CAPITAL ASSETS AND FINANCIAL STATEMENT DISTORTIONS

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EXECUTIVE SUMMARY

This paper investigates distortions in financial statements that arise from employing capital assets. Use of historical cost depreciation tends to overstate earnings because of inflation effects, which in turn misrepresents firms' capacities to expand operations or to distribute dividends. We argue that the financial statement effects of inflation can be traced to two main sources: understated depreciation, and interest expense. Depending on a firm's capital structure choices, the distortion from historical cost depreciation is heightened or mitigated.

Measurement errors in accounting numbers obscure the relation between price and earnings. We develop value relevant adjustments that enhance the informativeness of earnings. We also show that the effects of measurement errors from using historical cost depreciation are most pronounced in firms that carry lower levels of debt.

INTRODUCTION

It is widely understood that financial statements fall short in accurately reflecting the costs of employing capital assets. This tends to overstate earnings because of effects from inflation, thus misrepresenting the ability of a firm to distribute dividends or expand operations. We investigate measurement errors in accounting earnings arising from the use of historical cost depreciation.[i] By modifying net income with adjustments we develop, we improve the association between earnings and equity prices.

Distortions from inflation in historical cost accounts can be traced to two principal sources: understatement of depreciation, and interest expense. To the extent depreciable asset acquisition is debt financed, the overstatement of accounting earnings caused by historical cost depreciation is partly offset by changes in interest expense, since nominal interest rate adjustments follow price level changes. However, to the extent depreciable assets are internally financed, accounting earnings reflect "paper profits" caused by understated real depreciation and the absence of a capital usage charge for owner-supplied funds.

Thus, firm capital structure can be a factor in earnings measurement errors associated with historical cost depreciation. As a result, misstatement of earnings also varies depending upon firms' leverage levels. Cross-sectional differences in depreciation methods and capital structure then confound inter-firm comparisons of earnings if depreciation expense is a material portion of net income. Adjustment for earnings measurement errors arising from historical cost depreciation could increase the explanatory power of price/earnings models and permit financial statements prepared under current generally accepted accounting principles (GAAP) to reflect permanent earnings more accurately.

To assess this, we adjust earnings for differing accounting measurements across firms.[ii] We show that our modifications for historical cost depreciation expense and capital structure are value-relevant. Our paper thus contributes to the financial economics

literature by providing a new technique to reduce earnings measurement errors, and is useful to investors because it enhances the acuity of price/earnings models.

The remainder of the paper is organized as follows. In Section 2, we provide a theoretical background and develop hypotheses. Our research design is described in Section 3. Data are described in Section 4. Our findings are reported and interpreted in Section 5, along with specification tests. Our conclusion is in Section 6, and we provide a direction for future research.

BACKGROUNDAND HYPOTHESIS DEVELOPMENT

Numerous studies since Ball and Brown (1968) evaluate the informativeness of accounting numbers by observing stock market reactions to the release of accounting data. Beaver et al. (1980) extend the findings of Ball and Brown by dividing accounting earnings into two components, permanent and transitory. They show that changes in stock returns are primarily associated with a permanent change in unexpected earnings and provide a functional form for investigating the price/earnings relation. Nonetheless, prior studies have not succeeded in identifying the precise linkage of earnings to returns (Lev, 1989). To address this, Lipe (1986) investigates the empirical relation between stock returns and components of earnings, rather than earnings as a whole. Several other studies have also extended Lipe (1986) by focusing on specific industries or accounting items. Barth et al. (1990) report that security gains and losses in the banking industry are transitory compared to earnings from operations. Barth et al. (1992) show that investors assign different earnings multiples to components of pension expense depending upon their value-relevancy. Furthermore, Amir (1993) examines the *ex ante* effect of post-retirement benefits (PRB) other than pensions. He reports that investors took into account the liability associated with PRB even before SFAS No. 106 was mandated.

This paper continues this line of research by examining the effect of another earnings component, historical cost depreciation, on the association of earnings with stock returns. Given an economy with inflation, the purchasing power sacrifice represented by the sum of depreciation expense charged over the life of an asset is less than the initial investment using conventional accounting methods. If historical cost depreciation is a material expense and is understated, a firm's accounting earnings are overstated. Our adjustment technique is potentially significant: Hyon and Press (1993) report that depreciation charges average 47% of pre-depreciation earnings for industrial firms on the 1990 Compustat P-S-T file.

Since the primary reason a firm purchases depreciable fixed assets is to provide operating capacity, the economic sacrifice in acquiring depreciable fixed assets should be measured in terms of how much the firm must spend to replace worn-out assets.[iii] If there were no inflation and perfect accuracy in accounting earnings, accounting earnings would represent the excess that the firm's owners could consume while maintaining operating capacity at the current level, and this excess could be returned to shareholders as dividends. But with inflation, a firm's reported earnings tend to be biased upward by the difference between the capital expenditure required to maintain productive capacity, and

historical cost depreciation. If stock market prices provide unbiased estimates of future cash flows, market participants must adjust depreciation. Thus, the first hypothesis we test, stated in alternative form, is:

H_1: Investors adjust accounting earnings for the understatement of real depreciation cost in assessing the market value of a firm's equity.

