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A Comparison of Financial-Statement-Analysis-Based and Price-Based Earnings Forecasts*

*Susan M. Machuga, University of Massachusetts Boston**
Ray J. Pfeiffer, Jr., University of Massachusetts Amherst

ABSTRACT

This paper evaluates the relative performance of financial-statement-analysis-based, price-based, and financial analysts' earnings predictions along two dimensions: prediction accuracy and association of forecast errors with contemporaneous abnormal security returns. Two primary elements of this paper are (1) a formal framework to empirically evaluate the relative performance of these three forecast sources, and (2) modifications to the purely price-based model used in prior research to improve the model's accuracy in contexts where earnings contain transitory components. We find that price-based forecasts are more accurate than financial-statement-analysis-based forecasts. Financial analysts' forecasts are the most accurate. However, for firm-years with negative prior performance, the price-based model yields predictions that are as accurate as analysts' forecasts.

INTRODUCTION

Earnings expectations are generally measured based on one or more of the following sources: time-series models, financial-statement-analysis-based forecasts, financial analysts' forecasts (individual or "consensus"), and price-based forecasts. Previous research comparing these sources has shown that price-based and analysts' forecasts predict earnings more accurately than time-series forecasts and are better measures of the market's expectation of earnings.[1] Comparisons of analysts' forecasts and price-based forecasts indicate that both are complementary in predicting earnings and as measures of the market's expectation of earnings (Elgers and Murray 1992; Liu, et al. 1995).

However, the relative performance of price-based and financial-statement-analysis-based forecasts has not yet been examined. Ou and Penman (1989a, pp. 112-113) argue that price-based forecasts, based solely on stock returns, are poor predictors of future earnings relative to financial statement information because price-based models do not capture the mean-reversion in earnings time-series caused by transitory earnings. Their reasoning is that transitory components of earnings changes do not persist (by definition) in subsequent periods. This induces a negative serial correlation in earnings changes. However, if the transitory components of earnings changes in the prior year are value-relevant, they will be positively related to prior-year returns. Consequently, for firms whose earnings changes include large transitory components, the relation between prior-year returns and current-year earnings changes is expected to be negative. This is contrary to the positive relation that is expected when security returns anticipate future earnings changes, the relation on which the price-based model relies.

A second reason why price-based models may under-perform financial-statement-analysis-based models is that by design, the former predict components of earnings that are price-relevant. Thus any priced-based models are likely to do a relatively poor job of predicting price-irrelevant earnings components. A third reason to expect superior performance from financial-statement-based prediction models is that Ou and Penman (1989b) find unexplained stock returns in subsequent years that appear to be related to a set of financial ratios. This evidence, together with more recent evidence in Sloan (1996) and Abarbanell and Bushee (1998) suggests that the market may not fully impound the implications of accounting numbers for future earnings.

The main purpose of this study is to provide a framework for direct comparison of financial-statement-analysis-based and price-based forecasting models. In doing so we modify the pure price-based model to incorporate mean reversion caused by transitory earnings components. For comparison purposes, we also include analysts' forecasts in our tests as a benchmark.

Following previous research, we assess relative performance based on two dimensions: accuracy of earnings forecasts, and association of "unexpected earnings" with abnormal security returns. The importance of each dimension of performance depends upon the intended use of the forecast. We evaluate forecasts on both dimensions because a given forecast source may be relatively accurate, and yet the forecasted earnings may not be entirely relevant for security prices. Finally, we also assess the complementarity of alternative forecast sources, despite the apparent dominance of one source over another.

Our results indicate that the price-based forecasts are more accurate than the financial-statement-analysis-based forecasts. Analysts' forecasts, our benchmark, are the most accurate. In addition, across all contexts the price-based and analysts' forecast predictions are complementary in predicting earnings changes, consistent with Elgers and Murray (1992) and Liu, et al. (1995). Regarding the association of unexpected earnings and security returns, we find that estimated earnings response coefficients are highest when using analysts' forecasts to measure earnings expectations, followed by price-based forecasts and then financial-statement-analysis-based forecasts. This finding is robust across prior performance contexts. However, the three forecast sources complement each other as proxies for market expectations of earnings, suggesting that there is unique information in each forecast source that is relevant to security value.

This paper provides a formal evaluation of conjectures made in prior research about the relative performance of financial-statement-analysis-based and price-based forecasts and shows that a relatively simple linear model using only past earnings and returns generates predictions that are more accurate and more highly associated with security returns than a financial-statement-analysis-based model that is based on a much wider set of financial accounting variables.

DATA DESCRIPTION

The period used for estimating and testing forecast models spans the years 1979-1992. *Pr* is estimated as in Ou (1990) using a seven-year period ending in 1985. The remaining years, 1986-1992 are used to analyze relative performance of candidate forecasts. Throughout the analysis, we use size-adjusted returns as our return metric: $SAR_{it} = R_{it} - \overline{R}_{Dt}$, where R_{it} is the cumulative monthly return for firm i for the 12 months ended March 31 of year t+1, and $\overline{R}_{Dt}$ is the mean return for all firms in the same decile (measured as of April 1 of year t) as firm i for the same cumulation period. Earnings per share is defined as earnings before extraordinary items and discontinued operations (Compustat mnemonic EPSPX), consistent with most prior research.[2] Because we use parametric tests throughout the analysis that assume linearity, we exclude observations from the sample period where price-scaled, random walk prediction errors (with or without drift adjustment) exceed 1.0 in absolute value or where current-year or prior-year price per share is greater than $200 or where current- or prior-year earnings yield or price-scaled drift exceed 1.0 in absolute value.

