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# A Simultaneous Equations Analysis of Analysts' Forecast Bias, Analyst Following, and Institutional Ownership

LUCY F. ACKERT AND GEORGE ATHANASSAKOS*

## 1. INTRODUCTION

In this paper we use a simultaneous equations model to examine the relationship between analysts' forecast bias, analyst following, and institutional investors' demand for a firm's stock. A simultaneous equations model is appropriate because the behavior of analysts and institutions is intertwined. Analysts may begin following a firm and issue optimistic forecasts because of institutional demand for a firm's stock and, at the same time, institutions may make asset allocation decisions using analysts' research reports.

* The authors are respectively from the Department of Economics and Finance, Kennesaw State University and The Research Department, Federal Reserve Bank of Atlanta; and The Clarica Financial Services Research Centre, Wilfrid Laurier University and Cass Business School, City of London. The views expressed here are those of the authors and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. The authors thank the Social Sciences and Humanities Research Council of Canada and the Federal Reserve Bank of Atlanta for financial support and Bryan Church, Ole-Christian Hope, Penny Verhoeven, workshop participants at Wilfrid Laurier University, and an anonymous referee for helpful comments. (Paper received November 2001, revised and accepted May 2002)

**Address for correspondence:** Lucy F. Ackert, Department of Economics and Finance, Michael J. Coles College of Business, Kennesaw State University, 1000 Chastain Road, Kennesaw, Georgia 30144, USA.
e-mail: lucy_ackert@coles2.kennesaw.edu

The simultaneous decisions of analysts and institutional investors has been examined previously.[1] O'Brien and Bhushan (1990) examine the firm and industry characteristics that affect analyst coverage and institutional demand while recognizing the multiple-decision context. We also examine the decisions of analysts and institutional investors, though with a different focus. Our goal is to provide insight into forecasting behavior. We investigate how analysts respond to institutional demand by examining their forecasting behavior, in addition to their decisions to cover a particular firm. More analysts follow firms with significant institutional interest (Bhushan, 1989). We further examine whether analysts issue more positive forecasts for firms with high institutional interest in order to retain clients and draw even more institutional business (Ackert and Athanassakos, 1997; and Das, Levine and Sivaramakrishnan, 1998). At the same time, we recognize the endogenous nature of the environment and examine how institutions respond to the forecasts that analysts issue and the level of analyst following. We examine whether institutions demand more of a firm's stock if analysts are optimistic about the firm's future earnings and if more analysts follow the firm.

A large literature examines the properties of financial analysts' forecasts of earnings per share. On average, analysts' forecasts are biased upward (Ali, Klein and Rosenfeld, 1992; and De Bondt and Thaler, 1990). Analysts have incentives to issue optimistic forecasts because of the relationships between the analyst, brokerage firm, and client firm (Dugar and Nathan, 1995; Francis and Philbrick, 1993; and Schipper, 1991). The degree of optimism increases with the level of uncertainty surrounding the firm (Ackert and Athanassakos, 1997). Experimental studies have shown that individuals continue to demand upwardly biased forecasts as long as the bias is not too large and the forecasts have information content (Ackert, Church and Shehata, 1997; and Ackert, Church and Zhang, 1999).

Despite their bias or optimism, professional financial analysts act as information intermediaries. They provide research reports that are a useful source of information, as evidenced by investor demand. At the same time, securities firms use analysts' reports as drawing cards. Multi-service firms may attract institutional business through the research reports produced by their analysts. Institutions then use this information to make investment decisions. Moreover, institutional investors demand analysts' reports in order to provide evidence of adequate care and comply with fiduciary responsibilities. The use of analysts' research has been put forth as evidence that decisions are made carefully (O'Brien and Bhushan, 1990). Agency considerations also may have a significant impact on institutional managers' behavior as they are self-interested economic agents (Jensen and Meckling, 1976). According to the agency model of managerial behavior, institutional investors adjust portfolio holdings in order to influence their remuneration (Haugen and Lakonishok, 1988; and Lakonishok, Shleifer, Thaler and Vishny, 1991).

The simultaneous equations model constructed in this paper recognizes the link between the decisions made by analysts and institutional investors. A single decision approach leads to a misspecification known as simultaneous equations bias where the error term and independent variables are correlated, violating the Ordinary Least Squares (OLS) assumption that no such correlation exists. Our simultaneous equations approach uses a three equation system to model analyst's optimism, analyst following, and institutional ownership.

Using a sample of forecasts of annual earnings per share for US firms from the Institutional Brokers Estimate System (I/B/E/S), we estimate the model using single equation and simultaneous equations approaches and find some differences in inferences. In the simultaneous framework, increasing institutional demand leads to higher analysts' optimism and lower analyst following. At the same time, institutional demand increases with increasing optimism in analysts' forecasts but decreases with analyst following. Some aspects of the estimated relationship between institutions and analysts are perplexing.

We also find that agency-driven behavioral considerations are significant. Analysts are more optimistic for smaller firms and those with a more uncertain information environment. The forecasts they issue are less optimistic for firms with recent increases in stock price. Consistent with expectations, analyst following and institutional demand respond positively to firm size, holding all else constant. Analysts and institutions respond positively to firm uncertainty. Finally, we examine whether a seasonal pattern is evident in the decisions of analysts and institutions. Our results are consistent with earlier research that has shown that analysts' optimism declines over the forecast horizon (Ackert and Hunter, 1994; Ackert and Athanassakos, 1997; and Richardson, Teoh and Wysocki, 1999). Also like other research (Ackert and Athanassakos, 2001), our direct tests show a seasonal pattern in the change in institutional holdings. A seasonal pattern is expected if institutions systematically rebalance holdings throughout the year in response to agency considerations. Our evidence suggests that agency considerations were important for institutional investors during our sample period.

The remainder of this paper is organized as follows. In the following section we discuss the nature of the joint decision environment in which analysts and institutions operate. We review the sample selection methods and provide sample statistics in Section 3. We report the empirical evidence in Section 4. Section 5 discusses the evidence. The final section of the paper contains concluding remarks.

## 2. THE JOINT DECISION ENVIRONMENT

The behavior of analysts and institutional investors is intertwined. Bhushan (1989) finds that the number of financial analysts following a firm is related to institutional holdings and argues that the number of institutions holding a firm's shares impacts the demand and supply of analysts following the firm. If institutions use outside analysts to procure information about a firm, demand for analysts' services will increase with the number of institutional investors. In addition, because analysts attempt to generate transactions business, the supply of analysts following a firm is likely to be large when the number of institutional investors is high. Further, analysts may issue optimistic forecasts to draw more institutional business.

