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Inefficiency in Analysts' Earnings Forecasts: Systematic Misreaction or Systematic Optimism?

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ABSTRACT

A rational analysis of analyst behavior predicts that analysts immediately and without bias incorporate information into their forecasts. Several studies document analysts' tendency to systematically underreact to information. Underreaction is inconsistent with rationality. Other studies indicate that analysts systematically overreact to new information or that they are systematically optimistic. This study discriminates between these three hypotheses by examining the interaction between the nature of information and the type of reaction by analysts. The evidence indicates that analysts underreact to negative information, but overreact to positive information. These results are consistent with systematic optimism in response to information.

THE LITERATURE ON FINANCIAL ANALYSTS defines the phrase "forecast inefficiency" to mean forecasts that fail to accurately incorporate new information on a timely basis and/or that are biased. These forecasts have also been described as irrational or suboptimal. Prior studies report inefficiency in analysts' forecasts, finding that they are upwardly biased and inaccurately reflect available information. Some studies conclude from this that analysts underreact to information; other studies conclude that analysts overreact. If markets treat analysts' forecasts as both rational and statistically optimal, then inefficient forecasts could have important implications for the efficiency of pricing in securities markets. In this paper, we reexamine the apparent tendency of analysts to misinterpret earnings information. The intent of this study is to discriminate between three hypotheses: (1) that analysts systematically underreact to new *earnings* information; (2) that analysts systematically overreact to new earnings information; and (3) that analysts are systematically optimistic in their reactions.

For hypotheses (1) and (2), the direction of the misinterpretation (i.e., under- or overreaction) is independent of the nature of the information received. In contrast, hypothesis (3) predicts that analysts are optimistic in interpreting

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earnings information. In other words, whether they under- or overreact depends on the nature of the earnings information that they receive. Consequently, finding that analysts underreact to bad news and overreact to good news would indicate that analysts are systematically optimistic concerning the implications of new information, rather than systematically misinterpreting all new information.

Discriminating between systematic underreaction, overreaction, and optimism is important because it might indicate whether analysts irrationally err in processing earnings-relevant information or whether their forecast errors are more consistent with their economic incentives. Analysts can exhibit systematic optimism for two reasons. First, the sell side analysts generally used in these studies are employed by brokerage and investment banking firms and face economic incentives to promote the purchase of stocks, rather than to produce statistically optimal forecasts.[1] Second, analysts derive part of their expertise from their access to top executives of the firms they follow. This access might be diminished if analysts did not present the firm in a favorable light.[2] It is also possible that analysts are pessimistic about the future. Though this might well be the case for some firms or particular analysts, it is less likely that the consensus forecast would, on average, be pessimistic because analysts do not face incentives to behave in this manner.

We present evidence that is inconsistent with hypotheses (1) and (2). Specifically, our evidence shows that analysts' reactions are contingent on the nature of earnings information provided—that is, they underreact to negative information and they overreact to positive information. Together, these results suggest that analysts interpret new information optimistically.

The remainder of the paper is organized as follows. Section I discusses prior relevant studies. Section II describes our sample. In Section III, we examine analyst incorporation of the information contained in prior-year earnings. In Section IV we take a more general view of information, focusing on analyst revisions in response to prior-year forecast errors. Finally, in Section V we offer conclusions and implications.

I. Background

Prior studies of analysts' earnings forecasts provide evidence that analysts (1) make biased forecasts and (2) misinterpret the impact of new information. Fried and Givoly (1982), O'Brien (1988), Butler and Lang (1991), Brous (1992), Brous and Kini (1993), Francis and Philbrick (1993), Kang, O'Brien, and Sivaramakrishnan (1994), and Dreman and Berry (1995) provide evidence that analysts normally produce upwardly biased forecasts. Several

[1] See Schipper (1991), Pratt (1993), Womack (1996), and Carleton, Chen, and Steiner (1998).

[2] The *Wall Street Journal* reported a recent example of this when Archer-Daniels-Midland suddenly refused to provide information to an analyst following a switch from a buy to a sell recommendation. See Gibson (1995). According to Pratt (1993), several well-known and respected companies have explicitly told analysts that their phone calls will not be returned if they drop their ratings below neutral or hold. See also Womack (1996).

other studies document analysts' tendency to misinterpret new information. In particular, Lys and Sohn (1990), Abarbanell (1991), Abarbanell and Bernard (1992), Ali, Klein, and Rosenfeld (1992), Elliot, Philbrick, and Wiedman (1995), and Teoh and Wong (1997) suggest that analysts systematically *underreact* to new information, and DeBondt and Thaler (1990) find that analysts systematically *overreact* to new information. Systematic under- or overreaction to information can be perceived as inconsistent with rational forecasts and, perhaps, an efficient market for expert information.

A number of recent papers that examine stock returns have suggested that investors in general, as well as analysts in particular, err in making forecasts of future stock prices and earnings by irrationally extrapolating recent price and earnings information. Specifically, these papers say that analysts and investors observe abnormal earnings and price performance in a brief period and erroneously project these trends to continue. Examples of this literature include Lakonishok, Shleifer, and Vishny (1994) and La Porta (1996). For an extensive review of these findings see Daniel, Hirshleifer, and Subrahmanyam (1998, Appendix A).

Three recent models that produce patterns of under- and overreaction that are consistent with the empirical results have been proposed. These models are based on literature on the psychology of decision making. Barberis, Shleifer, and Vishny (1997) build a model of the behavior of a representative investor that they base on the concepts of representativeness and conservatism drawn from the psychology literature. In their terminology, "representativeness" means that investors ignore the laws of probability and behave as if the events they have recently observed are typical of the return (or earnings) generating process. "Conservatism" means that investors are slow to update their prior beliefs in response to new information. These two behavioral tendencies and a particular model structure combine to produce underreactions in some circumstances and overreactions in others.[3]

Daniel et al. (1998) also rely on psychology for insights into the traits of a representative investor's decision-making process. In their terminology, investors are overconfident and exhibit biased self-attribution. "Overconfidence" means that investors believe too strongly in their own private information, which leads to systematic overreaction to private information and underreaction to public information. "Biased self-attribution" means that investors attach too much significance to signals that confirm their prior beliefs and too little significance to signals that contradict them.