Overstatement of accounting earnings caused by historical cost depreciation is also affected by capital structure. If depreciable fixed assets are 100 percent externally financed (debt-financed), and a firm matches project duration with financing period, it recognizes inflation-adjusted interest as an operating expense in addition to depreciation. Then the effect of understated historical cost depreciation on accounting earnings would, in part, be offset by an increase in nominal interest expense.[iv]

In general, a change in inflation is reflected in nominal interest rates, with nominal interest rates rising commensurate to the increase in inflation. Real interest rates are not substantially affected by inflation, as empirical evidence on the performance of stocks and bonds demonstrates (Ibbotson & Sinquefield, 1976). A decrease in the purchasing power of a lender's initial outlay caused by inflation can thus be mitigated through adjusting the nominal rate of interest. Accordingly, in an efficient market, a firm pays its lenders interest equivalent to a fair return plus compensation for the loss of the purchasing power of the investment because of inflation.[v]

In contrast, if fixed assets are 100 percent equity-financed, a firm's accounting earnings are overstated to the extent of its understated real depreciation. In the equity case, however, there is no means for a change in nominal interest rates to affect accounting earnings through inflation adjustments.[vi] Thus, accounting earnings of highly leveraged firms are less susceptible to distortions from inflation relative to firms with lower relative debt.

Therefore, not only can a firm's accounting earnings distort economic performance because historical cost depreciation is used, but the extent of distortion depends upon capital structure. Because each firm maintains a unique capital structure, the degree of overstatement of earnings varies across firms identical in all other respects. Accordingly, the second hypothesis we test is:

H_2: Adjustments for earnings measurement errors caused by understated real depreciation are more important for firms with a preponderance of internally financed capital assets.

VALUATION MODELS

In perfect and complete markets, accounting earnings are a proxy for a firm's permanent earnings, and then accounting earnings discounted by cost of capital provide an estimate of firm value. This earnings valuation model assumes that the degree of measurement error in accounting earnings is constant across firms, and a homogeneous relation between earnings and returns across firms has also been assumed in empirical studies (Beaver and Landsman, 1983; Barth et al., 1992). Equation 1 express the model:[vii]

$$MV_t/BV_t=\beta_{1,0}+\beta_{1,1}AE_t/BV_t+\epsilon_t \qquad (1)$$

where

MV_t = the market value of the firm's common equity at the end of year t,
AE_t = the firm's accounting earnings before extraordinary items for year t,
BV_t = the book value of the firm's equity at the end of year t,
$\beta_{i,j}$ = the parameters of the equation where i and j refer to the equation number and order of the coefficients in the equation, respectively, and
ϵ_t = the disturbance term.

Equation 1 is deflated by the book value of the firm's equity to reduce potential heteroscedasticity caused by size differences across firms. If earnings measurement errors caused by historical cost depreciation are not constant across firms, firm-specific adjustments to earnings could increase explanatory power. Therefore, we modify equation 1 to test whether AE_t is overstated by understated real depreciation costs. Since the valuation model requires a proxy for future cash flows, AE_t is adjusted for the estimated capital expenditures needed to maintain the current level of operating capacity. To account for the measurement errors, we add a new variable in equation 2, the imputed cost of inflation adjustment (ICIA) from depreciating fixed assets.[viii]

$$MV_t/BV_t = \beta_{2,0} + \beta_{2,1} AE_t/BV_t + \beta_{2,2} ICIA_t/BV_t + \epsilon_t \quad (2)$$

where

BV_t = the book value of equity at time t,
$ICIA_t$ = the imputed cost after inflation adjustment at time t, and all other variables are as defined earlier.

$ICIA_t$ is the difference between historical cost depreciation and constant dollar restated depreciation expenses. Constant dollar restated depreciation expense (CDD) is computed based on a composite age method (Davidson & Weil, 1975). The composite age method estimates the average age of depreciable fixed assets as (accumulated depreciation)/(depreciation expense). Historical cost depreciation expense is restated as CDD by applying the change in price levels that is appropriate for the age of the depreciable fixed assets (i.e., CDD = HCD * change in price levels). The fixed investment component of the GNP Deflator is used to estimate the change in price levels associated with depreciating fixed assets (Davidson & Weil, 1975; Parker, 1977; Bernard & Ruland, 1987). If a firm adopts other depreciation methods such as the declining-balance method, this method might be less effective. Short (1985), however, indicates that, since Accounting Trends and Techniques reports that more than 95% of firms use the straight-line depreciation method for at least some assets, there is little difference between straight-line and declining-balance methods. The imputed cost for inflation adjustment at time t ($ICIA_t$) is the difference between HCD_t and CDD_t. The sign of $\beta_{2,2}$ will be negative if investors penalize accounting earnings for understating real depreciation cost.

