Business Cycles and Analysts' Forecasts: Further Evidence of Rationality

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Expectations about the future play an important role in economic behavior. Borrowing and investment decisions by consumers and businesses, purchase and labor contracts, and job choices require at least a crude forecast of economic variables. Thus, it should not be too surprising that explaining how expectations are formed has become a central point in the study of economics and economies. The issue is not of simply academic interest. Given that there are several alternative explanations or theories of how individuals form their expectations, the choice among these theories can influence both conclusions about how economies work and recommendations for macroeconomic policies designed to influence prices, output, and employment.

One major school of thought in this area—called rational expectations—can be seen as an attempt to provide a general theory of expectations formation. This theory, developed and refined over the past thirty years since its first statement by John Muth (1961), asserts that decisionmakers in the economy form their expectations or forecasts in the best way they know on the basis of all economically relevant information available to them at the time. Thus, the hypothesis asserts the rather reasonable position that decisionmakers make efficient use of all of the information that they currently have in predicting the future. This idea is consistent with the assumption that individuals do not act arbitrarily or without thought in their economic life, in forming expectations as in other economic decisions. Stated differently, people do not make systematic mistakes: in the long run they behave as if they understand the process generating the values of the variables that

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they are trying to predict. If people efficiently use available information and doing so in fact leads to systematic over- or underestimates of some important economic variable, then that information can be used to correct their future estimates.[1]

A large body of empirical literature has developed since Muth's first statement of his hypothesis, and there has been a long-running debate, exemplified in work by Edward Prescott (1977) and Michael C. Lovell (1986), on whether testing the rationality of economic agents' expectations is useful, or even possible.[2] While much of this research has applied rationality tests to surveys of economists about future values of economic variables such as inflation and gross domestic product, an important part of this literature deals with the expectations of stock analysts about firms' earnings. Because stock analysts' reputations and livelihoods depend at least in part on their accuracy, their forecasts are particularly appropriate subjects for rationality tests. One would assume that their forecasts are seriously considered and accurately reported. Such forecasts should more closely represent those of economic agents made in connection with real decisions than do more casual "opinion" forecasts often reported by economic surveys. Stock analysts' forecasts are also attractive for research because two sets of forecasts are systematically collected and reported, one in the Institutional Brokers Estimate System (I/B/E/S) data base produced by Lynch, Jones, and Ryan, and Standard and Poor's *Earnings Forecaster*.

With greater interest in expectations formation and attention to serious forecasters, the volume of research on the rationality of financial analysts' forecasts of corporate earnings has increased significantly over the past two decades.[3] Until recently much of this research has simply evaluated the accuracy of analysts' forecasts relative to naive extrapolations of past earnings. For example, analysts' forecasts of future earnings were evaluated against or compared with forecasts that assumed that current or past earnings were the best predictors of future earnings. More recently, however, research on earnings forecasts has addressed the much more fundamental issue of the economic rationality of these forecasts.

The growth in the number of studies examining analysts' forecasts has not clarified the issue of rationality, though. Results reported in the literature continue to be conflicting. Lack of a consensus may be partially explained by differences in the samples, data sets, and time periods examined by various researchers. Researchers' choices of statistical tests have no doubt been a contributing factor as well.

An oversight common to these studies results from their treatment of the relationship between the individual analysts' forecasts. Because the analysts arrive at their forecasts individually, one might argue that their forecasts should be thought of as independent. Researchers doing statistical tests of rationality have taken this forecaster independence as support for the statistically convenient assumption that individual analysts' forecast errors are not related to errors in any other analysts' forecasts.

However, if forecast errors are in fact correlated, statistical tests based on this assumption may not measure accurately. Because analysts' forecast errors are likely to be influenced by the effects of macroeconomic activity on particular companies' performance, there is good reason to believe that they are related. For example, a sharp, unexpected disruption in the supply of a critical productive input—such as might be caused by a weather-related natural disaster—can adversely affect the cost structure of firms across industries. Such adverse supply shocks can result in analysts' systematically over-predicting earnings (as they fail to account for higher production costs) and, hence, errors would be correlated across their forecasts. Under such conditions, standard statistical hypothesis tests that assume independence of forecast errors may reject rationality when it should be accepted. Research by Michael P. Keane and David E. Runkle (1990) points out that the effects induced by macroeconomic shocks or business cycles cause the standard errors in typical rational expectations or forecast models to be biased downward when forecast errors are assumed to be independent. However, when this bias is accounted for, valid tests of rational expectations formation in security analysts' forecasts can be conducted.