Finally, Hong and Stein (1997) model the phenomena of underreaction and overreaction by focusing on a market composed of two types of investors: "newswatchers" and "momentum traders." Both types of investors possess bounded rationality, in that they can only process a subset of publicly available information but they make maximum use of the information that they

[3] Barberis et al.'s (1997) model also assumes that true earnings follow a random walk but that investors believe that earnings either exhibit mean reversion or a trend. Further, their model assumes that earnings rarely change their characteristics.

do process. Hong and Stein's infinite-horizon model predicts that stock prices will underreact to information in the short run but will overreact in the long run.

In summary, all three of these models produce a tendency for investors and analysts to underreact to public information and/or information that conflicts with prior beliefs. None of the three models allows for the possibility that reactions are contingent on the type of information.

II. Data

We draw our sample from Institutional Brokers Estimate Systems, Inc. For the first analysis, we require (a) an eight-months-ahead consensus forecast of current (i.e., year t) earnings per share; (b) actual earnings per share for years $t-5$ through t; and (c) stock prices eight months prior to year-end for years $t-5$ through t. We define a consensus forecast as the median forecast reported by IBES when there are at least four individual analyst estimates (Elliott et al. (1995)). We establish the eight-month horizon to obtain reasonable assurance that analysts have the previous year's annual report available to them when they make their forecasts.[4] These data requirements yield a sample of 10,694 firm-year observations. From this sample, those observations for which the variable(s) of interest are greater than 100 percent of price are identified as outliers and are eliminated (Ali, Klein, and Rosenfeld (1992) and Frankel and Lee (1996)).

Table I provides details on several characteristics of the base sample. First, the sample consists of 10,694 firm-year observations with mean (median) total assets of \$4.5 (\$2.0) billion. This represents 208 industries (as defined by three-digit SIC) with a mean (median) individual industry representation of 51 (26). There are 1,608 individual firms represented, each of which is included an average (median) of 7 (6) times. We draw the sample's firm-year observations from a 14-year time period (1982 to 1995), with a mean (median) of 764 (749) observations per year. Table I also indicates that although the number of observations per year gradually increases over time, no one year is disproportionately represented.

Finally, the table includes the mean and median forecast error as a percentage of stock price, or

$$FE_t = \frac{E_t - F_t^{t-1}}{P}, \tag{1}$$

where FE_t denotes the forecast error at year t, E_t is actual earnings for year t, F_t^{t-1} is the forecast of year t earnings made at year $t-1$ (i.e., eight months prior to the end of year t), and P is the stock price at the time of the forecast.

[4] Penman (1987) reports that 92 percent of firms filing with the SEC file their annual reports within 12 weeks of the year-end. O'Brien (1988) finds that the average lag time between a forecast and the forecast's appearance on the IBES tapes is 34 days.

Table I

Sample Characteristics

The sample is composed of 10,694 firm-year observations that had eight-months-ahead forecasts of annual earnings and six consecutive years of annual earnings available from IBES. Forecast error is defined as $(E_t - F_t^{t-1})/P$, where E_t = actual year t earnings, F_t^{t-1} = forecast of year t earnings (eight months prior to year-end), and P = stock price at the time of the forecast.

Panel A: Sample Representation as a Function of Firm, Industry, and Year

		Number of Times Represented				
Representation by	Total	Minimum	Maximum	Mean	Median	Std. Dev.
Firm	1608	1	14	7	6	4.6
Industry (3-digit SIC)	208	1	581	51	26	71.4
Year	14	396	1,037	764	749	191

Panel B: Sample Distribution, Firm Size, and Forecast Error by Year

			Forecast Error as a Percentage of Stock Price			
Year	N	Avg. Assets (millions)	Mean	Median	Std. Dev.	t-Statistic on Mean
1982	396	$3,709	−4.40	−1.77	9.69	−9.04
1983	484	3,433	−1.84	−0.31	6.66	−6.07
1984	626	3,066	−2.19	−0.49	6.96	−7.89
1985	665	3,173	−3.10	−1.11	8.34	−9.57
1986	700	3,294	−2.78	−0.73	7.94	−9.26
1987	709	3,714	−3.00	−0.40	9.83	−8.13
1988	682	3,958	−0.79	0.04	6.62	−3.13
1989	788	4,405	−2.53	−0.46	8.11	−8.77
1990	846	4,672	−3.03	−0.70	8.21	−10.72
1991	863	4,994	−2.14	−0.59	6.85	−9.18
1992	923	5,185	−1.39	−0.21	4.70	−9.02
1993	963	5,284	−1.03	−0.17	4.07	−7.82
1994	1,012	5,592	−0.55	0.00	4.03	−4.33
1995	1,037	5,745	−0.65	0.00	2.93	−7.09
Overall	10,694	4,491	−1.93	−0.32	6.84	−29.12

Consistent with previous research, mean forecast error is significantly negative in all years represented and median forecast error is significantly negative in all but three years. Moreover, it seems that the magnitude of the error does not consistently move either up or down. This sample meets all data requirements for the first analysis.

We place a further limitation on the data for our second analysis. Specifically, this analysis uses analysts' forecast revisions and thus requires an additional consensus forecast of current earnings exactly *one year prior* to the eight-month forecast employed in the first analysis (i.e., a two-years-ahead forecast). This additional requirement results in a subset sample used in the second analysis of 6,067 firm-year observations.

III. Analysts' Use of Prior-Year Earnings Information

A. The Methods and Findings of Prior Studies

Two studies that examine analysts' tendency to misinterpret information about prior-year earnings are DeBondt and Thaler (1990) and Abarbanell and Bernard (1992). DeBondt and Thaler contend that analysts systematically overreact to the release of information. Their primary piece of evidence is a regression of actual earnings changes on forecasted changes. This regression has a negative intercept and a slope coefficient well below one. The negative intercept indicates that projected earnings exceed actual earnings. The size of the slope coefficient indicates that actual earnings change by less than the change in analysts' forecasts. Thus, DeBondt and Thaler show that larger predicted changes are associated with subsequently larger forecast errors. They argue that their results are consistent with the view that analysts overreact to publicly available information.