To the extent that firms use external financing, there is less need to make inflation adjustments, since interest payments reflect inflation expectations. The overstatement of accounting earnings is limited by the portion of fixed assets that are internally financed; thus the explanatory power of variable $ICIA_t$ in equation 2 is attenuated to the extent firms have mixed capital structures. Accordingly, we rank the sample firms on leverage and divide them into groups to evaluate whether the

information content of ICIA differs between high and low leverage firms.

Furthermore, earnings multiples could differ between the two groups. Since leverage can proxy for financial risk, investors might increase their discount rate as leverage increases. In other words, the inclusion of added debt can confound the price/earnings relation. As leverage decreases, the required discount rate might decrease, while simultaneously the portion of "paper gain" in accounting earnings increases because of understated real depreciation. Thus, in equation 3, we allow coefficients on AE and ICIA to vary between more and less leveraged firms in order to disentangle potential confounding effects caused by leverage differences.

$$MV_t/BV_t = \beta_{3,0} + \beta_{3,1}*D + \beta_{3,2}\,AE_t/BV_t + \beta_{3,3}\,D*AE_t/_{Bvt} + \beta_{3,4}ICIA_t/BV_t + \beta_{3,5}\,D*ICIA_t/BV_t + \epsilon_t \quad (3)$$

where

D = a dummy variable equal to 1 when a firm-year observation is in the low leverage group, and 0 otherwise, and all other variables are as defined earlier.

If coefficients on $D*AE_t/BV_t$ and $D*ICIA_t/BV_t$ are significantly different from zero, the two groups have different coefficients on AE and ICIA. Since low leverage firms would have a lower discount rate but a greater amount of "paper gain" than high leverage firms, the coefficient on $D*AE_t/BV_t$ ($\beta_{3,3}$) should be positive, but that on $D*ICIA_t/BV_t$ ($\beta_{3,5}$) should be negative.

If the magnitude of earnings measurement errors is not the same between the two groups in equation 3, it is efficient to include continuous measures of leverage instead of the dichotomous classification in equation 3. Equation 4 incorporates a variable that adjusts for leverage differences, the imputed cost after inflation adjustment for equity capital (ICIAC) in depreciating fixed assets. $ICIAC_t$ is computed by multiplying $ICIA_t$ by the firm's leverage, defined as [(equity)/(equity + long-term debt)].[ix] Thus, $ICIAC_t$ is substituted for $ICIA_t$ to yield:

$$MV_t/BV_t = \beta_{4,0} + \beta_{4,1}AE_t/_{Bvt} + \beta_{4,2}\,D*AE_t/BV_t + \beta_{4,3}\,ICIAC_t/BV_t + \epsilon_t \quad (4)$$

where

$ICIAC_t$ = the imputed cost for inflation adjustment for equity capital during time t, and all other variables are as defined earlier.

$ICIAC_t$ should be negative. A negative, significant $\beta_{4,3}$ suggests that market participants adjust firms' earnings for overstatement caused by understated real depreciation, while also allowing for capital structure differences that temper the need for adjustments.

SAMPLE SELECTION AND DATA COLLECTION

The sample firms are all firms on Compustat PC except for financial institutions (SIC 6000-6499). For each year, a firm is included in the sample if it meets these criteria:

1. Non-negative earnings,
2. Capital intensity (the ratio of depreciable fixed assets before accumulated depreciation to total assets) is greater than 30 %,and
3. The ratio of market value to book value is between 15 and .1.

Firms with negative earnings for a given year are eliminated from the sample since the relation between price and earnings is unclear. To increase test power, a 30% cut-off for capital intensity is chosen. The third criterion is intended to limit the effect of outliers on the findings, consistent with Amir (1993).

The stock price at the end of a firm's fiscal year (Compustat Item No. A199) and the number of shares outstanding (Item A25) are used to compute the market value of a firm's equity. Items A20 and A60 are used as accounting earnings and book value of a firm's equity, respectively. The firm's annual depreciation is measured using Item A14. The age of depreciable fixed assets is computed by dividing accumulated depreciation (Item A196) by depreciation. Leverage is estimated using the ratio of equity (Item A60) over the sum of equity and long-term debt (Item A9). An inflation-adjustment factor (IAF) is computed based on the fixed investment component of the GNP Deflator (Davidson & Weil, 1975; Parker, 1977; Bernard & Ruland, 1987). The fixed investment component of the GNP Deflator at the current year ($FIGD_c$) is divided by the fixed investment component of the GNP Deflator in the year of purchase ($FIGD_p$) of fixed assets (the current year minus age) and then one is subtracted in order to compute IAF. Thus, IAF = $FIGD_c/FIGD_p$ - 1. Based on IAF, age, and leverage, the imputed cost for inflation adjustment (ICIA) is estimated by multiplying depreciation by IAF; the imputed cost for inflation adjustment for equity capital (ICIAC) is estimated by multiplying ICIA by leverage. The number of firms sampled each year varies from 1,100 in 1982 to 1,456 in 1990; the total of firm-years is 13,014. There is no substantial difference between the mean and median of each variable for given years.x

FINDINGS

Pooled results

Empirical results are reported based on two sets of data: pooled, and disaggregated year-by-year. Table 1 shows the estimates for the parameters of equations 1, 2, 3, and 4 based on pooled data. The coefficient on earnings is 8.50, which represents about an 11% discount rate for an average valuation. When ICIA is added in equation 2, its coefficient is -2.96, statistically significant at the .01 level. This suggests investors adjust accounting earnings for measurement errors caused by understated real depreciation, but discount the information content of ICIA compared to that of earnings in establishing the market value of equity.