Other research shows that behavioral considerations are important when examining analysts' or institutions' decisions. For example, some empirical evidence suggests that analysts may be optimistic about a firm's stock in order to maintain good relations with management (Francis and Philbrick, 1993) or when providing information for investment banking clients

(Dugar and Nathan, 1995). This optimism may also be used to draw institutional business. Further, Ackert and Athanassakos (1997) argue that when there is a great deal of uncertainty surrounding a firm, analysts have fewer reputational concerns when they act on incentives to issue optimistic forecasts. They show that analysts' optimism increases with higher firm uncertainty where uncertainty is measured by the standard deviation of earnings forecasts.

*(i) The Simultaneous Approach*

In this paper we use a simultaneous equations approach because inferences based on a single-equation approach are problematic. If the behavior of analysts or institutions is examined in isolation, the estimates are subject to simultaneous equations bias because the error term and independent variables are correlated. Beaver, McAnally and Stinson (1997) show that joint estimation mitigates single-equation bias. In our view, the decisions of analysts and institutions are endogenous and jointly determined by a set of exogenous variables about which information is publicly available.[2] However, analysts can be affected by variables that do not affect institutions and institutions can be affected by variables that do not affect analysts.

We examine the determinants of analysts' forecast bias, analyst following, and institutional holdings, while recognizing the joint decision environment in which analysts and institutions function. Following Ackert and Athanassakos (1997), we measure analysts' bias or optimism for a firm as the difference between forecasted and actual earnings, scaled by the absolute value of actual earnings. As is common in the literature, we measure analyst following using the number of analysts providing earnings estimates. Following Bhushan (1989) and O'Brien and Bhushan (1990), we measure institutional investment using the number of institutions holding a firm's stock.

We use changes in our dependent variables rather than levels.[3] As argued by O'Brien and Bhushan (1990) and O'Brien (1999), changes in the variables provide a stronger test than levels because the levels of many variables are cross-sectionally and temporally correlated even when there is no causal connection.

We investigate the endogeneity of analysts' and institutions' decisions by examining whether more institutions decide to hold a firm's stock in response to increases in analysts' optimism and following. We model institutional ownership as being endogenously determined with analysts' optimism and analyst following. As O'Brien and Bhushan (1990), Hussain (2000) and others have argued, analysts and institutions are linked. But, Ackert and Athanassakos (1997) and Das, Levin and Sivaramakrishnan (1998) recognize that analysts' forecasting behavior, and not just their decisions to follow a firm, impact institutional interest. We model analysts' optimism as determined by institutional holdings to investigate whether analysts' forecasting behavior is affected by the level of institutional ownership. Analysts may be more optimistic for firms with large institutional holdings due to agency considerations (Ackert and Athanassakos, 1997). Analysts want to retain clients and attract institutional business. Finally, we examine whether more analysts follow firms with large institutional interest. The demand and supply of analysts is larger for firms with larger institutional interest (Bhushan, 1989; and O'Brien and Bhushan, 1990).

In addition to the primary interactions, we examine the effect of some firm characteristics on analysts' optimism, analyst following, and institutional holdings. In examining the behavior of financial analysts, a wide variety of explanatory variables has been considered in the literature (Hussain, 2000, p. 112). Our primary focus is on the joint behavior of analysts and institutions, recognizing the impact of agency considerations. Thus, the explanatory variables included in the model provide direct insight into these concerns. As discussed subsequently, the literature provides direction for the construction of the model and allows us to posit directional hypotheses for the influence of each variable.

### *(ii) Analysts' Optimism*

We examine the impact of firm size, uncertainty about earnings, and changes in stock price on analysts' optimism. O'Brien and Bhushan (1990) recognize the impact of firm size on analysts' decision-making. A large firm may be a particularly important client to an analyst's securities firm and, as a result, an analyst may be pressured to issue optimistic forecasts to increase brokerage commissions or to ensure good relations with the management of client firms (Ackert and Athanassakos, 1997). If analysts attempt to generate transactions business or maintain good relations by issuing optimistic forecasts, we expect to find a positive relationship between optimism and firm size.

We also examine the effect of uncertainty in a firm's information environment on analysts' optimism. Stevens, Barron, Kim and Lim (1998) show that analysts' forecast accuracy decreases in a more uncertain information environment.[4] Huberts and Fuller (1995) and Das, Levine and Sivaramakrishnan (1998) report that analysts are more optimistic for firms with low earnings predictability. Accordingly, if higher dispersion in earnings forecasts reflects greater uncertainty in a firm's information environment, the bias in analysts' forecasts should be positively related to the standard deviation of earnings forecasts. Other behavioral considerations may also play a role. When there is little uncertainty, dispersion in analysts' forecasts is likely to be low and analysts may wish to avoid standing out from the crowd. By comparison, when uncertainty is high, dispersion in analysts' forecasts is likely high and analysts have fewer reputational concerns when they act on their incentives to issue optimistic forecasts. Ackert and Athanassakos (1997) show that analysts are more optimistic when uncertainty is high where uncertainty is measured by the standard deviation of earnings forecasts. If these reputational concerns are important, we expect to find a positive relationship between the standard deviation of earnings forecasts and optimism.

We investigate the effect of stock price on analysts' behavior. Analysts may be more optimistic about firms with recent stock price increases as measured by the change in price. If the stock has appreciated in value, an analyst may be more optimistic about the firm.

Finally, we expect to find a seasonal pattern in analysts' optimism. Earlier research shows that analysts' forecast accuracy improves as the length of the forecast horizon declines (Ackert and Hunter, 1994; Ackert and Athanassakos, 1997; and Richardson, Teoh and Wysocki, 1999). Over time, information relating to the firm's performance is revealed so that there is less uncertainty about earnings as the forecast date approaches.

Seasonality in the level of analysts' forecast bias may also arise from the relationships between analysts, the firms that employ them, and their clients. Because portfolio managers rebalance their portfolios as a new year begins, analysts may be willing to be more optimistic at the beginning of the year in order to attract transactions business and please client firms' management. As a result, a large amount of funds is available to be reallocated among various investments at the beginning of the year. With a long forecast horizon, analysts have plenty of time to revise their forecasts. However, as the year progresses and the forecast horizon diminishes, analysts may be more concerned about bias in their forecasts.

### *(iii) Analyst Following*

Analysts have the most to gain from following firms when there is greater interest among investors (O'Brien and Bhushan, 1990). Chung and Jo (1996) document the important effect of market value on analyst following. Analysts have incentives to follow larger firms because larger firms have the potential to generate greater transactions business. In an examination of United Kingdom firms, Marston (1996) reports a positive relationship between analyst following and firm size. Further, in a simultaneous framework, Hussain (2000) provides evidence that larger firms are followed by more financial analysts in the United Kingdom.