Abarbanell and Bernard (1992) also begin by analyzing the relation between actual and predicted changes in earnings. They find that forecasts tend to systematically exceed the subsequently observed earnings figure, and that actual earnings changes tend to move less than forecasted changes. Abarbanell and Bernard argue that these findings are consistent with overreaction if extremely high (low) forecasts tend to follow strong (weak) prior-earnings performance. They present evidence that is inconsistent with overreaction—the most optimistic (i.e., highest) forecasts are those for which prior performance is weakest.

To provide a more meaningful test of the extent to which analysts over- or underreact, Abarbanell and Bernard (1992) regress the forecast error in a given year against the actual earnings change for the prior year. They find that forecast errors are positively related to prior performance and argue that this is evidence of analysts' aggregate tendency to underreact to prior performance.[5] They conclude that "overreactions to earnings cannot be found among analysts."

As a reference point, we begin our empirical analysis by replicating Abarbanell and Bernard's (1992) finding of underreaction to prior earnings. Specifically, we estimate the following equation:

$$FE_t = \gamma_0 + \gamma_1 PERF_{t-1} + \epsilon_t, \tag{2}$$

where FE_t is the time t forecast error as defined above, and $PERF_{t-1} = (E_{t-1} - E_{t-2})/P_{t-1}$. $PERF_{t-1}$ is the prior-year earnings change (from $t-2$ to $t-1$) scaled by price at $t-1$. E_{t-1} is the earnings per share at time $t-1$. Panel A of Table II reports our estimate of γ_1 and Abarbanell and Bernard's estimate. Using our data, the γ_1 estimate is 0.13 (t = 15.29), and the adjusted R^2 for equation (2) is 0.02. The corresponding slope in Abarbanell and

[5] Ali et al. (1992) also present evidence consistent with analysts' underreaction to past earnings.

Table II

Bivariate Regressions of Current Forecast Error on the Prior-Earnings Change

The sample is composed of 10,694 firm-year observations that had eight-months-ahead forecasts of annual earnings and six consecutive years of annual earnings available from IBES. Forecast error is defined as $(E_t - F_t^{t-1})/P$; where E_t = actual year t earnings, F_t^{t-1} = forecast of year t earnings (eight months prior to year-end), and P = stock price at the time of the forecast. $PERF_{t-1}$ is that prior-year earnings change (from $t-2$ to $t-1$) scaled by the concurrent price; $UPERF_{t-1}$ is $PERF_{t-1}$ minus the average of the $t-4$, $t-3$, and $t-2$ earnings changes scaled by the respective prices. t-statistics for the intercept and slope coefficients are reported in parentheses below the coefficient estimates.

	Intercept	$PERF_{t-1}$	UPERF_{t-1}	R^2	F-Statistic
Panel A: $FE_t = \gamma_0 + \gamma_1 PERF_{t-1} + \epsilon_t$					
Using raw prior performance and our data	−1.91%*	0.13*	—	0.02	233.65
	(−29.13)	(15.29)			
Abarbanell and Bernard's (1992) estimates (Table IV, p. 1202)	$ −0.44*	0.08*	—	0.01	NA
	(−13.10)	(3.30)			
Panel B: $FE_t = \gamma_0 + \gamma_1 UPERF_{t-1} + \epsilon_t$					
Using unexpected prior performance and our data	−1.92%*	—	0.05*	0.01	56.68
	(−29.14)		(7.53)		

* and ** indicate that the coefficient is significantly different from zero at the 0.01 and 0.05 levels or better, respectively.

Bernard is 0.08 (t = 3.30) with an R^2 of 0.01.[6] The performance of both regression models is similar and indicates that analysts underreact to information contained in the prior-year earnings change.

One possible shortcoming of our regression is that the independent variable could include both an expected and an unexpected component of the prior-earnings change. By focusing on the raw, instead of only the unexpected prior-earnings change, we might understate the inefficiency in analysts' underreaction and cause the low R^2. To address this possibility, we use $UPERF_{t-1}$ as the independent variable, where $UPERF_{t-1}$ is $PERF_{t-1}$ minus the firm's average earnings change over the preceding three years ($t-4$ through $t-2$) scaled by the respective stock prices. The average of the preceding earnings changes proxies for the firm's normal earnings change. Panel B of Table II shows the results for unexpected prior performance. These results are similar to those reported for raw prior performance.

[6] The scale of the intercept in our regression is different from theirs because we express forecast errors and earnings changes as a percent of price; Abarbanell and Bernard use unscaled dollar figures on a per share basis. We scale by price, as do many other studies, to control for the possibility that per-share dollar figures are drawn from different distributions. Consequently, our estimate of the intercept is −1.91 percent (t = −29.13), and their estimate is −0.44 (t = −13.10).

B. Modifying the Methodology

Abarbanell and Bernard's (1992) results and our replication of their method bring into question the rationality of analysts' forecasts. These results could be viewed as a systematic underreaction to new information or they could be consistent with the hypothesis that analysts make optimistic forecasts of earnings. For example, analysts might systematically underreact to prior earnings, or they might underreact to poor prior earnings because they are being optimistic. We discriminate between these competing hypotheses. We approach this issue by using the methodology employed by Abarbanell and Bernard, but we make a critical modification to their methodology. We group firms into low, normal, and high values of performance so that we can identify circumstances under which the prior year's information has positive, negative, or no implications for current earnings.

We begin our analysis by modeling analysts' forecasts of current earnings changes as a function of the nature of prior-year performance. We then construct a corresponding model of the actual current earnings change as a function of prior performance. Finally, we compare the two models to determine whether or not analysts have efficiently incorporated the information in prior earnings. We first model the predicted change in earnings as a function of prior-year performance:

$$\begin{aligned}(F_t^{t-1} - E_{t-1})/P_{t-1} = \alpha_0 &+ \alpha_1 LOPERF_{t-1} + \alpha_2 HIPERF_{t-1} + \alpha_3 PERF_{t-1} \\ &+ \alpha_4 (PERF_{t-1} \times LOPERF_{t-1}) \\ &+ \alpha_5 (PERF_{t-1} \times HIPERF_{t-1}) + e_t, \end{aligned} \tag{3}$$

where $PERF_{t-1}$ is that prior-year earnings change (from $t-2$ to $t-1$) scaled by concurrent price as defined above, and $LOPERF_{t-1}$ and $HIPERF_{t-1}$ equal one if $PERF_{t-1}$ is in the lower or upper quartile for year $t-2$, and 0 otherwise.