After partitioning sample firms depending upon their leverage, results from equation 3 in Table 1 show that coefficients on AE and ICIA are significantly different between the two groups. The high (low) leverage group has an earnings multiple of 7.51 (9.74). These findings are consistent with investors adjusting for risk and using a lower discount rate on firms with lower leverage.[xi] This is consistent with higher interest expenses for more leveraged firms reflecting the effect of inflation on permanent earnings. The coefficient on ICIA for the high leverage group is -1.12 and statistically significant at the .01 level. For the low leverage group—for which the effects of inflation on reported earnings tend to be more distorted—the coefficient of ICIA is -6.68, which is statistically significant at the .01 level. The coefficient on ICIA decreases by 5.56 as the leverage of firms in the sample partition decreases.

TABLE 1

Regressions of Market to Book Ratio on Earnings and Earning Adjustments to Book (1982-1991)

Equation number[1]	Intercept (*t*-stat.)	D* Intercept (*t*-stat.)	AE (*t*-stat.)	D*AE (*t*-stat.)	ICIA (*t*-stat.)	D*ICIA (*t*-stat.)	ICIAC (*t*-stat.)	Adjusted R^2	F-ratio[2]
	Estimated Coefficients								
(1)	.89 (41.63***)	8.50 (63.55***)						.236	4038.57***
(2)	.98 (44.52***)	8.61 (64.83***)		-2.96 (-14.95***)				.24	2165.61***
(3)	.93 (31.67***)	.12 (2.84***)	7.51 (43.30***)	2.2 (8.36***)	-1.12 (-4.92***)	-5.56 (-12.07***)		.267	949.11***
(4)	1.04 (45.75***)	7.47 (51.72***)	2.30 (15.33***)				-7.37 (-19.86***)	.271	1620.91***

Equation (1): $MV_t / BV_t = \beta_{1,0} + \beta_{1,1} AE_t / BV_t + \epsilon_t$

Equation (2): $MV_t / BV_t = \beta_{2,0} + \beta_{2,1} AE_t / BV_t + \beta_{2,2} ICIA_t / BV_t + \epsilon_t$

Equation (3): $MV_t / BV_t = \beta_{3,0} + \beta_{3,1} * D + \beta_{3,2} AE / BV_t + \beta_{3,3} D*AE_t / Bv + \beta_{3,4} ICIA / BV_t + \beta_{3,5} D*ICIA_t / BV_t + \epsilon_t$

Equation (4): $MV_t / BV_t = \beta_{4,0} + \beta_{4,1} AE_t / BV_t + \beta_{4,2} D*AE_t / BV_t + \beta_{4,3} ICIAC_t / BV_t + \epsilon_t$

Notes:

MV/BV Market value of common equity over book value of equity.

AE/BV Earnings over book value of equity.

ICIA/BV Imputed cost for inflation adjustment over book value of equity. ICIA is the difference between the constant dollar restated depreciation (CDD) and historical cost depreciation expense (HCD).

ICIAC/BV Imputed cost for inflation adjustment of equity capital over book value of equity. ICIAC = ICIA*[equity / (equity + long-term debt)].

1. Listed in order of discussion in text.
2. 11,407 observations are used.
3. *** Significant at the .01 level; ** Significant at the .05 level; * Significant at the .1 level.

When firm capital structure is considered, the price/earnings relation is substantially different between high and low leverage firms. Furthermore, measurement errors caused by understated real depreciation vary between these two groups after the effect of increased risk on earnings multiples is controlled. Thus, our evidence indicates that the impact of depreciation adjustments on accounting earnings does vary depending upon how a firm finances its fixed assets.