We also examine whether analyst following is related to the level of uncertainty in the firm's information environment. An analyst may have more to gain from following firms that are surrounded by significant uncertainty. Analysts have incentives to issue optimistic forecasts when higher uncertainty surrounds a firm (Ackert and Athanassakos, 1997).

In addition, we examine the effect of the price-to-earnings ratio on analyst following. Krische and Lee (2000) argue that analysts prefer stocks that appear to be overvalued. Analysts give more favorable recommendations for growth stocks that are over-valued based on traditional measures. We extend this research by examining whether analyst following increases with over-valuation where over-valuation is measured using the price-to-earnings ratio (Francis, 1991). A high price to earnings ratio may result from speculative excess (Shiller, 2000).

Finally, we test for a seasonal pattern in analyst following. O'Brien and Bhushan (1990) caution that the number of analysts tends to increase over the year. This structural feature of the data appears to be unrelated to the level of analyst following. We examine whether seasonality in the level of analyst following arises in our sample.

### *(iv) Institutional Holdings*

We examine the effect of firm size on institutional holdings. Size is one measure of information availability. A more certain information environment is associated with large firms and such an environment attracts institutional investors. Previous research documents a positive relationship between size and institutional holdings (Ackert and Athanassakos, 2001; and Falkenstein, 1996). Because of agency considerations, institutional investors may prefer to hold stock in large firms. Institutional investors' performance is evaluated ex post so that these investors may be concerned about their portfolios containing stock in small firms that are not well known (Haugen and Lakonishok, 1988). Using the market value of equity to proxy for firm size, we expect a positive relationship between institutional ownership and firm size.

In addition, we investigate the effect of uncertainty in a firm's information environment on the behavior of institutions. Because of their fiduciary responsibilities, institutional investors may avoid firms that are surrounded by much uncertainty (O'Brien and Bhushan, 1990).

Finally, we examine whether a seasonal pattern in institutional holdings is evident. Ackert and Athanassakos (2001) argue that agency considerations have a significant effect on the portfolio allocation decisions of institutions. According to the gamesmanship hypothesis, institutional managers adjust their portfolio holdings away from stock in highly visible firms at the beginning of the year and toward these stocks at the end of the year in order to lock in profits and affect their remuneration. As discussed subsequently, our sample firms are followed by at least three financial analysts so they are likely to be relatively visible and low risk. Because firms included in our sample are visible, we expect to find higher institutional demand as the year progresses.

## 3. SAMPLE SELECTION

Analyst following, earnings forecasts, dispersion of earnings estimates, and actual earnings data are obtained from the Institutional Brokers Estimate System (I/B/E/S) for each year in the 1981 through 1996 sample period. The firms included in the final sample passed through several filters, described below.

(1) The IBES 'Summary History Tape' database includes analysts' consensus forecasts for at least twelve consecutive months starting in January of the forecast year.

(2) At least three individual forecasts determine the consensus forecast of earnings per share.

(3) The company's fiscal year ends in December.[5]

(4) The Standard and Poor's *Stock Guide* contains information on institutional holdings, price per share, price to earnings ratios, and shares outstanding.[6]

The final sample contains 72,141 monthly observations for 455 firms.

In Table 1 we provide sample firm information for the overall sample, as well as for the initial (1981) and final years of the sample (1996). Sample statistics for 1981 and 1996 are reported for comparative purposes and illustrate how firm characteristics have evolved over time.

First the table reports information on analysts' optimism when forecasting earnings for sample firms. Our measure of forecast bias or optimism is:

$$\mathrm{OPT}_{i,T-t} = \frac{(\mathrm{FEPS}_{i,T-t} - \mathrm{EPS}_{i,T})}{\left|\mathrm{EPS}_{i,T}\right|} \tag{1}$$

where $\mathrm{FEPS}_{i,T\text{-}t}$ is the consensus forecast at time $T$-$t$ of time $T$ earnings per share for firm $i$ and $\mathrm{EPS}_{i,T}$ is the actual earnings level for firm $i$ at time $T$. We exclude observations for which the absolute value of actual earnings is less than 20 cents because $\mathrm{OPT}_{i,T\text{-}t}$ is undefined when actual earnings are zero and small earnings levels result in extreme values which have the potential to unduly influence the results. As Ackert and Athanassakos

**Table 1**

Summary Statistics on Sample Firms

| | | *1981* | *1996* | *1981–1996* |
|---|---|---|---|---|
| *Number of firms* | | *238* | *385* | *455* |
| Optimism | Mean | 0.26 | 0.23 | 0.37 |
| | Median | 0.03 | −0.00 | 0.02 |
| | Minimum | −1.12 | −10.00 | −18.00 |
| | Maximum | 20.67 | 44.00 | 50.00 |
| | Std. Deviation | 1.26 | 1.81 | 2.07 |
| No. of earnings estimates | Mean | 14.76 | 16.37 | 17.55 |
| | Median | 14 | 15 | 16 |
| | Minimum | 3 | 3 | 3 |
| | Maximum | 31 | 43 | 52 |
| | Std. Deviation | 5.32 | 7.82 | 7.85 |
| No. of institutions holding firm stock | Mean | 234.97 | 437.36 | 306.21 |
| | Median | 170 | 340 | 233 |
| | Minimum | 11 | 4 | 1 |
| | Maximum | 1,532 | 1,640 | 1,786 |
| | Std. Deviation | 213.30 | 310.99 | 246.74 |
| Market value ($ millions) | Mean | 246.94 | 7,479.38 | 4,333.56 |
| | Median | 250.26 | 2,693.25 | 1,695.92 |
| | Minimum | 212.88 | 85.29 | 9.51 |
| | Maximum | 268.68 | 129,636.52 | 129,636.52 |
| | Std. Deviation | 16.63 | 14,332.14 | 8,744.41 |
| Standard deviation of forecasted earnings | Mean | 0.20 | 0.13 | 0.19 |
| | Median | 0.08 | 0.08 | 0.09 |
| | Minimum | 0.01 | 0.01 | 0.01 |
| | Maximum | 14.08 | 1.66 | 53.25 |
| | Std. Deviation | 0.69 | 0.16 | 0.79 |
| Price | Mean | 18.75 | 34.83 | 25.08 |
| | Median | 11.25 | 30.88 | 20.31 |
| | Minimum | 0.72 | 1.30 | 0.72 |
| | Maximum | 804.22 | 341.00 | 2637.50 |
| | Std. Deviation | 49.71 | 22.48 | 49.16 |
| P/E ratio | Mean | 9.46 | 18.06 | 15.00 |
| | Median | 8 | 16 | 13 |
| | Minimum | 3 | 3 | 1 |
| | Maximum | 73 | 96 | 134 |
| | Std. Deviation | 5.49 | 10.57 | 9.72 |

**Table 1 (Continued)**

*Notes*:
The table reports the number of firms included in the sample, as well as their characteristics. The full sample includes data from January 1981 through December 1996, but for comparative purposes, the table also reports summary information for 1981 and 1996. The table includes sample information on the extent of analyst optimism in earnings forecasts as measured by the difference between analysts' consensus estimate of earnings per share minus actual earnings per share, normalized by the absolute value of actual earnings per share, as well as the number of analysts providing earnings estimates, the number of institutions holding the firm's stock, market value of equity, the standard deviation of forecasted earnings scaled by price, stock price, and price to earnings ratio.

