78
83	2.004	3.198*	6.385*	0.145	1.751*	0.222	0.628	43.387*	80
84	0.950	-0.172	3.266*	0.983	3.246*	1.610	0.454	17.714*	67
85	0.490	-3.022*	2.899*	0.311	5.444*	1.291	0.301	9.745*	71
86	0.910	-0.387	3.917*	0.500	3.233*	1.079	0.362	11.179*	62
87	2.450	1.946*	3.287*	1.332	1.384	0.962	0.526	19.240*	55
88	0.444	-1.514	1.207	0.609	1.585	0.600	0.152	3.712*	65
89	1.545	1.828*	5.180*	0.216	1.900*	0.337	0.434	20.668*	84

Table 3 Regression results for two years combined for Model CRUDE/1

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76-77	0.379	-6.351 ^a	3.875 ^b	-0.276	5.109 ^a	-1.944 ^b	0.165	6.899 ^a	108
77-78	0.816	-1.758 ^b	7.817 ^a	-0.631	2.365 ^a	-4.036 ^a	0.498	33.369 ^a	104
78-79	0.794	-1.348	5.195 ^a	0.182	6.199 ^a	0.954	0.674	64.232 ^a	96
79-80	1.388	1.962 ^a	7.007 ^a	0.288	3.200 ^a	1.292	0.785	99.987 ^a	85
80-81	0.338	-2.365 ^a	1.206	1.392	5.537 ^a	3.223 ^a	0.717	54.171 ^a	67
81-82	0.272	-4.676 ^a	1.746 ^b	1.024	8.006 ^a	4.051 ^a	0.664	39.576 ^a	63
82-83	1.186	0.705	4.504 ^a	0.011	2.567 ^a	0.028	0.555	28.278 ^a	71
83-84	1.417	1.192	4.054 ^a	0.775	3.807 ^a	1.661	0.705	46.978 ^a	62
84-85	0.529	-4.777 ^a	5.360 ^a	0.453	13.698 ^a	4.278 ^a	0.765	65.088 ^a	63
85-86	1.237	1.039	5.426 ^a	-0.138	4.277 ^a	-0.683	0.484	16.569 ^a	56
86-87	1.393	1.102	3.905 ^a	0.920	6.063 ^a	2.906 ^a	0.718	39.002 ^a	49
87-88	0.969	-0.068	2.152 ^a	0.388	2.342 ^a	0.656	0.543	15.450 ^a	42
88-89	1.129	0.395	3.456 ^a	-0.281	1.587	-0.619	0.305	7.178 ^a	52

Table 4 Regression results for two years combined for Model CRUDE/2

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76-77	0.336	-8.539 ^a	4.317 ^a	-0.315	3.933 ^a	-2.122 ^a	0.174	7.349 ^a	108
77-78	0.629	-4.145 ^a	7.041 ^a	-0.540	2.308 ^a	-2.710 ^a	0.445	27.013 ^a	104
78-79	0.980	-0.165	7.904 ^a	-0.032	4.089 ^a	-0.134	0.730	83.854 ^a	96
79-80	1.223	1.370	7.485 ^a	0.023	3.467 ^a	0.077	0.778	95.837 ^a	85
80-81	0.931	-0.311	4.187 ^a	0.505	3.184 ^a	1.069	0.665	42.408 ^a	67
81-82	0.398	-4.954 ^a	3.270 ^a	1.236	8.470 ^a	4.678 ^a	0.685	43.424 ^a	63
82-83	1.209	0.965	5.579 ^a	-0.052	2.121 ^a	-0.117	0.555	28.214 ^a	71
83-84	1.621	2.275 ^a	5.934 ^a	0.877	3.330 ^a	1.555	0.703	46.608 ^a	62
84-85	0.518	-8.528 ^a	9.151 ^a	0.750	8.578 ^a	3.670 ^a	0.797	78.656 ^a	63
85-86	1.003	0.015	5.061 ^a	0.180	3.480 ^a	0.530	0.434	13.528 ^a	56
86-87	1.862	2.358 ^a	5.095 ^a	0.235	1.925 ^b	0.367	0.661	29.901 ^a	49
87-88	1.226	0.666	3.617 ^a	-0.058	1.207	-0.074	0.548	15.761 ^a	42
88-89	0.777	-0.778	2.710 ^a	0.118	1.481	0.157	0.245	5.289 ^a	52

For both models the r^2 -values improve slightly, with a maximum of 0.785 being recorded in the 79-80 year combination for Model CRUDE/1. This is similar to what Haw & Lustgarten (1988) found.