We define HIPERF and LOPERF at $t-1$ relative to the distribution of lagged (i.e., $t-2$) performance to avoid a "look-ahead bias." In other words, ranking based on lagged rather than concurrent (i.e., $t-1$) performance avoids the assumption that the analyst knows the distribution of earnings changes for *all other* firms at $t-1$. As a robustness check, we also conducted the above tests using the concurrent (i.e., $t-1$) distribution of PERF to define HIPERF and LOPERF. The results of these tests are qualitatively similar to those presented, albeit slightly weaker.

In equation (3), α_3 measures the forecasted impact of the prior-year performance for the middle two quartiles, $\alpha_3 + \alpha_4$ measures the impact for the lower quartile, and $\alpha_3 + \alpha_5$ measures the impact for the upper quartile. In the following discussion, we refer to the sum of two coefficients (e.g., $\alpha_3 + \alpha_4$) as the combined coefficient. Our primary interest is in these combined coefficients because they indicate the implications of a realization falling in the extreme quartiles—that is, the impact of informative prior-year performance.

After estimating the model of projected changes in equation (3), we estimate a model of actual earnings changes using the same variables:

$$(E_t - E_{t-1})/P_{t-1} = \alpha_0 + \alpha_1 LOPERF_{t-1} + \alpha_2 HIPERF_{t-1} + \alpha_3 PERF_{t-1} + \alpha_4 (PERF_{t-1} \times LOPERF_{t-1}) + \alpha_5 (PERF_{t-1} \times HIPERF_{t-1}) + e_t. \tag{4}$$

We compare the parameters from this model of actual earnings changes with those from equation (3) to determine whether analysts underreact, overreact, or react efficiently to each piece of information.

Finally, we assess the statistical difference in the models of forecasted and actual earnings changes by regressing the year t forecast error on the same set of independent variables. Note that we define the equation (1) forecast error as the actual change in earnings minus the predicted change, or equation (4) minus equation (3). The forecast error regression is:

$$(E_t - F_t^{t-1})/P_{t-1} = \alpha_0 + \alpha_1 LOPERF_{t-1} + \alpha_2 HIPERF_{t-1} + \alpha_3 PERF_{t-1} + \alpha_4 (PERF_{t-1} \times LOPERF_{t-1}) + \alpha_5 (PERF_{t-1} \times HIPERF_{t-1}) + e_t. \tag{5}$$

If analysts' forecasts are based on parameters that are essentially the same as the actual process that generates earnings, then the forecast error regression should have no explanatory power and no significant coefficients. If Abarbanell and Bernard's (1992) finding of underreaction holds for all three partitions of prior performance, then the slope coefficients should be positive. Further, if underreaction holds equally for the three partitions, then the slopes should be equal across partitions. If DeBondt and Thaler's (1990) finding of overreaction holds for all three partitions, then the slope coefficients should be negative. Finally, if analysts are systematically optimistic, then $\alpha_3 + \alpha_4$ should be positive and $\alpha_3 + \alpha_5$ should be negative.

The framework outlined in equations (3) through (5) uses prior-year performance as the independent variable and for grouping purposes. However, it does not adjust for the fact that analysts are likely to anticipate a portion of the prior year's earnings change. Therefore, we also estimate equations (3) through (5) using $UPERF_{t-1}$ as defined above. Table III presents the results of three OLS regressions using $PERF_{t-1}$ as the independent variable, and Table IV presents the results using $UPERF_{t-1}$ as the independent variable. Since $UPERF_{t-1}$ could be preferred on intuitive grounds, our discussion focuses on Table IV. Minimal differences exist between the two tables.

C. Results

Table IV presents results for the forecasted earnings change, the actual earnings change, and the forecast error (i.e., actual minus forecast). In each set of three columns, the first column contains the combined coefficients

Table III

Earnings Change and Forecast Error Regressed on Prior-Earnings Change

$$\text{Model (right side)} = \alpha_0 + \alpha_1 LOPERF_{t-1} + \alpha_2 HIPERF_{t-1} + \alpha_3 PERF_{t-1} + \alpha_4 (PERF_{t-1} \times LOPERF_{t-1}) + \alpha_5 (PERF_{t-1} \times HIPERF_{t-1}) + e_t$$

The sample is composed of 10,694 firm-year observations that had eight-months-ahead forecasts of annual earnings and six consecutive years of annual earnings available from IBES. Prior-year earnings information is classified as low, normal, or high based on the magnitude of the unadjusted prior-earnings change. Combined intercept and slope coefficients for low, normal, and high groupings are reported. E_t = actual year t earnings, F_t^{t-1} = forecast of year t earnings (made eight months prior to year-end), and P = stock price at the time of the forecast. $PERF_{t-1}$ is that prior-year earnings change (from $t-2$ to $t-1$) scaled by the concurrent price. $LOPERF_{t-1}$ and $HIPERF_{t-1}$ are dummy variables coded as one if $PERF_{t-1}$ is in the lower/upper quartile of that variable in year $t-2$, and zero otherwise. Extreme $PERF$ at $t-1$ is defined relative to its distribution at $t-2$ to avoid a "look-ahead bias." t-statistics for the combined intercept and slope coefficients are reported in parentheses below the coefficient estimates.

	Dependent Variable								
	$(F_t^{t-1} - E_{t-1})/P$ (Forecasted Earnings Change)			$(E_t - E_{t-1})/P$ (Actual Earnings Change)			$(E_t - F_t^{t-1})/P$ (Forecast Error)		
	(1) Low	(2) Normal	(3) High	(4) Low	(5) Normal	(6) High	(7) Low	(8) Normal	(9) High
Performance									
Intercept	0.10	1.03	0.82	−1.59	−0.00	0.35	−1.69	−1.03	−0.48
	(1.05)	(14.77)*	(8.51)*	(−9.07)*	(−0.03)	(1.97)**	(−11.40)*	(−9.66)*	(−3.23)**
Slope	−0.65	−0.22	0.17	−0.35	−0.11	−0.12	0.30	0.12	−0.29
	(−82.41)*	(−2.81)*	(14.83)*	(−24.31)*	(−0.73)	(−5.86)*	(24.98)*	(0.96)	(−16.59)*
R^2	0.44 (F = 1,659.34)			0.06 (F = 130.63)			0.10 (F = 243.78)		

* and ** indicate that the coefficient is significantly different from zero at the 0.01 and 0.05 levels or better, respectively.