The analysis period sample size is 2,163 firm years (310 firms per year on average). The primary restrictions on the sample are the data requirements of the financial ratios for the financial-statement-analysis-based forecast, the requirement of separate estimation and analysis periods, and the availability of analysts' forecasts.

SELECTION AND DESCRIPTION OF ALTERNATIVE FORECAST SOURCES

We consider the following three forecast sources in the ensuing analysis: financial-statement-analysis-based forecast, price-based forecast, and financial analyst's forecast. Because prior research has documented the superiority of each of these forecasts over a time-series (e.g. random walk or random walk with drift) forecast, we do not consider time-series forecasts here. An explicit description of each forecast source follows.

Financial-Statement-Analysis-Based Forecast

A body of work by Ou and Penman (Ou and Penman 1989a,b; Ou 1990; Penman 1992) presents evidence that sets of financial statement ratios can be collapsed into a single measure, called *Pr*, that can be used to predict the direction of one-year-ahead earnings changes. *Pr* is a logistic-regression-based estimated probability of an earnings increase in the subsequent period based on the historical relation between accounting variables and drift-adjusted earnings changes. *Pr* lies between zero and one and is interpretable as the probability of an increase in earnings above a historical average drift in the subsequent year. *Pr*s greater than 0.5 are considered predictions of increases in subsequent period earnings. Ou (1990), using a parsimonious set of these variables shows predictive accuracy that matches that using the larger set of variables used in Ou and Penman (1989a,b). Consequently, because of the severe data requirements imposed by the larger model, we elect to use Ou's model. Estimation of *Pr* is performed over the seven-year estimation period 1979-1985. We exclude firms with non-December 31 fiscal year-ends to maintain consistency with the approach taken by Ou. In the estimation period, observations with extreme values of the eight accounting variables are excluded from the sample.[3] The results of our estimation and Ou's (1990) appear in Panel A of Table 1. The coefficient magnitudes and their statistical significance are similar across data sets, indicating that we are able to reasonably replicate Ou's (1990) model's results in our sample.

To assess the relative performance of the candidate models, we require (price-scaled) earnings forecasts for each firm-year. However, the *Pr* forecast is a prediction of the direction of the subsequent-year earnings change. For comparability, we can either construct a forecast of the magnitude of the earnings change from the *Pr* estimate, or we can evaluate all models based on their ability to predict the direction of earnings changes. Magnitude forecasts are preferable on the grounds that magnitudes convey more information than directions; also, most previous research regarding earnings forecasting focuses on magnitudes. Thus, we elect the former strategy.

To obtain a magnitude *Pr* forecast, we regress drift-adjusted earnings changes on *Pr* in the year immediately preceding the analysis year using the following equation:

$$\frac{\Delta E_t - D_t}{P_{t-1}} = \beta_0 + \beta_1 Pr_{t-1} + u_t$$

where ΔE_t is the change in earnings per share from period $t-1$ to t, D_t is the average earnings change over the four years prior to year t (the "drift"), and Pr_{t-1} is the *Pr* estimate constructed from financial statements for the year ended t-1. The estimated intercept and slope coefficient from equation (1) are used to forecast the magnitude of the drift-adjusted earnings change for year t+1 (the financial-statement-analysis-based forecast). Specifically, predicted earnings for period t+1 using the financial-statement-analysis-based forecast is determined by the following equation:

$$E[E_{t+1}] = (\hat{\beta}_0 + \hat{\beta}_1 Pr_t) P_t + E_t + D_t$$

Table 1

Development of *Pr*-Based Earnings Predictions

Model:[a] $Pr\{\Delta X_{it+1} > 0 \mid A_{it}, \theta\} = (1 + e^{-A_{it}\theta})^{-1}$

$n = 2{,}163$

Panel A: Estimation of logistic regression model

Accounting variable[b]	Replication 1979-1985		Ou (1990, 150) 1965-1977	
	θ	χ^2	θ	χ^2
Intercept	0.47	107.07*	1.07	265.78*
GWINVN	–0.46	12.93*	–0.58	15.58*
GWSALE	0.22	1.27	0.33	1.68
CHGDPS	–2.16	54.03*	–1.77	47.16*
GWDEP	0.15	1.21	–0.10	0.75
GWCPX1	–0.20	27.58*	–0.11	9.81*
GWCPX2	–0.23	36.06*	–0.12	11.40*
ROR	–3.90	170.17*	–5.09	134.32*
DROR	0.57	5.76**	1.69	9.66*

Panel B: Directional prediction accuracy for one-year-ahead earnings changes

	Pr (replication)	Ou (1990, 152)	FSAF
percentage correct	61.0%	60.9%	63.0%

Notes:

[a] *Pr* is the estimated probability that firm *i* will have an increase in drift-adjusted earnings per share in period $t + 1$, given A_{it} and θ. A_{it} is a vector of accounting variables (A_{it} = {GWINVN, GWSALE, CHGDPS, GWDEP, GWCPX1, GWCPX2, ROR, DROR}). θ is a vector of maximum likelihood estimates of coefficients of the accounting variables. θ is estimated using data for all firm years during the period 1979-1985.

[b] See exhibit 1 and Ou (1990, 147-48) for descriptions of these variables.