This article investigates whether earnings forecasts made by security analysts are economically rational—that is, whether they satisfy the rational expectations hypothesis. As noted above, this hypothesis makes the most sense from an economic perspective. However, recent studies have cast doubt on its applicability to security analysts' forecasts. For this study, statistical tests of the rationality of security analysts' forecasts were conducted with procedures similar to those reported in the previous literature. Using this approach demonstrates that erroneous conclusions can be reached and incorrect inferences made if the analysis does not properly account for biases introduced into analysts' forecasts by aggregate economic shocks. The study shows that once the effects of these biases are accounted for, it is not possible to conclude that security analysts' forecasts are inconsistent with rational expectations.

Rationality Testing

It is obvious that the process of forecasting any variable will be improved by incorporating as much information as possible about how the variable is determined. Because a forecaster who does not use all available relevant information is acting inefficiently, his or her forecast error—the difference between the actual realized value of the variable and the forecasted value—will be unnecessarily large and may exhibit systematic biases. Thus, it should come as no surprise that forecast error plays a central role in characterizing rational forecasts.

Two key properties, each involving forecast error, have been identified for testing the rationality of forecasts. First, if the forecasts are rational, a time series of forecast errors should have a mean of zero—that is, the forecasts should equally overshoot and undershoot the actual data. This property is called unbiasedness in this article. Secondly, the forecast errors should not be correlated with any relevant economic information readily available at the time the forecast was made, including the values of past forecast errors—referred to here as efficiency. Tests of the efficiency involving only current and past values of forecast errors are called serial correlation tests.[4]

Previous Studies of Analyst Forecast Rationality

The body of literature examining the properties of analysts' earnings forecasts is large, and many studies have directly addressed the issue of forecast rationality.[5] Most of these studies conduct tests of rationality using unbiasedness or lack of serial correlation tests—for example, studies by Timothy Crichfield, Thomas Dyckman, and Josef Lakonishok (1978), Lawrence D. Brown and Michael S. Rozeff (1979), Dov Fried and Dan Givoly (1982), Givoly (1985), Werner F.M. De Bondt and Richard H. Thaler (1990), and Ashiq Ali, April Klein, and James Rosenfeld (1992). However, none of the existing studies adjust for the possibility that individual analysts' forecast errors are correlated on the basis of such factors as macroeconomic shocks.

The study by Crichfield, Dyckman, and Lakonishok (1978) provides a good example of an unbiasedness test. These authors use the mean forecasts of earnings growth taken from Standard and Poor's *Earnings Forecaster*. They estimate the following simple regression model:

$$A_t = a + b \bullet E_t + e_t, \qquad (1)$$

where A_t represents realized earnings (or earnings growth), E_t is the predicted earnings (or earnings growth), and e_t is a random error expected to equal zero. Under rationality, expected earnings should neither consistently overstate nor understate actual earnings. Thus, the unbiasedness test examines the hypothesis that the parameters a and b are simultaneously equal to zero and one, respectively.

Analyzing forecasts made for forty-six companies for each year from 1967 to 1976, these authors concluded that analysts' forecasts were indeed rational in the sense that the estimated a and b values were not significantly different from their hypothesized values. Using a different approach, Burton G. Malkiel and John G. Cragg (1970) examined five-year earnings growth predictions made by several investment firms in the years 1961 through 1969 and reported similar results.

In a test of the efficiency property of the rationality hypothesis—that people use all relevant information available at the time of the forecast—Fried and Givoly (1982) examined whether financial analysts' earnings forecasts exploit what is known about actual earnings. That is, they tested whether publicly available information is incorporated in earnings forecasts. The specific public information examined was stock market earnings. Using a statistical methodology similar in spirit to that used by Crichfield, Dyckman, and Lakonishok and data from the *Earnings Forecaster* for the 1969-79 period, Fried and Givoly concluded that the financial analysts in their study not only fully exploited the time series properties of actual earnings but also fully incorporated the information available in stock market earnings (as represented by Standard and Poor's Composite 500) into their forecasts. In a related study Givoly (1985) tested forecast rationality using annual forecasts from the *Earnings Forecaster* and found that analysts made full use of information contained in the past forecasts and actual earnings.