Results for the three-year combinations are very similar to those for the two-year combinations. For the CRUDE/1 model the coefficient of NI^h does not differ significantly from its hypothesized value of +1 in 8 of the 12 periods, while for the CRUDE/2 model this number improves to 9 periods out of 12 periods. The aggregation of the raw data into three-year measures does, however, not seem to improve the significance of the coefficient of IA. Only Model CRUDE/2 displays 2 periods in which this coefficient does not differ significantly from its hypothesized value. The coefficient of IA frequently displays a positive sign. For these instances they were also tested to determine whether they differed from zero and it is found that the coefficients are significantly different from zero in a positive direction in each of four periods. The r^2 -values for the three-year combinations improve a little for all the models.

Unfortunately the available data is somewhat too limited to allow further detailed experimentation in an attempt to try and resolve the significant deviation from -1 of the coefficient of the inflation adjustment. (Haw & Lustgarten [1988] had a minimum of 381 companies in a single year, and a maximum of 576.) The limited number of South African companies do not allow the splitting of the samples into sub-samples on an annual basis. Some information may possibly be gleaned from pooling the data over a number of years.

Pooled regressions

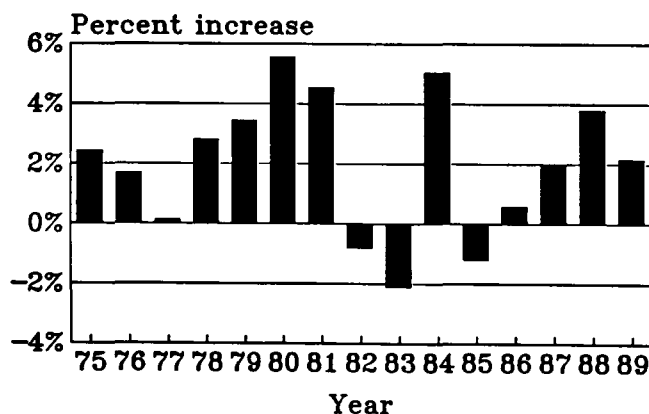
To see if the business cycle has an influence on the results, the data from years with a positive growth in the real Gross Domestic Product (GDP) are pooled together as well as those from years with a negative or zero growth in the real GDP. A slight variation is obtained by grouping data from years with an increasing growth rate in the real GDP and those with a decreasing growth rate in the real GDP. The GDP over the period is shown in Figure 1 and was extracted

Table 5 Regression results for three years combined for Model CRUDE/1

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76-78	0.478	-5.932 ^a	5.418 ^a	-0.296	5.498 ^a	-2.310 ^a	0.396	21.206 ^a	100
77-79	0.925	-0.809	9.840 ^a	-0.242	6.358 ^a	-2.027 ^a	0.751	90.461 ^a	93
78-80	1.353	1.930 ^b	7.396 ^a	-0.335	3.023 ^a	-1.521	0.811	113.002 ^a	82
79-81	0.417	2.617 ^a	1.871 ^b	1.077	6.108 ^a	3.169 ^a	0.775	67.614 ^a	62
80-82	0.280	-5.455 ^a	2.125 ^a	0.932	9.471 ^a	4.572 ^a	0.823	80.780 ^a	55
81-83	0.437	-2.127 ^a	1.654	1.082	5.395 ^a	2.803 ^a	0.644	33.184 ^a	58
82-84	0.933	-0.194	2.708 ^a	0.731	3.637 ^a	1.536	0.620	28.243 ^a	55
83-85	1.177	0.795	5.290 ^a	0.601	8.127 ^a	3.051 ^a	0.720	48.073 ^a	59
84-86	1.187	0.956	6.066 ^a	0.055	5.599 ^a	0.294	0.675	32.542 ^a	50
85-87	1.427	1.620	5.409 ^a	0.333	5.563 ^a	1.392	0.732	38.382 ^a	45
86-88	1.093	0.256	3.016 ^a	0.505	3.671 ^a	1.232	0.691	26.088 ^a	38
87-89	1.452	1.171	3.765 ^a	0.086	6.492 ^a	0.167	0.635	17.944 ^a	34