(1997) note, $\mathrm{OPT}_{i,T\text{-}t}$ is an ex post measure of optimism because it relates the forecast to actual earnings that are unobservable when analysts form their expectations. Consistent with previous research, Table 1 shows that the mean $\mathrm{OPT}_{i,T\text{-}t}$ for our sample firms is positive (0.37), suggesting that analysts were optimistic when predicting earnings. Also consistent with the results reported by Brown (1997), the degree of optimism in analysts' forecasts has declined over recent years. For the 1981–89 sub-sample, the mean $\mathrm{OPT}_{i,T\text{-}t}$ was 0.4085 whereas for 1990–96 it was 0.3273.

Analyst following varies considerably with 3 to 52 analysts reporting earnings estimates each month. Average following is substantial for the overall sample and each sample year and is relatively constant across sample years.

Table 1 also reports information of the number of institutional investors for sample firms. We see wide variation in the number of institutional investors with as few as 1 and as many as 1,786. However, the average number of institutions holding sample firms' stock (306.21) is substantial.

We study firm characteristics including the market value of equity, standard deviation of forecasted earnings scaled by stock price, stock price, and price to earnings ratio. As Table 1 reports, the mean market value increases over the sample period from $246.94 million in 1981 to $7,479.38 million in 1996. Given that these firms are visible and followed by at least three analysts each month, many are large. Note, however, that a significant number of sample firms are of more moderate capitalization. We get some perspective on size by considering the size of firms included in small cap indexes. For example, the Wilshire Small Cap Index as of June 30, 1993 included 250 firms with mean market value $511 million.[7] The smallest firm included in the Wilshire index had market capitalization of $89 million and the largest $1.461 billion suggesting that many of our sample firms can be classified as small.[8]

Next Table 1 reports the cross-sectional/times series mean of the standard deviation of the individual analysts' forecasts used to construct the consensus forecast scaled by stock price. Again we see that the information environment surrounding sample firms varies considerably with a minimum (maximum) variation in earnings forecasts of 0.01 (53.25). There is no apparent trend in the standard deviation of forecasted earnings from 1981 to 1996.

The table also reports summary information on stock price. Stock price shows wide variation with a minimum (maximum) of 0.72 (2,637.50). Not surprisingly, the average stock price showed an upward trend over the sample period.

Finally, the table reports summary statistics for the price to earnings ratio. How the market values earnings varies widely over sample firms. Sample firms display divergent levels of valuation as measured by the price to earnings ratio which varies from a minimum of 1 to a maximum of 134.[9] The observed price to earnings ratio is higher in 1996 (18.06) as compared to 1981 (9.46) and appears to trend upward over our sample period.

## 4. THE RELATIONSHIP BETWEEN ANALYSTS AND INSTITUTIONS

The dependent variables are first differences in analysts' optimism ($\Delta OPT_{i,t}$) and the natural logarithms of the number of analysts providing earnings estimates ($\Delta\#Est_{i,t}$) and the number of institutional investors ($\Delta Inst_{i,t}$). As discussed previously, we use changes in these variables because many economic variables are related in levels while no true causal relationship exists. Our differencing interval is one month as we have monthly earnings forecasts. A one-month interval provides sufficient time for analysts and institutions to respond to changes in their environment.

Before we formally test the relationship between analysts and institutions, we examine the correlation structure of the variables and appropriate transformations. The independent variables include several firm characteristics: the market value of equity, one plus the standard deviation of forecasted earnings scaled by stock price, stock price, and price to earnings ratio. All independent variables are first differences of the natural logarithm with Falkenstein (1996) providing direction for the appropriate transformations. Table 2 reports pair-wise correlation coefficients for all variables with $p$-values for a test of zero correlation below. Most of the independent variables are significantly correlated with the dependent variables providing univariate support of their importance. Some significant correlations between the independent variables are also reported suggesting that it is important to attempt to estimate the separate effect of each on the dependent variables. Collinearity may result in high standard errors but does not bias the estimated coefficient estimates. To ensure that multicollinearity is not a problem, we compute variance inflation factors (VIF) for each equation in the model as suggested by Kennedy (1992, p. 183). The VIF is higher when the linear dependence among the independent variables is greater, with $\mathrm{VIF} > 10$ indicating harmful collinearity. We find that VIFs for all equations are below 2 so that a multicollinearity problem is unlikely.

We estimate a three-equation model that examines the joint decisions of analysts and institutions.[10] We estimate the following pooled cross-sectional, time series model:

$$\Delta\mathrm{OPT}_{i,t} = \alpha_0 + \sum_{j=2}^{12} \alpha_j D_{j,t} + \beta_1 \Delta\mathrm{Inst}_{i,t} + \beta_2 \Delta\mathrm{MV}_{i,t} + \beta_3 \Delta\mathrm{StdF}_{i,t} + \beta_4 \Delta P_t + e_{i,t}, \tag{2}$$

$$\Delta\#\mathrm{Est}_{i,t} = \mu_0 + \sum_{j=2}^{12} \mu_j D_{j,t} + \eta_1 \Delta\mathrm{Inst}_{i,t} + \eta_2 \Delta\mathrm{MV}_{i,t} + \eta_3 \Delta\mathrm{StdF}_{i,t} + \eta_4 \Delta P/E_{i,t} + v_{i,t}, \tag{3}$$