[c] The *Pr* forecast is based on the value of *Pr*: $Pr > 0.5$ (≤ 0.5) implies a forecasted increase (decrease) in drift-adjusted earnings. The magnitude-based *Pr* forecast (FSAF) is based on the estimated cross-sectional linear relation between *Pr* and earnings changes in the year prior to the analysis year: $(\Delta E_t - D_t) / P_{t-1} = \beta_0 + \beta_1 Pr_{t-1} + u_t$, and thus FSAF =

$E[E_{t+1}] = (\hat{\beta}_0 + \hat{\beta}_1 Pr_t) P_t + E_t + D_t$, where E_t is earnings per share for year *t*, D_t is the drift adjustment to earnings, and P_t is price per share at the beginning of the earnings year. FSAF > 0 (≤ 0) implies a forecasted increase (decrease).

* Significant at probability below 0.01 (0.05).

Prior to comparing the financial-statement-analysis-based forecast to the other forecast sources, we assess the directional prediction accuracy of *Pr*, where *Pr*s greater than (less than or equal to) 0.5 are classified as predicted increases (decreases) and where positive (negative) magnitude predictions are classified as predicted increases (decreases) to enable comparisons to Ou and Penman (1989b) and Ou (1990). The results of this test are presented in Table 1 Panel B, which shows that the directional *Pr* model accurately predicts the direction of 61% of year-ahead earnings changes. This replicates the accuracy reported by Ou (1990) (p. 152, Table 2, Panel A; reported accuracy 60.9%). Panel B also shows that the comparable directional prediction accuracy for the financial-statement-analysis-based forecast (the magnitude version of *Pr*) is 63%. The *Pr* and FSAF forecasts appear to be very similar; in fact, for 85.3% of the sample cases, the two metrics produce identical predictions. For the 14.7% of the cases where the two metrics disagree, the financial-statement-analysis-based forecast is correct for 55.5% of those cases. These results alleviate the concern that converting *Pr* to a magnitude is detrimental to its accuracy as an earnings predictor.[4,5]

Price-Based Forecast

Security returns have been shown to be associated with subsequent earnings changes (e.g. Beaver, Lambert and Morse 1980; Beaver, Lambert and Ryan 1987; Collins, Kothari and Rayburn 1987, and Liu, et al. 1995). This relation is expected because some events that change the market's expectation of future cash flows – and consequently security prices in the current period – are not reflected in accounting earnings until later periods because Generally Accepted Accounting Principles only permit the recognition of transactions and events that are reliable and verifiable. In making use of this fact, we estimate earnings change predictions implicit in security returns using the following model:

$$\frac{\Delta E_t}{P_{t-1}} = \alpha_0 + \alpha_1 D^N + \alpha_2 SAR_{t-1} + \alpha_3 D^N SAR_{t-1} + \alpha_4 \frac{E_{t-1}}{P_{t-1}} + \alpha_5 D^N \frac{E_{t-1}}{P_{t-1}} + \mu_t$$

where ΔE_t is the (beginning-of-year-price-scaled) change in earnings per share from period t-1 to t, D^N indicates firms that had negative ($D^N = 1$) or positive ($D^N = 0$) size-adjusted returns in year t-1, SAR_{t-1} is prior-year security returns and E_{t-1}/P_{t-1} is earnings yield for year t-1.

This model differs from that developed in Collins, Kothari and Rayburn (1987) in order to address two issues. First, the price-based models widely used in prior research, which regress earnings change only on prior-year return, predict that any price-relevant component of earnings will persist. For value-relevant but transitory components, this will induce error in earnings predictions, since such components by definition will not repeat. Second, since there is no expected association between value-irrelevant transitory components of earnings and returns, a price-based model is inherently ill equipped to predict value-irrelevant components of earnings changes. Both of these shortcomings limit the ability of the price-based model to make accurate predictions of earnings. Rather than abandon the price-based model, however, we attempt to modify it to overcome these defects.[6]

Table 2 illustrates these problems empirically and foreshadows the implications for the accuracy of a price-based forecast. Panel A of Table 2 shows the relation between returns and future earnings changes under two portfolio grouping schemes. We first partition the data into five groups based on the prior-year price-scaled earnings change (ΔE_{t-1}) to illustrate the relations among the variables of interest especially for the most transitory earnings (those in the highest and lowest earnings change groups). The second and third columns show the negative relation between successive earnings changes especially in groups one and five, where transitory components are more likely to be located. The second and fourth columns show the positive contemporaneous relation between earnings changes and size-adjusted returns in period *t-1*, suggesting that even transitory earnings changes are somewhat value relevant. A comparison of the second and fifth column shows the inverse relation between Pr_{t-1} and contemporaneous earnings changes; whereas, a comparison of the third and fifth columns shows the positive relation between *Pr* and future earnings changes. When earnings changes are extremely negative *Pr* is largest, suggesting a high probability of positive earnings changes next period. The third and fourth columns illustrate the paradox noted by Ou and Penman (1989a); there is an inverse relation between SAR_{t-1} and ΔE_t. Given the price-based model posits a positive relation between current returns and subsequent-year earnings changes, this suggests that the price-based model is not likely to perform well. However, a *Pr* model may perform well because of its positive relation to ΔE_t.