Table 6 Regression results for three years combined for Model CRUDE/2

Period	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
76-78	0.416	-8.346 ^a	5.929 ^a	-0.339	4.534 ^a	-2.335 ^a	0.391	20.771 ^a	100
77-79	0.887	-1.437	11.163 ^a	-0.373	3.710 ^a	-2.208 ^a	0.759	94.269 ^a	93
78-80	1.145	1.019	8.063 ^a	-0.003	3.728 ^a	-0.010	0.804	107.785 ^a	82
79-81	0.892	-0.590	4.865 ^a	0.495	3.874 ^a	1.283	0.737	55.017 ^a	62
80-82	0.519	-4.072 ^a	4.394 ^a	0.744	7.061 ^a	3.013 ^a	0.790	65.323 ^a	55
81-83	0.694	-1.523	3.448 ^a	1.063	5.045 ^a	2.598 ^a	0.643	33.089 ^a	58
82-84	1.096	0.376	4.305 ^a	0.885	2.091 ^a	1.699 ^b	0.623	28.675 ^a	55
83-85	1.314	1.630	6.822 ^a	0.744	6.346 ^a	2.708 ^a	0.709	45.525 ^a	59
84-86	1.081	0.467	6.200 ^a	0.098	3.269 ^a	0.290	0.605	24.028 ^a	50
85-87	1.625	2.454 ^a	6.380 ^a	-0.031	2.145 ^a	-0.069	0.716	35.215 ^a	45
86-88	1.408	1.480	5.109 ^a	0.059	1.912 ^b	0.107	0.672	23.859 ^a	38
87-89	1.424	1.164	3.910 ^a	0.268	1.401	0.296	0.635	18.000 ^a	34

**Figure 1** Annual increase in real gross domestic product

from the *Quarterly Bulletin of the South African Reserve Bank*.

An alternative way of grouping the data is accomplished by pooling the data from companies that seemed to have made some attempt to account for the effect of inflation by either publishing supplementary inflation-adjusted income numbers, or by using some form of the last-in-first-out (LIFO) method of inventory valuation, or by accounting for additional depreciation in the income statement. Data from

companies that did not make any effort to account for the effects of inflation are pooled in a second sample.

A final grouping is achieved by pooling the data from companies that are no longer listed as industrial companies. The last three years' data prior to delisting or change in sector are pooled. The rationale for this grouping is that these companies could be seen as failed (a change from the industrial section to another section usually follows a takeover, and companies that have been the target of a takeover may well be seen as having failed). One reason for failing could be the neglect in accounting for the effects of inflation. For these companies one could thus expect higher inflation adjustments and the possibility of a stronger association with the share returns.

The results of the regressions for the various pooled groupings of the data are given in Tables 7 and 8 for the Models CRUDE/1 and CRUDE/2 respectively.

The results of the pooling of the data are disappointing. The coefficient of NI^h is significantly (at the 5% level) different from its hypothesized value of +1 in 5 out of 8 different cases of pooling for Model CRUDE/1 and for 3 out of the 8 cases for Model CRUDE/2. The coefficient of the inflation adjustment, however, remains positive, is small in value and is significantly different from its hypothesized

Table 7 Pooled regression results of annual data for Model CRUDE/1

Description	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
Positive GDP growth	0.731	-2.991 ^a	8.120 ^a	0.785	15.388 ^a	6.744 ^a	0.385	171.261 ^a	823
Negative GDP growth	0.793	-1.931 ^b	7.421 ^a	0.187	9.637 ^a	1.520	0.242	36.092 ^a	342
Increasing GDP growth	0.835	-1.478	7.481 ^a	0.698	12.403 ^a	5.097 ^a	0.422	132.295 ^a	546
Declining GDP growth	0.801	-2.381 ^a	9.497 ^a	0.261	11.784 ^a	2.435 ^a	0.270	76.037 ^a	619
With adjustment	1.415	2.203 ^a	7.510 ^a	-0.080	3.759 ^a	-0.325	0.483	46.649 ^a	153
Without adjustment	0.731	-3.665 ^a	9.963 ^a	0.604	16.234 ^a	6.118 ^a	0.331	167.001 ^a	1012
Delisted	1.057	0.380	7.013 ^a	0.441	4.060 ^a	3.206 ^a	0.421	45.049 ^a	189
All	0.813	-2.688 ^a	11.656 ^a	0.504	17.350 ^a	5.814 ^a	0.341	199.987 ^a	1165