More recently, however, De Bondt and Thaler (1990) applied unbiasedness tests for rationality to consensus I/B/E/S data and reached a different conclusion. They concluded that the forecasts are overly optimistic—forecasted earnings systematically exceeded actual earnings—and thus are inconsistent with rationality. Similarly, Ali, Klein, and Rosenfeld (1992) reject rationality in their study of behavior of analysts' earnings forecasts over time using consensus I/B/E/S

Table 1
Unbiasedness Test

$$A_t = a + b \bullet E_t + e_t$$

Coefficient	OLS with White Correction
a	−0.0110 (−0.709)
b	0.9928** (64.278) [−0.466]
R^2_{Adj}	.686
F	1.414

** Significant at the 1 percent level
* Significant at the 5 percent level

Note: OLS estimates are corrected for nonhomogeneous variances with the White (1980) correction. The estimated coefficients are reported along with *t*-statistics corresponding to the null hypotheses that the coefficient is 0(.) or 1[.]. An *F*-test is used to test the joint hypothesis that $a = 0$ and $b = 1$, that is, the hypothesis of rational expectations. A_t is actual quarterly earnings per share, E_t is forecasted quarterly earnings per share, and e_t is the error term.

Table 2
Serial Correlation Test

$$A_t - E_t = a + b(A_{t-1} - E_{t-1}) + e_t$$

Coefficient	OLS with White Correction	WLS Weight=SD	Bootstrap Method
a	−.0146 (−1.325)	−0.0022 (−0.722)	−0.0158 (−1.441)
b	0.0970 (1.572)	0.0417** (3.663)	0.0974** (6.279)
R^2_{Adj}	.0112	.0037	
F	2.0200	6.987**	

** Significant at the 1 percent level
* Significant at the 5 percent level

Note: The first column reports OLS estimates with the White correction for nonhomogeneous variances, the second column reports the weighted least squares (WLS) estimates using the standard deviation as the deflator, and the third column reports the bootstrapped coefficients and standard errors. The *F*-test statistic applies to the joint test for rational expectations—that is, $a = 0$ and $b = 0$. A_t is actual quarterly earnings per share for quarter t, E_t is the earnings per share forecasted for quarter t, and e_t is the error term.

forecasts. These authors also document what seems to be a significant overprediction bias. Studies by Jeffrey Abarbanell and Victor L. Bernard (1991) and Robert Mendenhall (1991) also report evidence that does not support the rationality of analysts' forecasts.

Two features of the tests reviewed above call for further research. First, applying similar tests to different data sets, the researchers do not agree on rationality. Second, the existing tests fail to account for possible correlation introduced into analysts' forecast errors by macroeconomic shocks or business cycle factors that affect all forecasters. It is possible that correction for the latter flaw would introduce greater uniformity into the results of rationality tests.

To facilitate comparisons with other studies, the research reported on in this article ran a series of tests using the unbiasedness and serial correlation tests common in research on rational expectations. The unbiasedness tests uses equation (1) above. The serial correlation uses the equation

$$A_t - E_t = a + b(A_{t-1} - E_{t-1}) + e_t, \qquad (2)$$

where the variables are as previously defined and the subscripts refer to time periods, to test the relationship of current to past errors. The possible bias introduced by macroeconomic shocks or business cycles was then accounted for.

Empirical Analysis

The tests applied equations (1) and (2) above to analysts' quarterly earnings forecasts from the I/B/E/S data base for the years 1984 through 1990. Both the mean and the median forecast were used as the measure of the consensus forecast. The results were strikingly similar, so only those obtained using the median are reported. Each firm was required to have at least three earnings forecasts in any given quarter for that quarter to be included in the sample. Further, in order to maximize the number of firms in the sample, the analysts' forecasts of quarterly earnings were sampled one month before the end of each quarter for which earnings are forecast. Earnings estimates for a sample of 220 companies, chosen randomly, were included for analysis. A total of 3,640 observations were included in the final sample.