We next partition the data based on prior-year return performance. We examine this alternative partitioning scheme because the price-based model posits an information flow from security prices into future earnings. With this partitioning scheme, we are able to detect a positive relation between SAR_{t-1} and ΔE_t and a negative relation between *Pr* and ΔE_t. That is, the $Pr > 0.5$ ($Pr < 0.5$) in group 1 (groups 2 to 5) indicates a positive (negative) predicted earnings change; however, actual earnings changes are negative (positive). In this framework it is *Pr* rather than prior-year return that appears to yield incorrect predictions.

Equation (3) includes two features designed to overcome the difficulties induced by transitory earnings changes. First, we add period *t*-1 earnings yield to the model to increase the model's ability to capture mean reversion of extreme earnings changes. Prior research documents a strong negative association between both successive years' earnings changes and between earnings yield and subsequent earnings changes, especially for extreme earnings (Elgers and Lo 1994; Ali, Klein and Rosenfeld 1992; Liu, et al. 1995).

TABLE 2
Development of the Price-Based Model

Panel A: Relations among prior and current earnings, returns, and *Pr* values (n = 2,163)

	Quintiles of prior earnings changes[a]				Quintiles of prior returns[b]			
Quintile	ΔE_{t-1}	ΔE_t	SAR_{t-1}	Pr_{t-1}	ΔE_{t-1}	ΔE_t	SAR_{t-1}	Pr_{t-1}
1	–0.108	0.039	–0.119	0.591	–0.035	–0.029	–0.348	0.527
2	–0.014	–0.013	–0.078	0.468	–0.006	0.001	–0.137	0.470
3	0.006	–0.004	0.032	0.413	0.007	0.000	–0.013	0.454
4	0.018	–0.006	0.081	0.411	0.016	0.008	0.122	0.443
5	0.103	–0.014	0.121	0.460	0.025	0.021	0.415	0.450

Panel B: Estimation of the price-based model (n = 4,146)[c]

Model: $$\frac{\Delta E_t}{P_{t-1}} = \alpha_0 + \alpha_1 D^N + \alpha_2 SAR_{t-1} + \alpha_3 D^N SAR_{t-1} + \alpha_4 \frac{E_{t-1}}{P_{t-1}} + \alpha_5 D^N \frac{E_{t-1}}{P_{t-1}} + \mu_t$$

	α_0	α_1	α_2	α_3	α_4	α_5	$\bar{R}^2$
parameter[d]	0.026	0.018	0.044	0.134	–0.483	–0.030	0.276
t statistic[e]	3.31*	2.42*	3.74*	5.06*	–8.62*	–0.47	

Pr_{t-1} is the estimated probability of an earnings increase in period t, E_t is price-scaled earnings per share before extraordinary items and discontinued operations in year t, P_t is share price at the end of year t, SAR_t is the size-adjusted stock return for the twelve months ended March 31, t + 1, and D^N is equal to 1 if SAR_{t-1} is negative and is equal to zero otherwise.

a The five quintiles are formed based on the signed magnitude of ΔE_{t-1}.

b The five quintiles are formed based on the signed magnitude of SAR_{t-1}.

c Estimation is performed annually for the years 1987-1992.

d Reported coefficients are the means of annual coefficient estimates from 1987-1992.

e *t* statistics are computed as the ratio of the means and standard errors of the six annual coefficients estimated for the years 1987-1992.

* Test statistic is significantly different from zero at a probability less than 0.05 (two-tailed test).

Adding a variable that captures the transitory portion of period t-1 earnings reduces the downward bias on the coefficient on SAR_{t-1} caused by the negative correlation between SAR_{t-1} and current-year earnings changes. Adding this variable also addresses the second shortcoming mentioned above by enabling the model to predict both value-relevant and value-irrelevant components of the current-year earnings change.

Also, following the results of Elgers and Lo (1994) who show that the returns/earnings relation is substantively different for firms with positive and negative prior-year returns, we allow intercept and slope shifts (on both R_{t-1} and on period t-1 earnings yield) for firms with poor stock price performance in period t-1. Elgers and Lo (1994) report that earnings response coefficients are lower for firms with poor prior-year return performance suggesting that security prices anticipate earnings innovations for firms with negative return performance.[7] The average of all prior-years' cross-sectional regression coefficients from equation (3) is used to generate price-scaled forecasts of earnings changes in period t. Table 2, Panel B summarizes the results of annual cross-sectional estimation of equation (3).

The estimates α_2 and α_3 confirm that negative and positive prior returns have different implications for current earnings changes. The observed positive coefficient sign of α_3 confirms that security prices anticipate earnings innovations for firms with negative returns performance more so than for firms with positive returns performance. The estimated coefficient on prior-period earnings yield (α_4) suggests that it strongly captures mean reversion in earnings changes. However, there does not appear to be any difference in the role of earnings yield across return partitions (t = −0.47). Accordingly, we exclude this term from the model when using the model to forecast earnings changes.[8] Our remaining tests compare the predictions from this price-based model, the financial-statement-analysis-based model, and analysts' forecasts.

Financial Analysts' Forecasts

Prior research has used a variety of measures of analysts' expectations of earnings, including "consensus" measures and expectations of individual analysts. "Consensus" forecasts have been shown to have a number of shortcomings, in particular the fact that individual forecasts included in consensus measures are often quite old (Lys and Sohn 1990). Brown and Kim (1991) suggest that unexpected earnings conditioned on the most recent forecast has the highest association with abnormal returns. For annual association tests, we selected the last forecast of year t earnings made prior to March 31 of year t, since we use an April 1, t through March 31, t+1 return cumulation period. We obtain such forecasts from the I/B/E/S detail history database.