and

**Table 2**

Pairwise Correlations

| | $\Delta \mathrm{OPT}_{i,t}$ | $\Delta \#\mathrm{Est}_{i,t}$ | $\Delta \mathrm{Inst}_{i,t}$ | $\Delta \mathrm{MV}_{i,t}$ | $\Delta \mathrm{StdF}_{i,t}$ | $\Delta P_{i,t}$ | $\Delta P/E_{i,t}$ |
|---|---|---|---|---|---|---|---|
| $\Delta \mathrm{OPT}_{i,t}$ | 1 | 0.0027 | −0.0063 | −0.0061 | 0.0087 | −0.0577 | −0.0103 |
| | | (0.4678) | (0.1301) | (0.1381) | (0.0197) | (0.0001) | (0.0173) |
| $\Delta \#\mathrm{Est}_{i,t}$ | | 1 | 0.3103 | 0.1937 | −0.0212 | 0.2056 | 0.0235 |
| | | | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| $\Delta \mathrm{Inst}_{i,t}$ | | | 1 | 0.0603 | −0.0093 | 0.3869 | 0.0450 |
| | | | | (0.0001) | (0.0257) | (0.0001) | (0.0001) |
| $\Delta \mathrm{MV}_{i,t}$ | | | | 1 | −0.0112 | 0.8055 | 0.0339 |
| | | | | | (0.0065) | (0.0001) | (0.0001) |
| $\Delta \mathrm{StdF}_{i,t}$ | | | | | 1 | 0.0356 | 0.0029 |
| | | | | | | (0.0001) | (0.5084) |
| $\Delta P_{i,t}$ | | | | | | 1 | 0.2435 |
| | | | | | | | (0.0001) |
| $\Delta P/E_{i,t}$ | | | | | | | 1 |

*Notes*:
The variables include first differences of optimism in analysts' earnings forecasts ($\Delta \mathrm{OPT}_{i,t}$) and the natural logarithms of the number of analysts providing earnings estimates ($\Delta \#\mathrm{Est}_{i,t}$), the number of institutional investors ($\Delta \mathrm{Inst}_{i,t}$), market value ($\Delta \mathrm{MV}_{i,t}$), one plus the standard deviation of these earnings estimates scaled by price ($\Delta \mathrm{StdF}_{i,t}$), stock price ($\Delta P_{i,t}$), and price to earnings ratio ($\Delta P/E_{i,t}$). The table reports correlation coefficients with the $p$-value for a test of the null hypothesis of zero correlation in parentheses.

$$\Delta \text{Inst}_{i,t} = \phi_0 + \sum_{j=2}^{12} \phi_j D_{j,t} + \lambda_1 \Delta \text{OPT}_{i,t} + \lambda_2 \Delta \#\text{Est}_{i,t} + \lambda_3 \Delta \text{MV}_{i,t} + \lambda_4 \Delta \text{StdF}_t + \varepsilon_{i,t}, \tag{4}$$

where $D_{j,t}$ is a dummy variable taking the value of one for month $j$ and zero otherwise.[11] The intercepts, $\alpha_0$, $\mu_0$, and $\phi_0$, reflect the average sample change in optimism and institutional holdings in January and the coefficients of the remaining dummy variables, $\alpha_j$, $\mu_j$, and $\phi_j$, $j = 2, \ldots, 12$, measure differences in monthly changes from the January base, after taking into account the effects of the remaining independent variables. The other independent variables are first differences of the natural logarithms of firm characteristics including market value, calculated as the stock price times the number of shares outstanding, ($\Delta \text{MV}_{i,t}$), one plus the scaled standard deviation of these earnings estimates ($\Delta \text{StdF}_{i,t}$), price ($\Delta P_{i,t}$), and the price to earnings ratio ($\Delta P/E_{i,t}$). The variable selection is motivated by earlier literature, as discussed previously. The system is identified because each equation has at least one exogenous variable that is constrained to have a zero coefficient in another regression. The model is estimated using single equation Ordinary Least Squares (OLS) and simultaneously using Three-Stage Least Squares (3SLS).

Table 3 reports Ordinary Least Squares (OLS) estimates of equations (2), (3) and (4), as well as simultaneous regression estimates of the three equations using Three-Stage Least Squares (3SLS). The system has a coefficient of determination of 4 percent. The table reports $t$-statistics below each coefficient estimate and, in the final two rows, the regression $R^2$ and an $F$-test of the null hypothesis that all coefficients equal zero. Each equation is highly significant with $p$-values for all $F$-statistics less than 0.001 and explains about 1 percent of the variation in optimism, analyst following, and institutional holdings.

Consistent with the findings of O'Brien and Bhushan (1990) and Alford and Berger (1999), comparison of the OLS and 3SLS estimates suggests that the OLS and simultaneous equations results are different in some cases. The estimates

**Table 3**

Regressions of Analyst Optimism, Analyst Following, and Institutional Holdings on Seasonal Dummies and Firm Characteristics

| | $\Delta OPT_{i,t}$ | | $\Delta \#Est_{i,t}$ | | $\Delta Inst_{i,t}$ | |
|---|---|---|---|---|---|---|
| *Independent Variables* | *OLS* | *3SLS* | *OLS* | *3SLS* | *OLS* | *3SLS* |
| Intercept | 0.0080 | 0.0085 | −0.0218 | −0.0247 | −0.0025 | −0.3416 |
| | (13.77)*** | (21.3)*** | (−19.66)*** | (−4.56)*** | (−1.66)* | (−5.65)*** |
| February | −0.0083 | −0.0086 | 0.0272 | 0.0179 | −0.0081 | 0.4193 |
| | (−10.16)*** | (−15.41)*** | (17.65)*** | (2.35)** | (−3.83)*** | (5.47)*** |
| March | −0.0089 | −0.0122 | 0.0241 | 0.0908 | 0.0193 | 0.4014 |
| | (−10.96)*** | (−13.80)*** | (15.55)*** | (8.32)*** | (9.09)*** | (5.84)*** |
| April | −0.0083 | −0.0086 | 0.0320 | 0.0307 | −0.0001 | 0.4345 |
| | (−10.23)*** | (−15.76)*** | (20.66)*** | (4.06)*** | (−0.03) | (5.51)*** |
| May | −0.0084 | −0.0116 | 0.0191 | 0.0756 | 0.0173 | 0.3555 |
| | (−10.31)*** | (−13.81)*** | (12.32)*** | (7.45)*** | (8.15)*** | (5.84)*** |
| June | −0.0081 | −0.0117 | 0.0259 | 0.0878 | 0.0174 | 0.4148 |
| | (−9.89)*** | (−14.03)*** | (17.08)*** | (8.43)*** | (8.20)*** | (5.78)*** |
| July | −0.0083 | −0.0110 | 0.0172 | 0.0611 | 0.0141 | 0.3316 |
| | (−10.20)*** | (−15.51)*** | (11.32)*** | (6.76)*** | (6.66)*** | (5.77)*** |
| August | −0.0087 | −0.0087 | 0.0199 | 0.0230 | 0.0017 | 0.3349 |
| | (−10.65)*** | (−16.15)*** | (13.12)*** | (3.10)*** | (0.80) | (5.57)*** |
| September | −0.0086 | −0.0043 | 0.0235 | −0.0602 | −0.0211 | 0.3201 |
| | (−10.48)*** | (−4.38)*** | (15.36)*** | (−4.88)*** | (−9.92)*** | (5.20)*** |
| October | −0.0091 | −0.0134 | 0.0214 | 0.1158 | 0.0290 | 0.3793 |
| | (−11.33)*** | (−11.96)*** | (14.23)*** | (8.69)*** | (13.89)*** | (6.02)*** |
| November | −0.0099 | −0.0104 | 0.0222 | 0.0513 | 0.0103 | 0.3631 |
| | (−12.36)*** | (−16.86)*** | (14.80)*** | (6.35)*** | (4.94)*** | (5.73)*** |