Unbiasedness and Serial Correlation Tests. The results of the statistical tests are displayed in Tables 1 and 2. Following Crichfield, Dyckman, and Lakonishok (1978) and Givoly (1985), Table 1 presents the results of a simple unbiasedness test using the model presented in equation (1) above. The coefficients in Table 1 were estimated using ordinary least squares (OLS) regression, where the standard errors were corrected for nonconstant variance, using the procedure developed by Halbert White (1980).[6] Under rational expectations, a regression such as that outlined in equation (1) should yield coefficient estimates of $a = 0$ and $b = 1$. In Table 1, both the estimated constant and slope appear very close to their hypothesized values. The F-test of the joint hypothesis that $a = 0$ and $b = 1$, reported in the fourth row of Table 1, does not reject rationality.

Table 2 reports tests of the hypothesis that analysts use the information contained in their past forecast errors in their current forecasts as outlined in equation (2). Three different statistical procedures were used to conduct these tests. The parameter estimates in the first column in Table 2 were obtained using OLS, where the standard errors were corrected for unequal variances using White's procedure. The estimates in the second column were obtained using weighted least squares (WLS) regression, where the standard deviation was used as the weighting variable. The third column in Table 2 presents the results obtained using a statistical method known as bootstrapping. This procedure is used to control for possible quarterly cross-sectional correlations across the firms included in the sample.[7] If analysts forecast rationally, new forecasts should reflect all information contained in past prediction errors—that is, $a = b = 0$. The coefficient estimates again appear to be fairly close to their hypothesized values. However, for two of the three alternative methods used (weighted least squares and bootstrap), the slope coefficient (b) does differ significantly from zero. The joint test of the rational expectations hypothesis is not rejected using OLS with the White correction (F-test with degrees of freedom two and infinity) but is rejected using the weighted least squares procedure.

The results presented in Tables 1 and 2 are inconclusive and similar to those reported in the literature.[8] Although it is not possible to give a definitive reason for the discrepancies, as will be explained below, the failure to account for possible time effects of macroeconomic shocks or business cycles could be a contributing factor, particularly in cases in which rationality is rejected.

Tests for Macroeconomic Shock or Business Cycle-Induced Time Effects. In order to determine whether the rational expectations hypothesis was rejected because of a failure to account for the possibility that forecast errors are not independent across the cross-sections of firms included in the sample, a careful examination was conducted of the residuals from the regressions summarized in Tables 1 and 2. This analysis indicates the presence of significant time series dependence.[9] Without correction, the presence of this type serial correlation can easily invalidate hypothesis tests. As stated in the introduction, because aggregate shocks affect the economic variables underlying the earnings being forecasted, they can induce bias into observed forecast errors. Furthermore, these aggregate shocks not only cause cross-sectional correlations but because of the cyclical nature of these variables, they may also lead to autocorrelated residuals.[10] As a result, it is possible to reject rational expectations when the hypothesis is actually valid. Given the somewhat inconclusive results in the initial tests, it is appropriate to account for these effects in the analysis.

This research involves two approaches to examining business cycle effects. The first runs regressions across analysts' forecasts for each quarter of the period covered.[11] Table 3, in which the results are reported, shows that the slope coefficient (b) is quite variable, suggesting that it is not stable over time. In addition, the model is rejected in a subset of the quarters.[12] These results suggest the presence of time or business cycle effects.

To test for the presence of the suggested business cycle effects, a fixed time effects model was used (see George G. Judge and others 1987, section 13.4). This model is basically a quarterly dummy variables model, which allows each time period a different intercept (the constant [a] in equations [1] and [2]) and allows testing for the rationality while the model is shifting over time.[13] Table 4 reports the results of an F-test for homogeneity of quarters along with the unbiasedness and serial correlation tests for rationality.