Depreciation adjustments are further refined by using a continuous measure of capital structure. We replace ICIA by ICIAC adjusted for inflation and leverage. We provide the results in Table 1. The incremental information content of ICIAC is greater than that of ICIA. The magnitude of the coefficient on the additional variable increases when a firm's leverage is taken into account (from -2.96 in equation 2 to -7.37). However, the increase in magnitude might in part be associated with the systematic reduction of ICIA based on leverage level. For example, average leverage over the 10 years studied is .66. If ICIA is multiplied by .66, the magnitude of the coefficient on ICIAC should increase by 52% even if the information content of ICIAC is the same as that of ICIA. Thus, the coefficient on ICIA, -2.96, would be equivalent in information content to a coefficient on ICIAC of -4.48. The difference between the two estimates is -2.89 (-7.37 less -4.48).[xii] This suggests there is incremental information in leverage levels for estimating earnings measurement errors caused by historical cost depreciation. Because dividends are not treated as an expense for accounting purposes, capital structure impacts the cost realizations of using depreciable assets that provide operating capacity.[xiii]

Annual results

Year-by-year results are reported in order to assess the appropriateness of stationarity assumptions underlying the pooled regressions in Section 5.1. Furthermore, year-by-year results can provide some evidence of whether findings in the pooled equations are subject to statistical bias caused by cross-sectional correlation in residuals of market models (Bowen et al., 1987).[xiv] Estimates for equation 2 based on year-by-year observations are disclosed in Table 2. The coefficients on AE/BV vary from 7.41 in 1984 to 10.82 in 1991 over the period of 1982 to 1991, consistent with results in Barth et al. (1992) reporting earnings multiples of 8.53 and 8.67 in 1987 and 1988, respectively.

Coefficients on ICIA all have the expected negative sign, and those in 7 of 10 years are statistically significant at the 1% level. The magnitudes of coefficients of AE/BV are consistently greater than those of ICIA/BV. The average coefficient on AE (ICIA) is 8.63 (-3.77) over the 10 years. The significance of the annual *t*-statistics is tested using two Z-statistics which assess whether the time-series mean *t*-statistic is equal to zero. Since the annual models are prone to cross-sectional and serial correlation problems, two Z-statistics are computed: Z1 assumes that each model is independent, and Z2 corrects for cross-sectional and serial correlation, following Barth 1994.[xv] The Z1(Z2) statistic of AE is 64.12 (14.83) while the Z1 (Z2) statistic for ICIA is -11.34(-4.3). All are significant at conventional levels. The findings for year-by-year observations are consistent with those in the pooled data. The annual evidence corroborates the result that market participants adjust overstated accounting earnings for understated depreciation.

TABLE 2

Regressions of Market to Book Ratio on Earnings to Book and ICIA to Book

Equation 2: $\frac{MV_t}{BV_t} = \beta_{2,0} + \beta_{2,1}\frac{AE_t}{BV_t} + \beta_{2,2}\frac{ICIA_t}{BV_t} + \epsilon_t$

Year	$\beta_{2,0}$ (t-statistic)	$\beta_{2,1}$ (t-statistic)	$\beta_{2,2}$ (t-statistic)	Adjusted R^2	F-Ratio (No. of firms)
1991	1.04 (15.73***)	10.82 (26.06***)	-4.18 (-3.86***)	.325	341.18*** (1412)
1990	.87 (16.37***)	8.12 (26.08***)	-.44 (-1.35)	.321	345.74*** (1456)
1989	1.09 (15.77***)	8.68 (21.79***)	-.95 (-1.50)	.254	237.36*** (1388)
1988	97 (15.68***)	7.93 (24.35***)	-3.43 (-4.01***)	.299	297.90*** (1390)
1987	1.03 (14.22***)	7.85 (18.08***)	-1.51 (-2.05**)	.195	168.56*** (1378)
1986	1.10 (14.11***)	9.81 (19.55***)	-4.75 (-5.87***)	.251	206.78*** (1229)
1985	1.14 (14.95***)	8.35 (18.43***)	-6.17 (-7.67***)	.244	200.20*** (1232)
1984	1.02 (13.71***)	7.41 (17.73***)	-6.75 (-9.55***)	.246	207.64*** (1267)
1983	1.11 (11.56***)	8.48 (14.18***)	-4.52 (-6.56***)	.176	125.12*** (1162)
1982	.88 (9.88***)	8.87 (16.66***)	-5.07 (-7.63***)	.232	167.33*** (1100)
Mean	1.02	8.63	-3.77		
Mean(t-stat.)	(14.20)	(20.29)	(-3.59)		
Z1	44.86**	64.12***	-11.34***		
Z2	20.69***	14.83***	-4.30***		

Notes:

1. Two Z-statistics are computed whether the time-series mean t-statistic is equal to zero. Z1 = $1/\sqrt{N}\sum_{=1} t_j / \sqrt{[df_j / (df_j - 2)]}$ where t_j is the t-statistic for year j, df_j is the degres of freedom, and N is the number of years. Z2 = / (std (t)/ √ (N-1) where is the mean of annual t-statistics and std(t) is the standard deviation of annual t-statistics.
2. All other variables are as defined in Table 1.
3. *** Significant at the .01 level; ** Significant at the .05 level;* Significant at the .1 level.

Table 3 provides year-by-year results when sample firms are divided into two groups: low and high leverage firms. Earnings multiples in the low leverage group are higher than those in the high leverage group in 8 out of 10 sets of yearly observations. The average coefficient on AE increases by 2.94 (10.49 and 5.16 are the Z1 and Z2 statistics). On the other hand, the average coefficient on ICIA decreases by 5.97 (-11.69 and -12.44 are the Z1 and Z2 statistics). Furthermore, in the low leverage group, the coefficient on ICIA ($\beta_{3,4}$) is statistically significant in only 3 of 10 years at the .05 level (the expected sign is negative).