Table 8 Pooled regression results of annual data for Model CRUDE/2

Description	$\hat{\alpha}_1$	t-value stated	t-value additional	$\hat{\alpha}_2$	t-value stated	t-value additional	r^2	F-test	n
Positive GDP growth	0.904	-1.123	10.627 ^a	0.723	9.423 ^a	3.956 ^a	0.364	156.266 ^a	823
Negative GDP growth	0.768	-2.231 ^a	7.391 ^a	0.390	6.857 ^a	1.923 ^b	0.243	36.365 ^a	342
Increasing GDP growth	1.045	0.406	9.522 ^a	0.593	7.018 ^a	2.612 ^a	0.399	120.243 ^a	546
Declining GDP growth	0.766	-2.873 ^a	9.410 ^a	0.540	9.167 ^a	3.214 ^a	0.274	77.377 ^a	619
With adjustment	1.460	2.369 ^a	7.514 ^a	-0.297	1.543	-0.651	0.484	46.922 ^a	153
Without adjustment	0.864	-1.917 ^b	12.225 ^a	0.506	10.390 ^a	3.483 ^a	0.316	155.148 ^a	1012
Delisted	1.098	0.624	7.008 ^a	0.495	6.411 ^a	2.123 ^a	0.403	41.920 ^a	189
All	0.905	-1.415	13.421 ^a	0.541	11.086 ^a	3.887 ^a	0.330	190.714 ^a	1165

value of -1 in all cases of pooling, over both models except for Model CRUDE/2 and companies with some disclosed inflation adjustments.

Haw & Lustgarten (1988) split their sample on positive and negative net income companies and found that for the negative net income companies the coefficients of the realized holding gains and the holding gains were largely insignificant and often with unexpected signs. Although Haw & Lustgarten (1988) performed different significance tests on their coefficients, it appears as if the results of this study are similar to their findings for negative net income companies.

The results can be summarized with the comment regarding each of the two explanatory variables. The historic cost income variable displays income measurement properties according to the hypothesized model in about half of all the regressions for both inflation-accounting models. The inflation adjustments generated by Model CRUDE/2, however, seem to be the only adjustments to contain some income measurement properties.

Conclusions

In this article an income measurement perspective was used to evaluate the relationship between share returns, historic cost income per share and an inflation adjustment per share estimated according to two simple or crude inflation-accounting models. For the historic cost income number the results confirm prior expectations in terms of the sign and size for about 50% of all regressions estimated. Only the inflation adjustments according to Model CRUDE/2 seem to have an influence on the share return.

A number of reasons could be forwarded in an attempt to try and explain why the inflation adjustments do not seem to have much value. The first is quite clearly the fact that the research was based on estimated adjustments and not disclosed adjustments. Although Bernard & Ruland (1987) found that they could estimate inflation adjustments for companies listed on the New York Stock Exchange with a high degree of accuracy, it does not necessarily mean that all attempts at estimating inflation adjustments will be successful.

A second reason could be that all assets and liabilities of the companies have not been recorded without error, yielding biases in the estimated inflation adjustments as well as the regression coefficients of the income measurement model. In addition the income measurement perspective assumes the existence of markets for all of the companies' assets which is clearly not the case.

The adjustments included in the models could also be insufficient. Neither of the two models contain estimates of the realized holding gains, while only Model CRUDE/2 contains an unrealized holding gain on fixed assets. Perhaps the estimated holding gains made this model superior to the other one.

Since the estimated adjustments according to Model CRUDE/1 do not seem to have income measurement properties, this model does not seem to be useful to investors. The limited success that was achieved using Model CRUDE/2 could point to a need to incorporate some form of

reporting about holding gains. Simple adjustments for inflation could, however, still be useful if they contained sufficient company specific information that cannot be captured by the crude estimates made.

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