If the analysts' forecasts are rational, the slope coefficients (b) in the unbiasedness and serial correlation tests with the inclusion of fixed time effects should not differ significantly from 1 and 0, respectively. The test results in Panels A and B in Table 4 show that the hypothesis of no time effects is strongly rejected at the 1 percent level by the F-test of homogeneity of quarters. On the other hand, the unbiasedness and serial correlation tests with the inclusion of fixed time effects do not reject rationality. As can be seen in Panel A of Table 4, the null hypothesis that the slope coefficient (b) is equal to 0 is rejected, but the rational expectations hypothesis that it is equal to the value of 1 cannot be rejected. Similarly, in Panel B, the null hypothesis

Table 3
Quarterly Examinations of Past Forecast Errors

Quarter	OLS Constant (*a*)	OLS Slope (*b*)	WLS Constant (*a*)	WLS Slope (*b*)	Number of Observations
85:2	–0.1262* (–1.965)	–0.1276* (–2.465)	–0.0025 –0.161)	–0.0862 (–1.032)	121
85:3	–0.1114 (–1.839)	0.8102 (0.995)	0.0393 (1.149)	0.6371** (3.138)	133
85:4	–0.0349 (–1.160)	0.02740 (0.993)	–0.0129 (–1.276)	0.0053 (0.445)	169
86:1	–0.1008** (–3.275)	–0.1695 (–0.925)	–0.0064 (–0.805)	0.3383 (0.370)	163
86:2	0.0095 (0.539)	0.1608** (3.367)	–0.0014 (–0.255)	0.0677 (0.968)	149
86:3	–0.0107 (–0.522)	0.2111 (1.754)	–0.0031 (–0.692)	0.2040** (3.872)	154
86:4	–0.0544 (–1.498)	0.2022 (1.707)	–0.0027 (–0.385)	0.1779 (1.869)	213
87:1	0.0518** (2.807)	0.0552 (0.914)	0.0118 (1.758)	0.0081 (0.265)	195
87:2	–0.0780 (–1.276)	0.6409** (3.363)	–0.0014 (–0.104)	0.0459 (0.754)	179
87:3	0.0728 (1.321)	0.0214 (0.494)	–0.0025 (–0.160)	0.0078 (0.087)	200
87:4	–0.0097* (–2.282)	0.1181 (0.999)	–0.0256 (–1.201)	0.0721 (0.894)	223
88:1	0.1482** (3.028)	0.0291 (0.900)	0.0019 (0.183)	–0.0230 (–0.778)	217
88:2	0.0536 (1.343)	0.3480** (5.285)	0.0008 (0.070)	0.2253** (4.365)	201
88:3	–0.0324 (–0.677)	0.2816* (2.342)	–0.0292 (–1.710)	0.2434 (0.120)	160
88:4	–0.0280 (–0.695)	0.0136 (0.050)	–0.0120 (–0.827)	0.6003** (7.499)	205
89:1	0.0946* (2.390)	–0.1292 (–1.653)	0.0065 (0.684)	–0.2540** (–3.908)	163
89:2	–0.0484 (–1.495)	0.7760 (1.928)	–0.0168 (–1.878)	0.2638** (2.956)	199
89:3	–0.1126* (–2.330)	0.0689 (1.237)	0.0011 (0.182)	0.1257** (2.618)	150
89:4	–0.0680* (–2.202)	0.2367 (1.887)	0.0058 (0.607)	–0.0231 (–0.339)	219

** Significant at the 1 percent level
* Significant at the 5 percent level

Note: Each column reports estimates of the coefficients and corresponding *t*-statistics using two estimation techniques. The first column reports OLS estimates with the White correction for nonhomogeneous variances while the second column reports the weighted least squares (WLS) estimates using the standard deviation as the deflator. The *F*-test statistic applies to the joint test for rational expectations—that is, *constant* = 0 and *b* = 0 from the model $A_t - E_t = constant + b(A_{t-1} - E_{t-1}) + e_t$, where A_t is actual quarterly earnings per share for quarter *t*, E_t is the earnings per share forecasted for quarter *t*, and e_t is the error term.