These results imply that the information content of ICIA in Table 2 is primarily derived from low, rather than high, leverage firms. For example, the difference of coefficients on ICIA between high and low leverage firms ($\beta_{3,5}$) is statistically significant at the .01 level in all 10 years. Investors appear to adjust earnings measurement errors caused by understated real depreciation in estimating the market value of a firm's equity. However, the adjustments are more substantial for firms that tend toward financing investments with internal funds rather than debt (external funds).

These results hold on a year-by-year basis. Table 4 shows that coefficients on ICIAC for every year between 1982 and 1991 are negative and statistically significant at the .01 level. The incremental information content of ICIAC is greater than that of ICIA. The average coefficient on AE (ICIAC) is 7.25 (-7.91) with -11.34 and -4.30 (-19.59 and -6.79) as Z1 and Z2 statistics, respectively. Additionally, a binomial test of proportions assuming equal likelihood of an explanatory increase of ICIAC over ICIA rejects the null of equal information content at the .01 level.[xvi]

In summary, the inclusion of an imputed cost for inflation adjustment (ICIA) in the price/earnings model increases the explanatory power of the model in 7 out of 10 years, and coefficients on ICIA are negative and statistically significant in eight years at the conventional level. Our findings support the first hypothesis. When the inflation adjustment to earnings is made by taking into account firm-specific capital structures, the explanatory power of the model increases in all 10 years. The information content of one unit of an imputed cost for inflation adjustment for equity capital (ICIAC) is greater than that of ICIA based on the pooled data for ten years. Year-by-year data also show consistent results. Accordingly, a capital structure effect also captures information about a portion of accounting earnings, consistent with our second hypothesis. In addition, the results are unaffected by when risk and growth are included in equation 4 (unreported).

First differences

We evaluate the robustness of our findings by replicating the estimation based on a first-differenced model. The levels study of the price/earnings relation adopted above regressed the level of market values on the level of earnings. Levels studies assume that cross-sectional differences in a firm's market value can be explained by differences in a firm's earnings (Bowen, 1981; Barth et al., 1990). However, levels tend to induce time-series dependency. Since the levels of prices are correlated over the time-series, residuals from each year's equation might be correlated.

The first-differenced form is used to test the empirical findings reported in

TABLE 3

Regressions of Market to Book Ratio on Earnings to Book and ICIA to Book with dummy variables

Equation 3: $MV/BV_t = \beta_{3,0} + \beta_{3,1} *D + \beta_{3,2} AE/ BV_t + \beta_{3,3} D*AE/BV_t + \beta_{3,4} ICIA / BV_t + \beta_{3,5} D* ICIA + \epsilon_t$

Year	$\beta_{3,0}$ (*t*-stat.)	$\beta_{3,1}$ (*t*-stat.)	$\beta_{3,2}$ (*t*-stat.)	$\beta_{3,3}$ (*t*-stat.)	$\beta_{3,4}$ (*t*-stat.)	$\beta_{3,5}$ (*t*-stat.)	Adjusted R^2	F-Ratio (No.of firms)
1991	.96 (10.93***)	-.07 (-.57)	9.13 (18.16***)	5.02 (5.76***)	-.05 (-.03)	-5.82 (-2.71***)	.351	154.15*** (1412)
1990	.91 (13.04***)	-.16 (-1.49)	6.89 (18.08***)	3.39 (5.24***)	.26 (.74)	-2.90 (-3.09***)	.340	150.96*** (1456)
1989	1.01 (10.76***)	.20 (1.45)	8.46 (16.23***)	.16 (.20)	.43 (.56)	-3.87 (-2.82***)	.258	97.43*** (1388)
1988	.92 (11.05***)	-.07 (-.62)	7.35 (17.04***)	1.08 (1.65*)	-.95 (-.87)	-5.87 (-3.25***)	.305	122.95*** (1390)
1987	1.10 (10.73***)	-.04 (-.30)	5.57 (8.66***)	3.75 (4.35***)	.92 (1.06)	-6.79 (-4.19***)	.222	79.92*** (1378)
1986	1.22 (11.88***)	-.30 (-1.95**)	7.45 (11.38***)	5.05 (5.01***)	2.30 (-2.40***)	-5.93 (-3.20***)	.274	93.67*** (1229)
1985	1.14 (11.02***)	-.02 (-.17)	6.66 (11.09***)	3.65 (4.06*)	-3.83 (-4.06***)	-6.21 (-3.42***)	.267	90.75** (1232)
1984	.92 (8.92***)	.25 (1.66*)	6.97 (12.31***)	.75 (.91)	-4.61 (-5.37***)	-6.49 (-4.04***)	.255	88.08*** (1267)
1983	.90 (6.90***)	.49 (2.54 ***)	6.63 (7.87***)	2.76 (2.34***)	-1.27 (-1.56)	-8.05 (-5.02***)	.213	64.19*** (1162)
1982	.69 (5.46***)	.38 (2.14**)	6.49 (8.45***)	3.85 (3.69***)	-1.36 (-1.63*)	-7.77 (-5.25***)	.271	82.90*** (1100)
Mean (*t*-stat.)	.97 (10.07)	.06 (.30)	7.16 (12.93)	2.94 (3.31)	-1.27 (-1.36)	-5.97 -3.70)		
Z1	31.82***	.96	40.12 ***	10.49***	-4.29***	-11.69***		
Z2	13.05***	.58	9.44 ***	5.16***	-1.92**	-12.44***		