Table IV

Earnings Change and Forecast Error Regressed on Unexpected Prior-Earnings Change

$$\text{Model (right side)} = \alpha_0 + \alpha_1\,\text{LOUPERF}_{t-1} + \alpha_2\,\text{HIUPERF}_{t-1} + \alpha_3\,\text{UPERF}_{t-1} + \alpha_4(UPERF_{t-1} \times LOUPERF_{t-1}) + \alpha_5(UPERF_{t-1} \times HIUPERF_{t-1}) + e_t$$

The sample is composed of 10,694 firm-year observations that had eight-months-ahead forecasts of annual earnings and six consecutive years of annual earnings available from IBES. Prior-year earnings information is classified as low, normal, or high based on the magnitude of the unadjusted prior-earnings change. Combined intercept and slope coefficients for low, normal, and high groupings are reported. E_t = actual year t earnings, F_t^{t-1} = forecast of year t earnings (made eight months prior to year-end), and P = stock price at the time of the forecast. $UPERF_{t-1}$ is $PERF_{t-1}$ minus the average of the $t-4$, $t-3$, and $t-2$ earnings changes scaled by the respective prices. $LOUPERF_{t-1}$ and $HIUPERF_{t-1}$ are dummy variables coded as one if $UPERF_{t-1}$ is in the lower/upper quartile of that variable in year $t-2$, and zero otherwise. Extreme $UPERF$ at $t-1$ is defined relative to its distribution at $t-2$ to avoid a "look-ahead bias." t-statistics for the combined intercept and slope coefficients are reported in parentheses below the coefficient estimates.

	Dependent Variable								
	$(F_t^{t-1} - E_{t-1})/P$ (Forecasted Earnings Change)			$(E_t - E_{t-1})/P$ (Actual Earnings Change)			$(E_t - F_t^{t-1})/P$ (Forecast Error)		
	(1) Low	(2) Normal	(3) High	(4) Low	(5) Normal	(6) High	(7) Low	(8) Normal	(9) High
Performance									
Intercept	−0.58	0.92	1.00	−1.83	−0.01	0.04	−1.25	−0.92	−0.96
	(−5.47)*	(14.41)*	(10.10)*	(−9.94)*	(−0.06)	(0.23)	(−8.02)*	(−9.97)*	(−6.66)**
Slope	−0.59	−0.04	0.17	−0.31	0.10	−0.01	0.29	0.14	−0.18
	(−70.65)*	(−0.59)	(21.15)*	(−21.04)*	(0.91)	(−1.00)	(23.54)*	(1.48)	(−15.70)*
R^2	0.37 (F = 1,245.18)			0.04 (F = 90.69)			0.09 (F = 213.69)		

* and ** indicate that the coefficient is significantly different from zero at the 0.01 and 0.05 levels or better, respectively.

that apply to low levels of performance (i.e., the lower quartile), the middle column contains those that apply to normal performance (i.e., the middle two quartiles), and the third column contains those that apply to high performance (i.e., the upper quartile).

All three models are significant at better than 0.0001. The significance of the forecasted and actual change models indicates that analysts do in fact utilize the information in prior performance ($R^2 = 0.37$, $F = 1{,}245$) and that this information is useful in explaining the current earnings change ($R^2 = 0.04$, $F = 90.69$). However, the significance of the forecast error model ($R^2 = 0.09$, $F = 213.69$) suggests that analysts fail to fully incorporate the information provided by these variables.

We begin our discussion of the combined coefficients by comparing the coefficients on performance across the first and fourth columns of Table IV. These coefficients describe the forecasted and the actual relationship between low prior-year performance and the current change in earnings, respectively. Comparing them allows us to determine if analysts underreact, overreact, or efficiently react to weak prior performance.

Our results are consistent with Abarbanell and Bernard (1992) and Daniel et al. (1998) in that they indicate that analysts underreact to the negative implications of weak prior-year performance. The intercept and slope coefficients for the actual change model in the fourth column of Table IV are -1.83 ($t = -9.94$) and -0.31 ($t = -21.04$), respectively. The negative intercept suggests that weak prior performance negatively impacts the current change in earnings. However, the negative slope coefficient suggests that this impact is mitigated, or perhaps reversed, at *extreme* levels of such performance. Approximately 95 percent of the observations in the low-performance group exhibit negatively signed deviations in prior performance. Consequently, multiplying the negative slope coefficient by these negative deviations lessens, or could even reverse, the impact of the intercept.

The forecasted change model in the first column of Table IV contains the analyst-determined intercept and slope. These are -0.58 ($t = -5.47$) and -0.59 ($t = -70.65$), respectively. The difference in intercepts between the actual and the forecasted change models (-1.25) is significant at better than 0.01 (see the seventh column). This difference indicates that analysts estimate the intercept to be higher or less negative than implied by the actual model. Furthermore, the difference in slope coefficients (0.29) is also significant and indicates that analysts overestimate this coefficient and therefore overestimate its positive impact on the current change. Together, these two "misestimations" result in an overestimation of the current earnings change in response to weak prior-year performance and are consistent with underreaction to such performance.

If analysts systematically underreact to prior-year performance, we would expect them to underreact to both low and high prior-year performance. However, a comparison of coefficients across the third and sixth columns of Table IV indicates that they do not underreact to high prior-year performance. Instead, a comparison of the two models shows that analysts *overreact*. The intercept and slope for the actual change model in the sixth column are 0.04 ($t = 0.23$) and -0.01 ($t = -1.00$), respectively. Neither of these coefficients is different from zero. The forecasted counterparts for the intercept and slope coefficients in the third column are 1.00 ($t = 10.10$) and 0.17 ($t = 21.15$), respectively. This positive intercept implies that analysts expect high prior performance to have a positive impact on the current change in earnings. Furthermore, the positive slope suggests that the extent of this impact is related to prior performance. Comparing these forecasted coefficients with those from the actual change model indicates that analysts overestimate both the intercept and slope (see column nine). These differences between the forecasted and the actual change coefficients suggest that analysts overestimate earnings in response to strong prior performance and thus are consistent with overreaction to such performance.