Table 4
Test for Fixed Time Effects

Panel A

Unbiasedness Test
$A_t = FTE + b \bullet E_t + e_t$

b	0.9884
	{0.017}
	(58.485)**
	[–0.686]
R^2_{Adj}	.690
F	3.545**

Panel B

Serial Correlation Test
$A_t - E_t = FTE + b(A_{t-1} - E_{t-1}) + e_t$

b	0.0967
	{0.061}
	(1.585)
	[14.808]**
R^2_{Adj}	.023
F	3.509**

** Significant at the 1 percent level
* Significant at the 5 percent level

Note: *In each panel, the first row reports the estimated slope coefficient, the associated standard error in braces {}, and t-statistics corresponding to the null hypotheses that the coefficient equals zero (.) or one [.]. The second row reports the adjusted coefficient of determination (R^2). The third row reports the F-statistic, which tests for homogeneity of quarters—that is, no time effects.*

that the slope coefficient is equal to zero as implied by the rational expectations hypothesis cannot be rejected, but the hypothesis that it is equal to the value 1 can be. These results are consistent with those reported for price expectations by P.C. O'Brien (1990) and Keane and Runkle (1990) and provide evidence in support of the rationality of analysts' forecasts. In addition, and perhaps more importantly, the analysis and discussion also raise questions concerning the robustness of recent studies that reject rationality but do not test or account for the presence of time or business cycle effects of the type induced by macroeconomic shocks. Because these effects can easily invalidate or reverse the conclusions reached in these studies, caution must be used in interpreting the results reported.[14]

The delicate nature of rational expectations tests may raise questions about their results. Nonetheless, to explain rejection of analysts' rationality by saying that analysts repeatedly and systematically make costly mistakes and do not learn from them does not seem realistic. Such seemingly nonrational behavior is within the realm of possibility, but, in the absence of an acceptable theoretical foundation, it seems unlikely for professionals whose livelihood depends on rational forecasts.[15] These points are buttressed by the fact that the rational expectations hypothesis is most applicable in situations in which the phenomena being forecasted are well understood by economic agents, as would appear to be the case with security analysts regularly providing earnings forecasts. As Robert E. Lucas (1977) has observed, "In so far as business cycles can be viewed as repeated instances of essentially similar events, it will be reasonable . . . to assume [that economic agents'] expectations are rational, that [economic agents] have fairly stable arrangements for collection and processing information, and that they utilize information in forecasting the future in a stable way, free of systematic and easily correctable biases" (1977).

Conclusion

This article evaluates the rationality of earnings forecasts by security analysts participating in the I/B/E/S data base. Following previous studies, the analysis considers unbiasedness and serial correlation tests. The results of the initial tests are generally negative and inconclusive, similar to several past studies. Like the results generally reported in the literature, the findings are ambiguous because of the possible presence of time or business cycle effects induced by, for example, macroeconomic shocks. Such effects could cause the standard errors in forecast models to be biased, invalidating standard hypothesis tests. The study documents the presence of significant quarterly time effects in the sample and, as a result, conducts unbiasedness and serial correlation tests that explicitly account for these time effects. Using this more general statistical model, the hypothesis of analyst forecast rationality cannot be rejected.

The results presented in the article provide support for the notion that security analysts engage in their forecasting activities in a rational fashion. That is, these analysts appear to learn from their past forecasting mistakes, make use of all economically relevant information in forming their forecasts, and process information efficiently. Thus, the results call into question the conclusion reached in studies that found that security analysts do not forecast in a rational manner. Taken literally such a conclusion makes it difficult to explain, from an economic survival perspective, the continued employment of analysts to forecast corporate earnings. The results reported in this article demonstrate the effects that business cycles can have on analysts' forecasts and how important it is that statistical tests examining the rationality of these forecasts properly account for these effects. As shown above, failure to do so can lead to erroneous conclusions and inferences concerning the usefulness of analysts' forecasts.

By providing evidence suggesting that stock analysts' forecasts are rational, these results confirm that these forecasts are the best available, given current knowledge. Because they are rational, the forecasts can be considered trustworthy as inputs into formulating policies. They can provide valuable information for use in both economic decisionmaking and the formation of economic policy.