Notes:
1. Z1 and Z2 are defined in Table 2.
2. All other variables are as defined in Table 1.
3. *** Significant at the .01 level; ** Significant at the .05 level; * Significant at the .1 leve

sections 5.1 and 5.2.[xvii] The percentage change in prices may not be correlated in time-series. If earnings are assumed to follow a random walk, the unexpected change in price is captured by the change in earnings. Similarly, the unexpected portion of the imputed cost for inflation adjustment for equity capital (ICIAC) is computed by taking the difference in the portion of depreciation that is related to equity-financed assets. Then, the difference is multiplied by an inflation adjustment factor (IAF). We restate equation 4, using the first-differenced form as follows:

$$CP_t = \beta_{5,0} + \beta_{5,1} CAE_t + \beta_{5,2} CICIAC_t + \epsilon_t \quad (5)$$

where

$CP_t = (P_t - P_{t-1})/P_{t-1}$,
$CAE_t = (AE_t - AE_{t-1})/AE_{t-1}$,
$CICIAC_t = (DEP_t * LEV - DEP_{t-1} * LEV_{t-1}) / AE_{t-1} * IAF_t$, and

all other variables as defined earlier.

Equation 5 is tested with the same data set used for the levels of prices and earnings. However, in a given year, if a firm has negative earnings at t-1 or the change in earnings (CAE)
is greater than 300%, the firm is deleted from the sample, following Barth et al. (1990).[xviii]

The empirical results from testing equation 5 are reported in Table 5. The coefficients of CAE are positive and statistically significant, and consistent with the prior findings. The estimates for CICIAC are a little mixed. A 7 year period shows positive and statistically significant coefficients of CICIAC at conventional levels, but CICIAC is not significantly different from zero in 1984, 1987 and1988. These mixed results can be explained in part in terms of the instability of measurement of CICIAC, that is, its high standard deviation (Landsman & Magliolo, 1988).[xix] Because measurement error is included in the computation of ICIAC, differencing ICIAC tends to increase the standard deviation of the coefficient on ICIAC. This explains why the first-differenced model provides weaker empirical evidence compared to the levels model. However, when all observations are pooled over the 10 years, CICIAC is negative and statistically significant at the .01 level. In general, variable CICIAC contains incremental information content beyond the change in earnings (CAE) in explaining stock price behavior.

SUMMARY AND CONCLUSION

This study investigates earnings measurement errors arising from the use of historical cost depreciation in financial statements. We find that historical cost depreciation distorts the informativeness of earnings, and that the depreciation adjustments we make are value-relevant. Our evidence suggests the assumption of a homogeneous relation between price and accounting earnings across firms reduces the explanatory power of price/earnings models.

To the extent that depreciable asset acquisition is financed with debt, interest expense changes partly offset overstated historical cost accounting earnings. But to the extent fixed that assets are internally financed, the absence of a capital use change against earnings for owner-supplied funds fails to offset the effect of understated real depreciation expense. We show that allowing for the effects of capital structure on our depreciation adjustments increases their information content. After controlling for the association of leverage with financial risk, we provide evidence that the earnings numbers of firms with lower debt

TABLE 4

Regressions of Market to Book Ratio on Earnings to Book and ICIAC to Book

Equation 4: $MV/BV_t = \beta_{4,0} + \beta_{4,1} AE/BV_t + \beta_{4,2} AE/BV_t * D + \beta_{4,3} ICIAC_t/BV_t + \epsilon_t$