**Table 3 (Continued)**

| | $\Delta OPT_{i,t}$ | | $\Delta \# Est_{i,t}$ | | $\Delta Inst_{i,t}$ | |
|---|---|---|---|---|---|---|
| *Independent Variables* | *OLS* | *3SLS* | *OLS* | *3SLS* | *OLS* | *3SLS* |
| December | −0.0085 | −0.0093 | 0.0212 | 0.0377 | 0.0038 | 0.3521 |
| | (−10.65)*** | (−16.61)*** | (14.03)*** | (4.95)*** | (1.81)* | (5.62)*** |
| $\Delta OPT_{i,t}$ | – | – | – | – | 0.0255 | 20.6249 |
| | | | | | (2.11)** | (4.74)*** |
| $\Delta \# Est_{i,t}$ | – | – | – | – | 0.1148 | −8.1114 |
| | | | | | (17.46)*** | (−4.45)*** |
| $\Delta Inst_{i,t}$ | 0.0052 | 0.1773 | 0.0532 | −3.4254 | – | – |
| | (2.85)*** | (4.99)*** | (15.88)*** | (−8.36)*** | | |
| $\Delta MV_{i,t}$ | −0.0270 | −0.0067 | 0.0917 | 0.3347 | 0.1638 | 0.4714 |
| | (−8.23)*** | (−2.85)*** | (28.04)*** | (10.52)*** | (38.17)*** | (7.47)*** |
| $\Delta StdF_{i,t}$ | 0.0419 | 0.0182 | 0.0536 | 0.0687 | −0.0029 | 0.0489 |
| | (14.11)*** | (7.59)*** | (7.92)*** | (2.07)** | (−0.37) | (0.39) |
| $\Delta P_{i,t}$ | 0.0045 | −0.0144 | – | – | – | – |
| | (1.18) | (−3.77)*** | | | | |
| $\Delta P/E_{i,t}$ | – | – | −0.0089 | −0.0611 | – | – |
| | | | (−5.51)*** | (−6.73)*** | | |
| Adjusted $R^2$ | 0.0156 | 0.0166 | 0.0410 | 0.0030 | 0.0605 | 0.0020 |
| $F$-statistic | 49.74*** | 48.79*** | 121.99*** | 8.40*** | 198.86*** | 5.40*** |

*Notes*:
*,**,*** Indicates statistical significance at the 10%, 5% and 1% levels, respectively.
The dependent variables are the first differences of optimism in analysts' earnings forecasts ($\Delta OPT_{i,t}$), the natural logarithm of the number of analysts providing earnings estimates ($\Delta \# Est_{i,t}$), and the natural logarithm of the number of institutional investors ($\Delta Inst_{i,t}$). Optimism is measured as the difference between analysts' consensus estimate of earnings per share minus actual earnings per share, normalized by the absolute value of actual earnings per share. The independent variables include seasonal dummy variables taking the value of one for each month and the first differences of the natural logarithms of firm characteristics including market value ($\Delta MV_{i,t}$), one plus the scaled standard deviation of these earnings estimates ($\Delta StdF_{i,t}$), price ($\Delta P_{i,t}$), and price to earnings ratio ($\Delta P/E_{i,t}$). The model is estimated using single equation, Ordinary Least Squares (OLS) and simultaneously using three-stage least squares (3SLS). The table reports $t$-statistics below each coefficient estimate and, in the final two rows, the regression $R^2$ and an $F$-test of the null hypothesis that all coefficients equal zero.

suggest that analysts respond to higher institutional interest by reporting more optimistic forecasts and reducing following. Institutions respond to analysts' optimism by increasing their holdings, but at the same time, greater analyst following leads to lower institutional holding. Consistent with our expectations, analysts and institutions function in a joint information environment.[12]

The estimates of the effects of firm characteristics from our simultaneous model provide additional insight into analysts' and institutions' behavior. Analysts are less optimistic for larger firms and analysts and institutions both show more interest in large firms. Further, inconsistent with our expectations, analysts are less optimistic for firms that have experienced stock price appreciation. Also, consistent with our expectations, analysts are more optimistic for firms that are surrounded by greater uncertainty as measured by $\Delta \mathrm{StdF}_{i,t}$. Analysts are also more likely to follow firms surrounded by uncertainty. The estimated response of analysts to changes in $\Delta P/E_{i,t}$ is negative, leading us to conclude that if analysts prefer to recommend stocks that are over-valued, they do not display preference for these firms by increasing their coverage.

The estimates reported in Table 3 document strong seasonality in analysts' optimism and institutional holdings, after controlling for the remaining independent variables. Inconsistent with O'Brien and Bhushan's (1990) observation that the number of analysts included in the I/B/E/S database increases over the year, we find that the seasonal pattern does not reflect a clear pattern of increases over the calendar year. Consistent with our expectations, analysts are more optimistic in January than any other month of the year and their optimism consistently moves down over the year. Estimated coefficients of the seasonal dummy variables in the institutional holdings equation are also consistently increasing throughout the year. These estimates suggest that gamesmanship may be important.

## 5. DISCUSSION OF RESULTS

We find that behavioral considerations are important in understanding analysts' and institutions' decisions. The effects of the characteristics we study are summarized as follows. Analyst following and institutional holding are higher for larger firms but optimism is higher for smaller firms. Our results suggest that optimism increases with increases in the dispersion of forecasts so that research quality deteriorates with greater uncertainty in a firm's information environment. Greater uncertainty is associated with higher analyst following and greater institutional interest. We also report a strong seasonal pattern in analysts' optimism after controlling for endogenous and exogenous influences. Finally, estimated seasonals in the institutional investment equation provide support for the gamesmanship hypothesis which suggests that institutions systematically rebalance holdings over the year in response to agency considerations.