EMPIRICAL ANALYSIS AND RESULTS

Comparisons of Forecast Accuracy: Predicting Direction of One-Year-Ahead Earnings

Panel A of Table 3 compares the accuracy of directional earnings change predictions from the financial-statement- analysis-based and price-based forecasts. As mentioned above, in all comparisons we also include analysts' forecasts as a benchmark. In general, directional forecasts are not as useful as magnitude forecasts. However, we perform this analysis for two reasons. First, it allows the financial-statement-analysis-based forecast to be compared on its own terms (*Pr* as designed is a directional forecast). Second, it permits comparisons of forecasts that are not influenced by the possible presence of disproportional errors.

The pooled results suggest that in general, analysts' and price-based forecasts are both more accurate than the financial-statement-analysis-based forecasts. We expect, however, that analysts' forecasts will be less accurate for firms with poor prior-year performance, especially relative to the price-based and the financial-statement-analysis-based forecasts. The evidence supports this conjecture. For firms with poor prior-year performance, the price-based model and the financial-statement-analysis-based forecasts both outperform analysts (69% and 68%, respectively compared to 65%), while for firms with good prior-year performance, the analysts' forecasts dominate (68% versus 65% and 60%, respectively).

The financial-statement-analysis-based forecast is markedly less successful for firms with good prior-year performance, suggesting that the overall success of this forecast source may be largely attributable to more accurate predictions for poor prior-year performance firms. This supports Ou and Penman's (1989a) conjecture that financial-statement-analysis-based forecasts work better for transitory earnings changes (negative prior-earnings performance) than for permanent earnings changes.

Panel B of Table 3 tests the accuracy of predictions of the magnitude of earnings rather than the direction of earnings changes. Selecting a single metric to evaluate relative accuracy requires an assumed loss function. Because research has not yet identified a single appropriate loss function for earnings predictions, we compare accuracy using a variety of error metrics popularized in prior studies: bias, mean squared forecast error (MSE), and mean absolute forecast error (MAE).

For the full sample, relative MSE and MAE support the inference that the price-based forecast outperforms the financial-statement-analysis-based forecast.[9] This result is consistent with Panel A and also with the inference that the price-based model used in this analysis overcomes the shortcomings of the traditional price-based model sufficiently to generate more accurate predictions than the financial-statement-analysis-based forecast.

TABLE 3

Comparisons of Earnings Prediction Accuracy

$n = 2,163$

Panel A: Directional predictions of earnings changes[d]

	FSAF	PBF	AF
All firms	63%	67%	67%
Positive prior earnings performance ($n = 1,270$)[a]	60%	65%	68%
Negative prior earnings performance ($n = 893$)[a]	68%	69%	65%

Panel B: Magnitude predictions of earnings changes

					Significance of differences[c]		
	Error Metric[b]	FSAF	PBF	AF	FSAF v. PBF	FSAF v. AF	PBF v. AF
All firms	Bias	–0.006	–0.013	–0.027	3.73*	9.05*	8.44*
	MSE × 100	1.53	0.97	0.79	6.48*	6.21*	1.90
	MAE × 100	6.75	5.00	3.73	12.90*	16.28*	8.52*
Positive[a]	Bias	–0.001	–0.011	–0.037	3.05*	7.78*	7.91*
	MSE × 100	2.27	1.40	1.02	5.58*	5.35*	2.31*
	MAE × 100	8.55	6.66	4.84	7.79*	10.16*	6.35*
Negative[a]	Bias	–0.010	–0.014	–0.020	2.19*	4.75*	3.54*
	MSE × 100	1.02	0.67	0.62	3.51*	3.24*	0.38
	MAE × 100	5.49	3.83	2.96	10.59*	13.89*	5.75*

Notes: FSAF =financial-statement-analysis-based forecast, PBF = price-based forecast, and AF = analysts' forecast.

a Firm-years are classified based on the sign of price-scaled changes in earnings before extraordinary items and discontinued operations for year t - 1.

b Bias is the difference between mean actual and mean forecasted price-scaled earnings per share. MSE is the mean squared difference between actual and forecast price-scaled earnings per share for all firm years 1987-1992. MAE is the median absolute difference between actual and forecast price-scaled earnings per share for all firm years 1987-1992.

c Reported amounts are t-values based on matched-pairs t tests.

* Test statistic is significantly different from zero at probability less than 0.05 (two-tailed tests).

The analysts' forecasts are most accurate based on MSE and MAE, although the difference in MSE between the analysts' and price-based forecasts is not statistically significant, suggesting that the price-based model is very competitive with analysts' forecasts. This is an impressive result in that analysts have access to a broad information set, including the past earnings, returns and prices that are used to generate price-based forecasts. However, the finding is consistent with evidence in prior research that on average analysts imperfectly incorporate the information in past earnings and prices (Abarbanell 1991; Ali, Klein and Rosenfeld 1992), especially for poor performing firms (Elgers and Lo 1994). Alternatively, the price-based model may be capturing components of earnings that analysts do not have incentives to forecast. Evidence regarding this conjecture is presented in the association tests that follow.