Year	$\beta_{4,0}$ (t-statistic)	$\beta_{4,1}$ (t-statistic)	$\beta_{4,2}$ (t-statistic)	$\beta_{4,3}$ (t-statistic)	Adjusted R^2	F-ratio (No. of firms)
1991	.95 (14.30***)	9.46 (21.74***)	4.18 (7.66***)	-5.36 (-3.59***)	.350	254.84*** (1412)
1990	.85 (15.55***)	7.38 (22.53***)	2.31 (5.63***)	-2.50 (-2.96***)	.338	249.02*** (1456)
1989	1.12 (15.75***)	8.34 (19.30***)	.69 (1.43)	-3.06 (-2.95***)	.258	162.06*** (1388)
1988	.99 (16.01***)	7.45 (20.67***)	.95 (2.51***)	-7.06 (-5.42***)	.308	207.32*** (1390)
1987	1.12 (15.49***)	6.16 (11.98***)	2.69 (5.60***)	-5.16 (-4.14***)	.220	130.85*** (1378)
1986	1.15 (14.55***)	8.31 (15.41***)	2.75 (5.33***)	-10.39 (-7.14***)	.279	159.52*** (1229)
1985	1.18 (15.33***)	6.79 (13.80***)	3.16 (6.65***)	-12.23 (-8.41***)	.274	156.19*** (1232)
1984	1.09 (14.41***)	6.44 (14.15***)	1.65 (4.04***)	-12.78 (-10.60***)	.265	153.73*** (1267)
1983	1.31 (13.24***)	5.82 (8.95***)	4.07 (7.50***)	-11.05 (-8.61***)	.231	117.81*** (1167)
1982	.98 (10.80***)	6.43 (10.98***)	4.13 (8.32***)	-9.51 (-8.18***)	.278	142.02*** (1100)
Mean[1]	1.07	7.25	2.65	-7.91		
Mean(t-stat.)	(14.54)	(15.95)	(5.47)	(-6.2)		
Z1	45.95***	50.41***	17.28***	-19.59***		
Z2	27.95***	9.96***	7.28***	-6.79***		

Notes:
1. Z1 and Z2 are defined in Table 2.
2. All other variables are as defined in Table 1.
3. *** Significant at the .01 level; ** Significant at the .05 level; * Significant at the .1 level.

TABLE 5

Regressions of Change in Stock Price on Change in Earnings (CAE) and Change in an Imputed Cost for Inflation Adjustment of Equity Capital (CICIAC)

Equation 5: $CP_t = \beta_{5,0} + \beta_{5,1} CAE_t + \beta_{5,2} CICIAC_t + \epsilon_t$

Year	$\beta_{5,0}$ (*t*-statistic)	$\beta_{5,1}$ (*t*-statistic)	$\beta_{5,2}$ (*t*-statistic)	R^2 (No. of firms)
1991	.27 (18.53***)	.34 (13.72***)	-.43 (-2.30**)	.141 (1129)
1990	-.06 (-5.61***)	.26 (13.77***)	-.37 (-1.76*)	.139 (1160)
1989	.18 (15.50***)	.22 (10.51***)	-.36 (-2.23**)	.087 (1134)
1988	.09 (7.99***)	.19 (10.32***)	-.39 (-1.36)	.087 (1108)
1987	-.01 (-1.42)	.27 (14.52***)	-.08 (-.45)	.170 (1033)
1986	.20 (15.85***)	.23 (10.71***)	-.13 (-5.40***)	.121 (945)
1985	.27 (21.70***)	.43 (16.95***)	-.66 (-2.30**)	.220 (1010)
1984	.00 (.53)	.13 (7.68***)	-.04 (-.37)	.053 (1005)
1983	.31 (14.32***)	.25 (7.33***)	-.37 (-2.09**)	.055 (890)
1982	.22 (13.52***)	.39 (13.67***)	-.40 (-2.21**)	.156 (958)
1982-1991	.13 (31.61***)	.24 (33.06***)	-.14 (-5.50***)	.095 (10372)

Notes:
$CP_t = (P_t - P_{t-1}) / P_{t-1}$,
$CAE_t = (AE_t - AE_{t-1}) / AE_{t-1}$,
$CICIAC_t = (DEP_t * LEV - DEP_{t-1} * LEV_{t-1}) / AE_{t-1} * IAF_t$, and
All other variables as defined in Table 1.

levels are more distorted because of the inability of GAAP procedures to adjust for inflation effects.

The robustness of our findings is evaluated using a first-differenced form, since residuals of the levels model might be serially correlated. Although the first-differenced form does not yield results as strong as the levels model, they are consistent with our general findings. The findings are also robust to different specifications of the valuation model that allow earnings multiples to vary depending upon levels of risk and growth opportunities.

There are some limitations to these tests. First, this paper focuses on the portion of accounting earnings that is overstated by the amount of understated real depreciation. However, there are other accounts that are substantially influenced by changes in general price levels, an example of which is inventory profits.[xx] Also, as earnings of firms in the merchandise industry appear to be materially affected by revenues generated from their inventories that reflect inflated prices in a relatively timely manner, understated real depreciation is not a serious problem in computing earnings. Thus, future research might assess whether earnings measurement errors can be reduced by simultaneously incorporating fixed asset and inventory adjustments.

Second, the estimation of constant dollar restated depreciation is based on the assumption that all firms depreciate their fixed assets using the straight-line method. The constant dollar restated depreciation estimate deviates from true economic depreciation to the extent that firms use different depreciation methods. Future research could generate more accurate adjustments using, for example, the composite age method in estimating constant dollar restated depreciation. Nonetheless, our findings show that market participants price securities as if they adjust overstated accounting earnings for understated depreciation; the adjustments we provide enhance the specification of price/earnings models.

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