There are several puzzling aspects to our findings. Paradoxically, our estimates indicate that institutions respond to higher analyst following by reducing their holdings. Similarly, analysts respond negatively to increased institutional holdings. These findings are inconsistent with the notion that institutions prefer holding stock in firms covered by analysts due to fiduciary responsibilities and increased information and with some findings reported in the extant literature (Hussain, 2000). Other research, however, finds mixed evidence on the response of institutions to analyst following (O'Brien and Bhushan, 1990). Future research might provide additional insight into the behavior of institutional investors.

The estimated effect of uncertainty on institutional behavior is also perplexing. Institutional demand is higher with increases in the dispersion of forecasts, again a result inconsistent with the notion that institutions avoid risk due to their fiduciary responsibilities.

Finally, the estimated effect of changes in market value on analysts' optimism is noteworthy. Interestingly, O'Brien and Bhushan (1990) note that their results do not support conventional assumptions about how firm size affects analyst behavior. They find no support for the hypothesis that analyst following increases with increases in firm size. Although we expected to find increasing optimism with size if analysts issue optimistic forecasts in order to generate transactions business or maintain positive relations with managers, the results do not support our expectation. We find that size had a negative effect on optimism.

Optimism may be lower for large firms if a more certain information environment is associated with these firms. With less uncertainty, analyst forecast bias should be low, and thus optimism low. Future research might further examine the effect of firm size on analysts' decision-making.

It is possible that some of these puzzles derive from a limitation of our analysis. Our 3SLS model may be subject to misspecification (Alford and Berger, 1999, p. 232). However, when we re-estimated the equation system using 2SLS, inferences were unchanged. Moreover, our analysis considers contemporaneous changes in the variables and other models can be envisioned. However, no better fitting model was evident from our examination. We also examined the impact of including firms in regulated industries. Hussain (2000), and others, have included a dummy variable for firms in regulated industries. The demand for analysts' services may be lower for highly regulated firms because these firms are closely monitored. We re-estimated the model including a dummy for regulated industries. The dummy was insignificant in all regressions. We also estimated the model excluding all firms in regulated industries and inferences were unchanged.

## 6. CONCLUDING REMARKS

This paper uses a simultaneous equations model to examine the behavior of professional financial analysts and institutional investors. Because their decisions are intertwined, examination of either analysts or institutions in isolation misses feedback effects and may result in erroneous inferences. Our results document the importance of the joint information environment in which these agents operate. Single and simultaneous approaches result in different inferences in some cases. Analysts respond to increases in institutional holdings by increasing their optimism for a firm's earnings and are less likely to follow firms with more significant institutional interest. Likewise, institutions increase their holdings in a firm when analysts revise their earnings expectations upward. Behavioral considerations are important when we examine analysts' and institutions' decisions. Yet paradoxically, we find that analysts and institutions respond negatively to each other. Future research should address the behavior of institutional investors.

## NOTES

1 Others have used simultaneous behavior models to examine analysts' behavior. For example, Brennan and Subrahmanyam (1995) examine analyst following and adverse selection costs and Alford and Berger (1999) examine analyst following, forecast bias, and trading volume.
2 Tests for endogeneity are consistent with this view. See note 10.
3 The first differenced design corrects for cross-sectional correlation and allows the regression to be estimated using pooled data (Beaver, McAnally and Stinson, 1997; and O'Brien, 1999). An alternative approach is adopted by Alford and Berger (1999) who estimate their models using levels. Their coefficient estimates are averages of yearly estimates of their regression model. See also note 11.
4 In related work, Capstaff, Paudyal and Rees (1995) conclude that forecast accuracy falls when earnings are declining because analysts avoid forecasting lower earnings. Firms with lower earnings outcomes likely have a more uncertain information environment. Furthermore, Moses (1990), Dowen (1996) and Butler and Saraoglu (1999) find that financial analysts are very optimistic when firms report negative earnings.
5 Following Givoly (1985) we exclude firms with non-December year ends to ensure convenient and appropriate inter-temporal comparisons over the cross-section. A common year-end yields a common forecast horizon.
6 Institutional holdings data includes investment companies, banks, insurance companies, college endowments, and '13F' money managers and is obtained by the Standard and Poor's Corporation from Vickers Stock Research.
7 See the July 1993 Chicago Board of Trade Supplement.
8 In fact, 38.87% of our sample firms had market capitalization of less than $1.461 billion in 1993.
9 Firms with negative profits are excluded from the analysis because the price to earnings ratio is meaningless and is, thus, not reported in the Standard and Poor's *Stock Guide*.
10 Analysts' and institutions' decisions are viewed as endogenous. Empirical support for this assumption is provided by Hausman's (1978, 1983) test which indicates significant endogeneity.
11 We estimate the coefficients using a pooled technique rather than averages of yearly estimates as in Alford and Berger (1999). Seasonal effects cannot be estimated using year by year estimation. See Beaver, McAnally and Stinson (1997) on using pooled regressions.
12 To further understand how the relationship between analysts and institutions has evolved over time, we re-estimated our model for two non-overlapping sub-periods: 1981–1989 and 1990–1996. The first sub-period represents a period of relatively high inflation that preceded the last recession experienced in the United States. The latter sub-period, on the other hand, represents a more recent period of historically low and stable

inflation. The estimates are similar in both sub-periods to the overall sample results. In fact, the linkages appear to have strengthened over time.

## REFERENCES

Ackert, L.F. and G. Athanassakos (1997), 'Prior Uncertainty, Analyst Bias, and Subsequent Abnormal Returns', *Journal of Financial Research*, Vol. 20, No. 2 (Summer), pp. 263–73.

——— ——— (2001), 'Visibility, Institutional Preferences, and Agency Considerations', *Journal of Psychology and Financial Markets*, Vol. 2, No. 4, pp. 201–9.

——— and W.C. Hunter (1994), 'Rational Expectations and the Dynamic Adjustment of Security Analysts' Forecasts to New Information'. *Journal of Financial Research*, Vol. 17, No. 3 (Fall), pp. 387–401.

———, B.K. Church and M. Shehata (1997), 'An Experimental Examination of the Effects of Forecast Bias on Individuals' Use of Forecasted Information', *Journal of Accounting Research*, Vol. 35, No. 1 (Spring), pp. 25–42.

——— ——— and P. Zhang (1999), *The Effect of Forecast Bias on Market Behavior: Evidence from Experimental Asset Markets*, Working Paper (Federal Reserve Bank of Atlanta).

Alford, A.W. and P.G. Berger (1999), 'A Simultaneous Equations Analysis of Forecast Accuracy, Analyst Following, and Trading Volume', *Journal of Accounting, Auditing, and Finance* (New Series), Vol. 14, No. 3 (Summer), pp. 219–40.