Finally, the second and fifth columns of the table give the performance coefficients that apply at normal levels of prior performance. Again, analysts significantly overestimate the intercept (forecast of 0.92 versus an actual of -0.01), suggesting that they exhibit a levels bias even in the absence of new information. However, neither of the slope coefficients is significantly different from zero, and the eighth column indicates they are not significantly different from each other. This finding is consistent with normal levels of prior performance providing little or no new information about the current earnings changes.[7]

This method of estimating expected performance in $t - 1$ uses the average of these values over the prior three-year period, $t - 4$ through $t - 2$. A possible shortcoming of this approach is that in forming the expectation of performance, it weights each of the prior years equally. If the importance of prior-year values declines over time, then this approach underweights performance for year $t - 2$ in forming expectations and overweights year $t - 4$.

To test the possibility that a misspecified model of the expectations of performance contributes to the results reported above, we develop a model of $t - 1$ expectations that allows the weights to differ across the years $t - 4$ through $t - 2$. This is accomplished by regressing the $t - 1$ change in earnings on the values for $t - 2$, $t - 3$, and $t - 4$. We estimate the regression parameters using the pooled data set of firm-years, and compute the predicted values of the $t - 1$ change in earnings for each firm-year using these regression parameters. We substitute this predicted value for the equally weighted average of the preceding three earnings changes in the calculation

[7] The primary difference between Tables III and IV concerns the slope coefficients for the firms with normal performance. In Table III, which is based on the raw prior year earnings change ($PERF_{t-1}$), the slope coefficient for the forecasted change in earnings is negative and significant. In contrast, the slope coefficient for the actual change regression is negative and insignificant. The difference in slopes is, however, not significant.

of *UPERF*. The results are essentially the same as those reported in Table IV.

Thus, our findings indicate that analysts underreact to the negative implications of weak prior-earnings performance, and overreact to the positive implications of strong prior-earnings performance. These conclusions are robust with respect to the method of computing the normal or expected earnings change for the prior year and hold even for the raw earnings change in year $t-1$. Therefore, the findings are inconsistent with a systematic misinterpretation of the information provided by prior-year earnings. They are instead consistent with a systematically optimistic interpretation of such information.

IV. Analysts' Response to Prior-Year Forecast Error

The preceding section utilizes a modified version of Abarbanell and Bernard's (1992) model that focuses on the relationship between the current earnings change and the unexpected prior-year earnings change, where the *expected* prior-year earnings change is assumed to equal the historical, firm-specific norm. As mentioned previously, this assumption allows for a more refined definition of "informative" prior performance than in Abarbanell and Bernard's study. However, our results are still limited in that historic norms do not necessarily reflect the full information set available to analysts in forming their prior performance expectations. This assumption limits the generalizability of our results. Therefore, in this section, we remove this assumption by shifting the focus from unexpected prior-year earnings change to prior-year forecast error. By definition, prior-year forecast error measures the difference between forecasted and actual prior performance.

This shift in focus to prior-year forecast error allows for the introduction of richer, more objective expectations of prior-year earnings changes than those allowed in the first analysis. Forecast error incorporates not only the information in the prior year's earnings change but also any relevant information about the macroeconomy, stock returns, changes in the structure of the industry(-ies) in which the firm operates, or any other event that might affect actual earnings or analysts' forecasts. Analyzing a broader definition of information allows us to address the question of whether analysts only misinterpret the information in the prior-earnings change in an optimistic manner or whether analysts generally misinterpret earnings-relevant information in an optimistic manner. To focus on this larger question, we shift our focus from the incorporation of information in forecasts to the process by which analysts revise their forecasts of earnings at some future date. This is accomplished by examining the change in forecast of year t earnings as the forecast horizon narrows from two years ahead to one year ahead in response to the revelation of the year $t-1$ forecast error. With these modifications, we reexamine the question of whether analysts systematically under/overreact or whether they exhibit systematic optimism.

A. Methodology

Many analysts make both one-year-ahead and two-years-ahead forecasts of earnings. In this section we use the subset of firms from our base sample that have both forecasts on IBES.[8] This phase of our analysis begins by examining the impact of year $t-1$ forecast error (i.e., actual $t-1$ earnings minus the forecast of $t-1$ earnings made at $t-2$) on the year $t-2$ to $t-1$ change in analysts' forecast of year t earnings. In a manner analogous to the approach used in Section III, we estimate the following regression:

$$(F_t^{t-1} - F_t^{t-2})/P = \beta_0 + \beta_1 LOFE_{t-11} + \beta_2 HIFE_{t-1} + \beta_3 FE_{t-1} + \beta_4 (FE_{t-1} \times LOFE_{t-1}) + \beta_5 (FE_{t-1} \times HIFE_{t-1}) + \epsilon_t, \quad (6)$$

where FE_{t-1} is the forecast error for year $t-1$, and $LOFE_{t-1}$, $HIFE_{t-1}$ are one if the forecast error (FE_{t-1}) lies in the lower/upper quartile, and zero otherwise. Equation (6) resembles equation (3), except that the change in earnings forecasts replaces the forecasted change in earnings as the dependent variable, and the independent variable changes to prior forecast error. In equation (6), β_3 measures the impact of the $t-1$ forecast error on the revision for the middle two quartiles, $\beta_3 + \beta_4$ measures the impact for the lower quartile, and $\beta_3 + \beta_5$ measures the impact for the upper quartile.

In order to assess whether analysts exhibit either systematic under/overreaction to information or if they are systematically optimistic, the estimates from equation (6) must be compared with a model based on the actual process that generates earnings. Toward that end, we estimate

$$(E_t - F_t^{t-2})/P = \beta_0 + \beta_1 LOFE_{t-1} + \beta_2 HIFE_{t-1} + \beta_3 FE_{t-1} + \beta_4 (FE_{t-1} \times LOFE_{t-1}) + \beta_5 (FE_{t-1} \times HIFE_{t-1}) + \epsilon_t, \quad (7)$$

where the dependent variable is the two-years-ahead year t forecast error. Thus, equation (7) is a regression of the two-years-ahead year t forecast error on the one-year-ahead year $t-1$ forecast error, where both forecasts are made at the same date but apply to two different points in the future. The only difference between equations (6) and (7) is that equation (7) substitutes the actual year t earnings, E_t, for the $t-1$ forecast of those earnings, F_t^{t-1}.

