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A Simultaneous Equations Analysis of Analysts' Forecast Bias and Institutional Ownership

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Abstract: In this paper we use a simultaneous equations model to examine the relationship between analysts' forecasting decisions and institutions' investment decisions. Neglecting their interaction results in model misspecification. We find that analysts' optimism concerning a firm's earnings responds positively to changes in the number of institutions holding the firm's stock. At the same time, institutional demand responds positively to increases in analysts' optimism. We also investigate several firm characteristics as determinants of analysts' and institutions' decisions. We conclude that agency-driven behavioral considerations are significant.

JEL classification: G10, G20

Key words: financial analysts, institutional ownership, earnings forecasts

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1. Introduction

In this paper we use a simultaneous equations model to examine the relationship between analysts' forecast accuracy 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 because of institutional demand for the firm's stock and, at the same time, institutions may make asset allocation decisions using analysts' research reports.

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. Importantly, their empirical results are quite different when the simultaneous nature of analysts' and institutions' decisions is recognized. Though we also examine the decisions of analysts and institutional investors, we investigate how analysts respond to institutional demand by examining their forecasting behavior rather than their decisions to cover a particular firm. At the same time, we examine how institutions respond to the forecasts that analysts issue.

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 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)).

Our simultaneous equations model recognizes the link between the decisions made by analysts and institutional investors. Although many previous studies have examined analyst behavior and institutional demand, the joint nature of the relationship between analysts and institutions has been ignored, with the exception of O'Brien and Bhushan (1990). A single decision approach leads to a misspecification known as simultaneous equations bias where the error term and dependent variable are correlated, violating the Ordinary Least Squares (OLS) assumption that no such correlation exists.

Using a sample of forecasts of annual earnings per share from the Institutional Brokers Estimate System (I/B/E/S), we estimate our model using single equation and simultaneous equations approaches and show that inferences are strikingly different. When the equations are estimated ignoring feedback effects, we find that analysts and institutions respond negatively to each other. However, when we recognize their interaction, institutional demand increases with increasing optimism in analysts' forecasts and analysts' optimism increases with increasing institutional demand. To examine whether the relationship between analysts and institutions has changed over time, we re-estimate our model for two sub-periods and find that their relationship has strengthened over our sample period.

We also find that agency-driven behavioral considerations are significant. Analysts' optimism is higher when a firm's information environment is more uncertain. Although optimism decreases with increases in firm size and analyst following, institutional demand responds positively to firm size and analyst following, holding all else constant. Our results further suggest that institutional demand responds negatively to increases in risk as measured by the price to earnings ratio. However, sub-period estimates of firm-specific variables are not stable.

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)). However, unlike other research (Ackert and Athanassakos (1999)), our direct tests show no clear seasonal pattern in the change in institutional holdings. A seasonal pattern is expected if institutions systematically rebalance holdings through the year in response to agency considerations. Though there is some evidence that agency considerations may have been important for institutional investors in the early part of our sample period, these concerns seem to have dissipated over time.

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 the third section. We report the empirical evidence in the fourth section. The final section provides discussion of the results and directions for future research.

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.

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)). 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. We examine whether analysts' optimism or institutional holdings can be explained by these behavioral considerations.

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 dependent variable 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 accuracy and institutional holdings, while recognizing the joint decision environment in which analysts and institutions function. Following Ackert and Athanassakos (1997), we measure analysts' optimism for a firm as the difference between forecasted and actual earnings, scaled by the absolute value of actual earnings. 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 that levels because the levels of many variables are cross-sectionally 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 whether analysts decide to issue more optimistic forecasts when institutional holdings increase.

In addition to the two endogenous variables, we examine the effect of several firm characteristics on analysts' optimism and institutional holdings. In the following subsections we discuss the expected associations and their signs.

2.1 Agency Considerations and Analysts' Forecast Bias

We examine the impact of firm size, analyst following, and uncertainty about earnings on analysts' optimism. The literature that examines the properties of analysts' earnings forecasts provides direction for the construction of the model. Also based on prior research, we posit directional hypotheses for the influence of each variable on analysts' behavior.