Looking at subsamples of the data based on prior-year earnings performance reveals that the price-based forecast outperforms the financial-statement-analysis-based forecast in both partitions of the data. Even in the poor performance partition of the sample where transitory earnings are more prevalent, the price-based forecast still appears to generate more accurate predictions. In addition, all three forecast sources produce smaller errors for firms with poor prior performance. Since the financial-statement-analysis-based and price-based forecasts are expected to predict transitory earnings changes well (because of predictable reversals of poor performance), this result is sensible.[10]

Association of Forecast Errors from Competing Models with Abnormal Returns

Because not all components of earnings are relevant to security market investors for valuation purposes, accurate forecasts of realized earnings are not necessarily accurate forecasts of value-relevant earnings. In an efficient market abnormal security returns will be associated only with the value-relevant portions of forecast errors. As a result, success based on an accuracy criterion does not necessarily imply success based on a market-association criterion. Accordingly, we turn next to an evaluation of the relative degree of association of security returns with forecast errors defined using each of the candidate forecast sources. Relative performance from this perspective is based on the relative magnitude of earnings response coefficients estimated using each forecast source.

Table 4 shows the results of this test, and reports the means of the estimated earnings response coefficients from the empirical (bootstrapped) distributions using each of the three forecast sources as the definition of "expected" earnings. The relative magnitude of the coefficients reveals that the price-based forecasts always yield larger earnings response coefficients than the financial-statement-analysis-based forecasts. Within the prior-performance subsamples, the earnings response coefficients are higher for good performing firms than poor performing firms, which is as expected since positive prior earnings are more persistent than negative prior earnings. The differences among the earnings response coefficient estimates are greater for the poor performing firms, reflecting the ability of the price based model to incorporate mean reversion of negative prior earnings.[11]

TABLE 4

Comparisons of Earnings Forecasts As Proxies For Security Market Earnings Expectations

$n = 2{,}163$

Model: $SAR_t = \beta_0 + \beta_1 UE_{mt} + e_t$

		Estimates of β_1			**Significance of differences[c]**		
		FSAF	PBF	AF	FSAF v. PBF	FSAF v. AF	PBF v. AF
All firms	coefficient[b]	0.583*	0.870*	1.110*	121.91*	203.72*	86.98*
Positive[a]	coefficient	0.731*	1.015*	1.107*	77.98*	100.89*	22.44*
Negative[a]	coefficient	0.486*	0.763*	1.131*	86.91*	182.98*	95.77*

Notes

SAR_t is size-adjusted return for the twelve months ended March 31, $t + 1$; UE_{mt} is the difference between actual and forecasted year t earnings using forecast source m, when m = (financial-statement-analysis-based forecast (FSAF), price-based forecast (PBF), or analysts' forecast (AF)).

a Firm-years are classified based on the sign of the change in earnings before extraordinary items and discontinued operations in period $t - 1$.

b Coefficients are the means of the empirical distribution of coefficient estimates obtained using bootstrapping.

c Reported numbers are t statistics obtained using a matched-pairs t test of the differences between 1,000 bootstrapped estimates of the parameters.

* A 95% confidence interval around the mean coefficient does not include zero.

Overall, the foregoing results suggest that the price-based forecast outperforms the financial-statement-analysis-based forecast. This contrasts with the discussion in the introductory section of the paper, which foreshadows the relative advantages of the financial analysis-based forecast. The apparently surprising results can be attributed to at least two factors: First, conjectures about price-based forecasts were conditional on a version of the price-based model that failed to capture transitory and value-irrelevant components of earnings. Our version of the price-based model overcomes these shortcomings and thus improves the price-based model's relative performance. Second, although there are potential benefits to financial-statement-analysis-based forecast sources because they draw on a large set of information variables, collapsing such information into a single metric such as *Pr* perhaps loses information and thus reduces the relative benefits.

Complementarity of Competing Forecast Sources in Predicting Earnings and as Market Expectations Proxies

The previous sections provide evidence of differential predictive accuracy of the three forecast sources. Differences in accuracy are driven by differences in the types of information incorporated in each forecast, as well as the manner in which the information is transformed into an earnings prediction. Given that the three sources draw on different information and use that information in different ways, it is possible that each source may be complementary to the other sources. Accordingly, Panel A of Table 5 contains the coefficient estimates and *t* statistics from the regression of earnings changes on the predicted earnings change of each forecast source. The results of the pooled analysis ("all firms") shows that the price-based forecast complements analysts' forecasts in explaining cross-sectional variation in actual earnings changes. This suggests that each of these two sources contains unique information for predicting future earnings changes. The financial-statement-analysis-based forecast, however, does not appear to have any incremental information for predicting earnings after considering the price-based and analysts' forecasts. This conclusion is robust across performance contexts.

Complementarity of forecast sources in predicting earnings suggests (but does not imply) complementarity in explaining cross-sectional variation in abnormal returns. To test this possibility, we regress size-adjusted returns on the forecast errors from all three competing forecast sources. The results in Panel B of Table 5 for the full sample indicate that all three forecast sources are complementary as measures of the market's expectation of earnings. It appears that analysts fail to fully exploit the information in past security prices and earnings when predicting firms' earnings, consistent with prior research. Moreover, analysts' also appear to overlook some portion of value-relevant information in the financial statement ratios that comprise the *Pr* measure.