The estimates of the parameters in equation (7) define the information content of the $t-1$ forecast error for year t earnings. If, for the average firm-year, earnings in the prior and current periods are independently and identically distributed, then the $t-1$ forecast would contain no information

[8] Note that in some cases the number of analysts forecasting earnings may either increase or decrease between $t-2$ and $t-1$. Our only requirement is that there be at least four analysts at the date of both forecasts.

for year t earnings. In this case, β_3 and both combined coefficients will be zero and the model will have no explanatory power. If, on the other hand, the forecast error for year $t-1$ contains information about year t earnings, then this regression indicates the content of that information. For example, earnings shocks that have some permanent component will produce a positive coefficient for β_3, and the magnitude of the coefficient increases with the permanence of the earnings shock. If unusually low and high forecast errors for $t-1$ have the same implications for year t earnings (but in opposite directions), then the combined coefficients will be equal and not different from β_3. If the implications for unusually low and high forecast errors for $t-1$ are different, then the two combined coefficients will indicate this. The estimates of the coefficients in equation (6) similarly indicate *analysts' interpretation* of the information in the $t-1$ forecast error.

A comparison of the coefficients in equations (6) and (7) indicates whether or not analysts react optimally in a statistical sense. If analysts react optimally, then the slope and intercept coefficients for the two equations will be the same. If the coefficients are different between the two equations, then the estimates will indicate under/overreaction to the type of forecast error observed. To test whether apparent differences in coefficients are statistically significant, we run a regression of the forecast error for year t earnings on the component of forecast error for year $t-1$. That is, we estimate the following regression:

$$(E_t - F_t^{t-1})/P = \beta_0 + \beta_1 LOFE_{t-1} + \beta_2 HIFE_{t-1} + \beta_3 FE_{t-1} + \beta_4(FE_{t-1} \times LOFE_{t-1}) + \beta_5(FE_{t-1} \times HIFE_{t-1}) + \epsilon_t. \quad (8)$$

Equation (8) tests the significance of the difference in equations (6) and (7) because the forecast error for year t is defined as equation (7) minus equation (6). In a manner similar to Section II, a comparison of the coefficients between the extreme groups will indicate whether analysts systematically underreact to the information content in prior forecast error, systematically overreact to this information, or whether they react optimistically to this information. If Abarbanell and Bernard's (1992) finding of underreaction holds for all three partitions of prior forecast error, then the slope coefficients will be positive. If underreaction holds equally for the three partitions, then the slopes will be equal across partitions. If DeBondt and Thaler's (1990) finding of overreaction holds for all three partitions, then the slope coefficients will be negative. Finally, if analysts are systematically optimistic, then $\beta_3 + \beta_4$ will be positive and $\beta_3 + \beta_5$ will be negative.

B. Results

Table V presents the results for these three regressions using the $t-2$ forecast errors to group the data. The first three columns in the table present the results for forecast revision, the fourth through sixth columns present

Table V

Forecast Revision, the Two-Years-Ahead Forecast Error, and the Current Forecast Error Regressed on the Prior-Year Forecast Error

Model (right side) = $\beta_0 + \beta_1 LOFE_{t-1} + \beta_2 HIFE_{t-1} + \beta_3 FE_{t-1} + \beta_4(FE_{t-1} \times LOFE_{t-1}) + \beta_5(FE_{t-1} \times HIFE_{t-1}) + \epsilon_t$

The sample of 6,067 firm-years consists of those firms included in the prior analyses that also had two-years-ahead forecasts of current earnings. Prior-year forecast error is classified as low, normal, or high based on the magnitude of the prior forecast error. Combined intercept and slope coefficients for low, normal, and high groupings are reported. E_t = actual year t earnings, F_t^{t-1} = forecast of year t earnings (made eight months prior to year-end), P = stock price at the time of the forecast, and FE_{t-1} is the forecast error for year $t-1$. $LOFE_{t-1}$ and $HIFE_{t-1}$ are dummy variables coded as one if FE_{t-1} is in the lower/upper quartile of that variable in year $t-2$, and zero otherwise. Extreme FE at $t-1$ is defined relative to its distribution at $t-2$ to avoid a "look-ahead bias." t-statistics for the combined intercept and slope coefficients are reported in parentheses below the coefficient estimates.

	Dependent Variable								
	$(F_t^{t-1} - F_t^{t-2})/P$ (Forecast Revision of Year t Earnings from $t-2$ to $t-1$)			$(E_t - F_t^{t-2})/P$ (Two-Years-Ahead Forecast Error for Year t)			$(E_t - F_t^{t-1})/P$ (One-Year-Ahead Forecast Error for Year t)		
	(1) Low	(2) Normal	(3) High	(4) Low	(5) Normal	(6) High	(7) Low	(8) Normal	(9) High
Performance									
Intercept	−5.67*	−2.61*	−2.08*	−8.23*	−3.44*	−2.45*	−2.56*	−0.83*	−0.37
	(−21.64)	(−14.32)	(−8.44)	(−23.63)	(−14.21)	(−7.47)	(−12.11)	(−5.67)	(−1.85)
Slope	0.36*	1.41	0.14	0.61*	2.06*	−0.22	0.25*	0.65*	−0.35*
	(19.34)	(6.78)	(1.43)	(24.35)	(7.47)	(−1.74)	(16.14)	(3.90)	(−4.62)
R^2	0.15 (F = 220.39)			0.21 (F = 324.07)			0.10 (F = 132.49)		

* and ** indicate that the coefficient is significantly different from zero at the 0.01 and 0.05 levels or better, respectively.

results for two-years-ahead forecast error for year t, and the last three columns report the results of forecast error for year t on forecast error for year $t - 1$. The F-statistic and R^2 for each equation indicate that the models explain a significant portion of the variation in the dependent variables. In particular, the R^2 and significant F for the third equation suggest that the coefficients in the models of forecasted revisions and two-years-ahead forecast errors are indeed statistically different.