Notes

1. Most alternative explanations of how expectations are formed necessarily rely on a belief in systematic mistakes—that is, the belief that people do not learn from their past forecasting mistakes. The rational expectations hypothesis is attractive to economists because it assumes that individuals learn from their past mistakes and take steps to avoid repeating these mistakes; it seems consistent with how people really behave.
2. The econometric analysis of direct expectations and forecasts has a long history in economics. Earlier studies by Anderson (1952) and Theil (1952, 1955, and 1966) and the more recent studies by Pesando (1975), Mullineaux (1978, 1980), B. Brown and Maital (1981), Figlewski and Wachtel (1981), Keane and Runkle (1990), and others have contributed immensely to the authors' understanding of how agents form their expectations as well as the statistical properties of these expectations.
3. Studies by Crichfield, Dyckman, and Lakonishok (1978), L. Brown and Rozeff (1979), Givoly and Lakonishok (1979, 1980, 1982, 1984), Elton, Gruber, and Gultekin (1981), Givoly (1985), Ofer and Siegel (1987), and De Bondt and Thaler (1990) are just a few of the papers examining various aspects of financial analysts' forecasts. For a comprehensive review of this voluminous literature, see Givoly (1985) or various editions of the *Institutional Brokers Estimate System* bibliography produced by the brokerage firm Lynch, Jones, and Ryan.
4. It should be noted that these properties need not hold, in the sense of Muth (1961), if expectations or forecasts are formed on the basis of a misspecified model or a correct model structure that has incorrect parameter values. In addition, the efficiency property is also used to define an efficient market. Thus, there is no fundamental distinction between the hypothesis that expectations are rational and the hypothesis that markets are efficient.
5. See Givoly (1985) for a comprehensive bibliography of studies addressing the rationality of analysts' earnings forecasts.
6. Previous studies have employed various deflators in attempts to correct for nonhomogeneous—that is, unequal—variances. Givoly (1985) and Ali, Klein, and Rosenfeld (1992) conclude that the choice of deflator does not materially affect the statistical inferences. The present study also estimated the coefficients using weighted least squares (WLS), where the standard deviation was the weighting variable. The results obtained using this alternative procedure were not significantly different from those reported in Table 1.
7. The bootstrap procedure described in Noreen (1989) was used. This procedure was also used by Ali, Klein, and Rosenfeld (1992).
8. For example, De Bondt and Thaler (1990) used standard WLS techniques and rejected the rationality of annual I/B/E/S forecasts for the period from 1976 to 1984. (De Bondt and Thaler normalized using the standard deviation of earnings per share.) Crichfield, Dyckman, and Lakonishok used standard techniques, and the rationality of annual *Earnings Forecaster* forecasts for the 1967-76 period is not rejected. As is often the case in this literature, they do not weight their variables.

   The results of other studies are also conflicting (for instance, see Ali, Klein, and Rosenfeld 1992 in comparison with Givoly 1985). Similarly, rationality is not rejected for certain samples of forecasts (annual *Earnings Forecaster* 1967-76 [Crichfield, Dyckman, and Lakonishok 1978], annual *Earnings Forecaster* 1969-79 [Givoly 1985], quarterly I/B/E/S 1984-90) and rejected for other samples (annual I/B/E/S 1976-84 [De Bondt and Thaler 1990], quarterly *Value Line* 1976-86 [Abarbanell and Bernard 1991], annual I/B/E/S 1976-90 [Ali, Klein, and Rosenfeld 1992]).
9. The usual battery of diagnostics for serial dependency in the residuals were conducted.
10. Ali, Klein, and Rosenfeld (1992) attempt to control for cross-sectional correlations caused by aggregate shocks using a bootstrap procedure. This method does not, however, correct for the serial dependence resulting from these shocks.

11. As in other tests, OLS with the White correction and WLS were used.
12. P. Brown, Foster, and Noreen (1985) also document large yearly variations in mean and median forecast errors.
13. O'Brien (1990) uses a similar methodology to test for analyst, firm, and year effects. Using individual I/B/E/S forecasts for nine industries, she finds significant firm and year effects for most of the industries examined.
14. This point is amplified if one considers the fact that recent studies rejecting analyst forecast rationality—for example, Ali, Klein, and Rosenfeld (1992) and De Bondt and Thaler (1990)—examine time periods characterized by significant macroeconomic shocks or business cycles. Thus, the bias discussed above would seem to be more pronounced for these studies.
15. In a forthcoming paper, the authors offer and test a dynamic model of analysts' earnings forecasts (Ackert and Hunter 1994). The paper demonstrates that what is often taken to be irrational behavior on the part of security analysts can be shown to be consistent with a dynamic, more complicated form of rationality.

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