TABLE 5

Evaluation of the Complementarity of Alternative Forecast Sources

$n = 2{,}163$

Panel A: Complementarity in association with actual earnings changes

Model: $\Delta E_t = \beta_0 + \beta_1 E[\Delta E_{FSAF,t}] + \beta_2 E[\Delta E_{PBF,t}] + \beta_3 E[\Delta E_{AF,t}] + \varepsilon_t$

		β_0	β_1	β_2	β_3	$\bar{R}^2$
All firms	Coefficient[a]	–0.012	–0.002	0.495	0.435	0.328
	t statistic[a]	–6.45*	–0.06	10.03*	14.07*	
Positive[b]	Coefficient	–0.007	0.007	0.407	0.133	0.063
	t statistic	–3.88*	0.21	6.47*	2.83*	
Negative[b]	Coefficient	–0.021	0.048	0.464	0.542	0.446
	t statistic	–5.62*	0.75	5.96*	11.25*	

Panel B: Complementarity in association with security returns

Model: $SAR_t = \alpha_0 + \alpha_1 UE_{FSAF,t} + \alpha_2 UE_{PBF,t} + \alpha_3 UE_{AF,t} + u_t$

		α_0	α_1	α_2	α_3
All firms	Coefficient[c]	0.0113*	0.0729*	0.3524*	0.7893*
Positive	Coefficient	0.0041*	0.1391*	0.4392*	0.6471*
Negative	Coefficient	0.0227*	0.0465*	0.3000*	0.8751*

Notes

ΔE_t is price-scaled change in earnings per share before extraordinary items and discontinued operations, $E[\Delta E_{FSAF}]$, $E[\Delta E_{PBF}]$, and $E[\Delta E_{AF}]$ are predictions of ΔE_t based on the financial-statement-analysis-based forecast (FSAF), price-based forecast (PBF), and analysts' forecast (AF), respectively. SAR_t is size-adjusted stock return for the twelve months ended March 31, $t + 1$; UE_{FSAF}, UE_{PBF}, and UE_{AF} are unexpected earnings computed using forecasts from the FSAF, PBF, and AF models, respectively.

[a] Coefficient estimates are the means of annual coefficients from cross-sectional regressions in 1987-1992. *t* statistics are based on the means and standard errors of the six sets of annual coefficient estimates.

[b] Firm-years are classified based on the sign of the change in earnings before extraordinary items and discontinued operations in period $t - 1$.

[c] Coefficients are the means of the empirical distribution of coefficient estimates obtained using bootstrapping.

* Test statistic is significantly different from zero at a probability below 0.01 (two-tailed test). For the bootstrapped coefficient estimates, * indicates that a 95% confidence interval around the mean coefficient does not include zero.

SUMMARY AND CONCLUSIONS

This paper evaluates the relative performance of financial-statement-analysis-based, price-based, and financial analysts' earnings predictions along two dimensions: prediction accuracy and association of forecast errors from each source with contemporaneous abnormal security returns. Two primary elements of this paper are (1) a formal framework to empirically evaluate the relative performance of these two forecast sources, and (2) modifications to the purely price-based model used in prior research to improve the model's accuracy in contexts where earnings contain transitory components.

In the full sample, we find that price-based forecasts are more accurate than the financial-statement-analysis-based forecasts, and financial analysts' forecasts, our benchmark, are the most accurate. In addition, across all contexts the price-based and analysts' forecast predictions are complementary in predicting earnings changes. For firm-years in our sample with negative prior performance, the price-based model yields predictions that are as accurate as analysts' forecasts.

Regarding the association of unexpected earnings and security returns, we find that estimated earnings response coefficients are highest when using analysts' forecasts as expectations, followed by price-based forecasts and then financial-statement-analysis-based forecasts. This finding is robust across prior performance contexts. However, the three forecast sources complement each other as proxies for market expectations of earnings, suggesting that there is some unique information in each forecast source that is relevant to security value.

This paper advances the literature as follows. We provide empirical evidence about the relative ability of financial-statement-analysis-based forecasts, such as *Prs*, and price-based forecasts in predicting earnings and their association with contemporaneous abnormal security returns. In addition, we demonstrate that a relatively simple linear model using only past earnings and returns generates predictions that are more accurate and more highly associated with security returns than a financial-statement-analysis-based model that is based on a much wider set of financial accounting variables. We have used a very simple measure, *Pr*, to summarize financial statement data. Therefore, conclusions from this study about the usefulness of financial statements as a source of earnings forecasts should be made keeping in mind that more complex models may lead to different results.

EXHIBIT 1
Variable Definitions (Ou 1990)

$GWINVN_t$	percentage change in the inventory-to-total assets ratio for year t
$GWSALE_t$	percentage change in the sales-to-total-assets ratio for year t
$CHGDPS_t$	change in dividends declared per share in year t versus year t-1
$GWDEP_t$	percentage change in depreciation for year t
$GWCPX1_t$	percentage change in the capital-expenditures-to-total-assets ratio for year t
$GWCPX2_t$	percentage change in the capital-expenditures-to-total-assets ratio for year $t-1$
ROR_t	accounting rate of return for year t; income before extraordinary items divided by beginning-of-year total stockholders' equity
$DROR_t$	difference between ROR_t and ROR_{t-1}
ΔX_t	dichotomous indicator of the direction of earnings change in period t: $EPS_t - EPS_{t-1} - D_{t-1}$, where D_{t-1} is an estimated earnings drift, equal to the average change in earnings during the four years prior to the year of prediction.
Pr_t	$e^{\hat{y}} / (1+e^{\hat{y}})$, where $\hat{y} = \hat{\gamma}_0 + \sum_{k=1}^{8} \hat{\gamma}_k (\text{accounting variable})_k$, and $\hat{\gamma}_k$ are estimates from a logistic regression of ΔX on the eight accounting variables measured at time t.