For each group of three columns, the first column contains the combined coefficients for the low forecast error group (the lower quartile with forecast error below normal), the middle column contains the intercept and slope coefficients for the normal forecast error group (the middle two quartiles), and the third column contains the combined coefficients for the high forecast error group (the upper quartile with forecast errors well above normal). Consider first a comparison of the first and fourth columns for the low forecast error quartile (i.e., large negative values of the independent variable). In the current context, this quartile most closely resembles Abarbanell and Bernard's (1992) poor prior performance group. The results document that the one-year-ahead forecast error for year $t - 1$ is positively related to both the two-years-ahead forecast error for t and the forecast revision. However, the impact of the $t - 1$ forecast error differs between the regressions. In particular, the regression for the two-years-ahead error has a lower or more negative intercept than the regression for the forecasted changes (-8.23 in column (4) versus -5.67 in column (1)). Moreover, the regression for the two-years-ahead error has a larger slope coefficient than the regression for the forecasted changes (0.61 in column (4) versus 0.36 in column (1)). This combination implies that analysts overestimate year t earnings in response to an unusually negative forecast error in year $t - 1$.[9] The seventh column in Table V shows that the differences in the combined slope (0.25) and intercept coefficients (-2.56) between equations (6) and (7) are significant at the 1 percent level. Thus the results of this test are consistent with both the results in Section III and the results in Abarbanell and Bernard (1992) which indicate that analysts underreact to negative earnings performance in the prior year. They are also consistent with Elliot et al.'s (1995) finding that analysts systematically underreact to all new information and with the predictions of Daniel et al.'s (1998) model.

If analysts *systematically* underreact to prior-year forecast errors, we would expect them to underreact to both low and high errors. A comparison of the third and sixth columns of Table V allows us to investigate this. The intercept for the forecast revision, -2.08 ($t = -8.44$), exceeds the intercept for the two-years-ahead forecast error, -2.45 ($t = -7.47$), indicating that analysts systematically overestimate year t earnings for this group. The difference in intercepts is significant only at the 10 percent level. The ninth column, however, shows that the slope coefficient for the forecast revisions is 0.35 greater than the slope coefficient for the two-years-ahead forecast errors and that

[9] Note that the independent variable (forecast error in year $t - 1$) for these observations is negative and is multiplied by a positive coefficient.

this difference is significant at the 1 percent level. Thus the combination of intercept and slope coefficients suggests that analysts systematically overestimate year t earnings and that they do so for firms that experienced year $t-1$ earnings substantially above forecasts. This finding that, in the face of apparently positive news about earnings for year $t-1$, analysts overestimate year t earnings suggests that analysts overreact to the information. Thus the results for the high forecast error group (relative to their norms) are inconsistent with the findings of systematic underreaction in Elliot et al. (1995), Abarbanell and Bernard (1992), and the other literature in this area, but they are consistent with DeBondt and Thaler (1990).

Finally, the second and fifth columns present the results for the forecast revision and the two-years-ahead forecast error for the middle group. A comparison of the two intercepts shows that, on average, analysts forecast higher earnings for the current year than are subsequently realized. The eighth column indicates that this difference is significant at the 1 percent level. The same column also shows that the slope coefficients for this group are different between the two regressions. In particular, the significant positive coefficient in the eighth column indicates that analysts underreact to the information in the two middle quartiles of prior forecast error in much the same way that they underreact to information in the lower quartile of prior forecast error. These two findings are consistent with the view that analysts exhibit a systematic levels bias that leads them to consistently overestimate subsequent earnings.

Combining the findings for the $t-1$ forecast errors indicates that analysts underreact in the face of information that has negative implications for current earnings, they overreact to apparently positive information, and they exhibit a systematic levels bias for the middle group of firms with $t-1$ forecast errors that have no clear implications for year t earnings. These findings are inconsistent with the conclusions of systematic underreaction. Instead, the differential reaction to positive and negative information is consistent with the hypothesis that analysts are systematically optimistic in their interpretation of new information. Thus the findings of this section that focus on analysts' reaction to information using a more refined definition of earnings-relevant information are consistent with the result in Section III that focus on analysts' incorporation of information about prior earnings in their forecasted changes of earnings.

V. Conclusions

A classic analysis of financial analysts views them as rational experts in the market for information who predict future earnings and make trading recommendations. This view presumes analysts' earnings forecasts immediately and unbiasedly incorporate all new information. Some recent studies provide evidence that analysts systematically *underreact* to new information; others find that analysts systematically *overreact* to new information. These results appear to be inconsistent with each other and inconsistent with rational forecasts. These findings could be due either to a systematic tendency for analysts to misinterpret information in a particular direction or to a systematic tendency for analysts to interpret information in an optimistic fashion. This study reexamines these competing explanations.

Two approaches are used in this reexamination. The first approach focuses on whether or not analysts efficiently incorporate information contained in the prior year's performance. To address this issue, we decompose analysts' forecast error into the forecasted change in earnings and the actual change, and we model both. Specifically, we regress the forecasted change in earnings, the actual change in earnings, and the forecast error on prior performance in a manner similar to that of Abarbanell and Bernard (1992). However, we make two critical modifications to the standard methodology. First, to control for differences in earnings changes that routinely occur for the firm-years in our sample, we construct a measure of abnormal prior performance. Thus we identify unexpected values of this variable by comparing the prior year's earnings change with recent experience. Second, and critically, we group firms into low, normal, and high values of abnormal performance so that we can identify circumstances where the prior year's information has positive and negative implications for current earnings (or no implications).

We document that analysts both *underreact* to negative information and *overreact* to positive information. These findings bring together the apparently disparate conclusions of Abarbanell and Bernard (1992) and DeBondt and Thaler (1990). They are also consistent with the view that analysts systematically react to information in an optimistic manner and are inconsistent with the view that they either systematically underreact or systematically overreact. Finally, the results appear inconsistent with recent models in behavioral finance. Specifically, these models do not allow for the possibility that reactions are contingent on the nature of the information provided by the prior-earnings change. Further research is needed to determine whether our results are limited to analysts and the specific incentives they face or whether the optimistic behavior we document is typical of investors in general.

The second approach focuses on analysts' revision of forecasts in response to the prior year's forecast error. This modification is important because it focuses on a less restrictive definition of information than that used in the first analysis, plus it highlights the extent to which analysts learn from their errors. In a manner similar to the first approach, we find that analysts underreact to abnormally negative forecast errors and overreact to abnormally positive forecast errors. Again, these findings are consistent with analysts being systematically optimistic, but are inconsistent with the view that analysts either systematically overweight or systematically underweight information.

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