Ali, A., A. Klein and J. Rosenfeld (1992), 'Analysts' Use of Information about Permanent and Transitory Earnings Components in Forecasting Annual EPS, *Accounting Review*, Vol. 67, No. 1 (January), pp. 183–98.

Beaver, W.H., M.L. McAnally and C.H. Stinson (1997), 'The Information Content of Earnings and Prices: A Simultaneous Equations Approach', *Journal of Accounting and Economics*, Vol. 23, pp. 53–81.

Bhushan, R. (1989), 'Firm Characteristics and Analyst Following', *Journal of Accounting and Economics*, Vol. 11, Nos. 2–3 (July), pp. 255–74.

Brennan, M.J. and A. Subrahmanyam (1995), 'Investment Analysis and Price Formation in Securities Markets', *Journal of Financial Economics*, Vol. 38, No. 3 (July), pp. 361–81.

Brown, L.D. (1997), 'Analyst Forecasting Errors: Additional Evidence', *Financial Analysts Journal*, Vol. 53 (November/December), pp. 81–88.

Butler, K.C. and H. Saraoglu (1999), 'Improving Analysts' Negative Earnings Forecasts', *Financial Analysts Journal*, pp. 48–56.

Capstaff, J., K. Paudyal and W. Rees (1995), 'The Accuracy and Rationality of Earnings Forecasts by UK Analysts', *Journal of Business Finance & Accounting*, Vol. 22, No. 1, pp. 67–85.

Chung, K.H. and H. Jo (1996), 'The Impact of Security Analysts' Monitoring and Marketing Functions on the Market Value of Firms', *Journal of Financial and Quantitative Analysis*, Vol. 31, No. 4, pp. 493–512.

Das, S., C.B. Levine and K. Sivaramakrishnanm (1998), 'Earnings Predictability and Bias in Analysts' Earnings Forecasts', *Accounting Review*, Vol. 73, No. 2, pp. 277–94.

De Bondt, W.F.M. and R.H. Thaler (1990), 'Do Security Analysts Overreact?' *American Economic Review*, Vol. 80, No. 2 (May), pp. 52–57.

Dowen, R.J. (1996), 'Analyst Reaction to Negative Earnings for Large Well-Known Firms', *Journal of Portfolio Management*, pp. 49–55.

Dugar, A. and S. Nathan (1995), 'The Effect of Investment Banking Relationships on Financial Analysts' Earnings Forecasts and Investment Recommendations', *Contemporary Accounting Research*, Vol. 12 (Fall), pp. 131–60.

Falkenstein, E.G. (1996), 'Preferences for Stock Characteristics as Revealed by Mutual Fund Portfolio Holdings,' *Journal of Finance*, Vol. 51, No. 1 (March), pp. 111–35.

Francis, J.C. (1991), Investments: Analysis and Management (McGraw-Hill, New York).

——— and D. Philbrick (1993), 'Analysts' Decisions as Products of a Multi-Task Environment,' *Journal of Accounting Research*, Vol. 31, No. 2 (Autumn), pp. 216–30.

Givoly, D. (1985), 'The Formation of Earnings Expectations,' *Accounting Review*, Vol. 60, No. 3 (July), pp. 372–86.

Haugen, R.A. and J. Lakonishok (1988), The Incredible January Effect: The Stock Market's Unsolved Mystery (Dow-Jones-Irwin, Homewood, Illinois).

Hausman, J. (1978), 'Specification Tests in Econometrics,' *Econometrica*, Vol. 46, pp. 1251–71.

——— (1983), 'Specification and Estimation of Simultaneous Equations Models,' in Z. Griliches and M. Intriligator (eds), Handbook of Econometrics (Horth-Holland, Amsterdam).

Huberts, L.C. and R.J. Fuller (1995), 'Predictability Bias in the U.S. Equity Market,' *Financial Analysts Journal*, pp. 12–28.

Hussain, S. (1996), 'Over-Reaction by Security Market Analysts: The Impact of Broker Status and Firm Size', *Journal of Business Finance & Accounting*, Vol. 23, Nos 9/10, pp. 1223–44.

——— (2000), 'Simultaneous Determination of UK Analyst Following and Institutional Ownership', *Accounting and Business Research*, Vol. 30, No. 2, pp. 111–24.

Jensen, M.C. and W.H. Meckling (1976), 'Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure,' *Journal of Financial Economics*, Vol. 3, No. 4 (October), pp. 305–60.

Kennedy, P. (1992), *A Guide to Econometrics* (3rd ed., The MIT Press, Cambridge, Massachusetts).

Krische, S.D. and C.M.C. Lee (2000), 'The Information Content of Analyst Stock Recommendations', Working Paper (Cornell University).

Lakonishok, J., A. Shleifer, R. Thaler and R. Vishny (1991), 'Window Dressing by Pension Fund Managers,' *American Economic Review*, Vol. 81, No. 2 (May), pp. 227–31.

Marston, C. (1996), 'Firm Characteristics and Analysts Following in the UK,' *The British Accounting Review*, Vol. 29, No. 2 (December), pp. 335–47.

Moses, O.D. (1990), 'On Bankruptcy Indicators From Analysts' Earnings Forecasts', *Journal of Accounting, Auditing, and Finance*, pp. 379–404.

O'Brien, P.C. (1999), 'Discussion: A Simultaneous Equations Analysis of Forecast Accuracy, Analyst Following, and Trading Volume,' *Journal of Accounting, Auditing, and Finance (New Series)*, Vol. 14, No. 3 (Summer), pp. 241–46.

——— and R. Bhushan (1990), 'Analyst Following and Institutional Ownership,' *Journal of Accounting Research*, Vol. 28, pp. 55–76.

Richardson, S., S.H. Teoh and P. Wysocki (1999), 'Tracking Analysts' Forecasts Over the Annual Earnings Horizon: Are Analysts' Forecasts Optimistic or Pessimistic?,' Working Paper (University of Michigan).

Ross, S.A., R.W. Westerfield and J. Jaffe (1999), Corporate Finance (5th ed., Irwin McGraw-Hill, Boston).

Schipper, K. (1991), 'Analysts' Forecasts,' *Accounting Horizons*, Vol. 5 (December), pp. 105–21.

Shiller, R.J. (2000), *Irrational Exuberance* (Princeton University Press, Princeton, New Jersey).

Stevens, D.E., O.E. Barron, O. Kim and S.C.K. Lim (1998), 'Using Analysts' Forecasts to Measure Properties of Analysts' Information Environment,' Working Paper (University of New Hampshire).