Notes

In the estimation period (1979-1985), observations with extreme values of the eight accounting variables are excluded from the sample, where extreme is defined by examining the pooled sample's distribution of each variable. This analysis resulted in exclusion of the largest and smallest one percent of observations based on each accounting variable other than return on equity, and the largest and smallest five percent of return on equity observations (the ROE distribution was more extreme than the other accounting variables).

To mitigate the potential disproportionate influence of extreme observations, we exclude observations from the sample period where price-scaled, random walk prediction errors (with or without drift adjustment) exceed 1.0 in absolute value. We also exclude any observations where current-year or prior-year price per share is greater than $200 or where current- or prior-year earnings yield or price-scaled drift exceed 1.0 in absolute value.

Endnotes

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[1] See Beaver, Lambert and Morse (1980), Collins, Kothari and Rayburn (1987), Fried and Givoly (1982) Brown, et al. (1987), and Liu, et al. (1995) for evidence regarding accuracy; see Collins, Kothari and Rayburn (1987), Brown, et al. (1987), and Fried and Givoly (1982), for evidence regarding performance as proxies for the market's earnings expectations.

[2] When comparing the accuracy of analysts' forecasts, we use actual earnings as reported by I/B/E/S, which differs from the Compustat definition for firms where analysts choose to exclude certain components of earnings (i.e. restructuring charges) from their forecasts.

[3] Exhibit 1 defines the particular accounting variables used in Ou (1990) and describes the details of our treatment of extreme observations.

[4] Note that the directional financial-statement-analysis-based forecast is a linear transformation of *Pr* (see equation (1) above), and thus the ranking of cases based on the directional financial-statement-analysis-based forecast will be identical to the ranking using *Pr*. Therefore, any difference in prediction success across the two metrics must be attributable to a shift in the increase/decrease cutoff of *Pr* away from 0.5.

[5] The *Pr* and financial-statement-analysis-based forecast metrics predict *drift-adjusted* earnings change; however, the other metrics in this study predict earnings change. Of course, the forecasted drift-adjusted earnings change implies a forecast of the earnings level; adding back the drift and previous period earnings (as done in equation (2)) yields a forecast of earnings that is comparable to the other metrics. Likewise, the predicted earnings change from a price-based model or analysts' forecast implies a forecast of the earnings level. Accordingly, for consistency all comparisons of performance in the empirical results that follow are based on comparisons of predicted earnings level.

[6] Liu, et al. (1995) develop a similar price-based model. They regress future earnings changes on current and past earnings and price changes after partitioning based on current E/P. Our price-based model differs from theirs in that we use size-adjusted returns instead of price changes; we incorporate E/P as a continuous

independent variable in our model; we do not include past earnings change as an independent variable because of its insignificance in the presence of E/P; and we allow a slope shift for prior-year return performance. These differences seem to improve the R^2 and prediction accuracy over that in Liu, et. al (1995).

[7] Elgers and Lo (1994) find that good and poor-performing firms (defined alternatively using prior-year returns or prior-year earnings changes) have systematically different patterns (e.g. reversal tendencies) in their earnings. Earnings changes for firms that experience poor performance in the prior year exhibit significant mean reversion, likely due to a greater proportion of transitory components in their earnings. No such tendencies exist for firms with good performance in the prior year. Analysts' forecasts systematically over-estimate the tendency of earnings performance to reverse for firms with poor prior-year performance. For such firms, analysts predict significantly greater reversals than are exhibited by actual earnings. Therefore, the price-based or financial-statement-analysis-based forecasts, which are perhaps better able to capture these reversal tendencies, may out-perform analysts' forecasts for firms with poor prior performance.

[8] In results not reported, we investigated the incremental importance of partitions based on firm size and earnings extremity in equation (3). There were no significant coefficient differences across partitions other than the prior-year returns performance partition as shown in Table 2, Panel B.

[9] The price-based forecast is slightly more biased, but as can be seen in the table, bias is a very small component of total MSE, and thus we focus our main attention on the MSE and MAE metrics.

[10] However, Elgers and Lo (1994) show that analysts' predictions for poor performing firms generally contain more error than their predictions for firms with good prior-year performance. We attribute this difference in results to differences in our partitioning variable and the choice of analysts' forecast metric.

[11] To check the sensitivity of these results to alternative return metrics, we replicated these tests using market-model-adjusted returns (CARs). For the sub-sample of firms for whom both return metrics were available, the inferences are unaffected by the choice of return metric. However, within this sub-sample, which consists of systematically larger firms, the financial-statement-analysis-based forecasts yield larger response coefficients than do the price-based forecasts. This is consistent with the interpretation that larger, more stable firms have more stable financial statement variables and thus have earnings that are more easily predicted using financial analysis. Nevertheless, Table 4 reports the results using SAR for three reasons: (1) Prior research shows that size is an

important omitted variable from market-model returns; (2) Requiring CARs causes a loss of almost 15% of our sample and makes the results less generalizable to other than large firms; and (3) In our sensitivity results (not tabulated) SARs result in larger response coefficients for all three forecast error proxies, suggesting that it is a better return metric, consistent with (1).

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