O'Brien and Bhushan (1990) recognize the impact of firm size on analysts' decision-making. Analysts have the most to gain from following firms when there is greater interest among investors. Analysts have incentives to follow larger firms because larger firms have the potential to generate greater transactions business. O'Brien and Bhushan (1990), however, find no evidence that analyst following increases with firm size once the interactions between analysts and institutional investors are recognized. Yet, analysts 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)). A large firm may be a particularly important client to an analyst's securities firm. 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.

Analysts have more to gain from following a firm when there is little competition from other analysts (O'Brien and Bhushan (1990)). When few analysts follow a firm, an analyst has little competition and more opportunity to generate transactions business by issuing an optimistic report. On the other hand, when many analysts follow a firm, the quality of analysts' reports increases because the collective expenditure on private information acquisition is higher (Alford and Berger (1999)). When more analysts follow a firm forecast accuracy should improve and observed forecasts should be closer to actual earnings. Thus, we expect to find a negative relationship between optimism and analyst following.

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. Accordingly, if higher dispersion in earnings forecasts reflects greater uncertainty in a firm's information environment, the error 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.

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 more willing to err on the upside 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 accuracy.

2.2 Institutional Holdings

We examine the effects of firm size, analyst following, and risk on institutional holdings. Generally speaking, institutional ownership increases with information generated about a firm and decreases with risk. Again we appeal to the extant literature to posit directional hypotheses.

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 (1999) 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.

We also expect a positive relationship between institutional holdings and analyst following. This relationship may arise from demand or supply effects (Bhushan (1989)). Demand for analysts' services will increase with greater institutional holdings if large institutions find it more cost-effective to purchase analysts' services than do small investors. At the same time, the supply of analysts will increase with greater institutional holdings if more transactions business is generated by institutions. Ackert and Athanassakos (1999) find that institutional holdings increase with the number of analysts following a firm.

We expect a negative relationship between institutional holdings and risk, as measured by the price to earnings ratio. Institutions face the potential of costly losses in lawsuits if their decisions are judged to lack prudence and, thus, institutional investors may be more risk averse than ordinary investors (O'Brien and Bhushan (1990)). As a result, institutions may prefer to avoid investing in high risk firms.

Finally, we expect to find a seasonal pattern in institutional holdings. Ackert and Athanassakos (1999) 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 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.[4]

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

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 optimism is

$$OPT_{i,T-t} = \frac{(FEPS_{i,T-t} - EPS_{i,T})}{\left|EPS_{i,T}\right|} \tag{1}$$

where $FEPS_{i,T-t}$ is the consensus forecast at time T-t of time T earnings per share for firm i and $EPS_{i,T}$ 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 $OPT_{i,T-t}$ 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 (1997) note, $OPT_{i,T-t}$ 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 $OPT_{i,T-t}$ 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 somewhat over recent years. For the 1981-89 sub-sample, the mean $OPT_{i,T-t}$ was 0.4085 whereas for 1990-96 it was 0.3273.

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, number of analysts providing earnings estimates, price to earnings ratio, and standard deviation of forecasted earnings scaled by stock price. 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.[5] 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.[6]

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.

Next the table reports summary statistics for the price to earnings ratio. Sample firms display divergent levels of riskiness as measured by the price to earnings ratio which varies from a minimum of 1 to a maximum of 134.[7] 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.

Finally, 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.

4. The Relationship between Analysts' Bias and Institutional Ownership

The two dependent variables are first differences in analysts' optimism and the natural logarithm of the number of institutional investors. As discussed previously, we use changes in these two 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' optimism and institutional holdings, we examine the correlation structure of the variables and appropriate transformations. The independent variables include several firm characteristics: the market value of equity, number of analysts providing earnings estimates, price to earnings ratio, and one plus the standard deviation of forecasted earnings scaled by stock price. All independent variables are first differences of the natural logarithm with Falkenstein (1996) providing direction for the appropriate transformations. Table 2 reports estimated correlation coefficients with the p-value 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, page 183). The VIF is higher when the linear dependence among the independent variables is greater, with VIF > 10 indicating harmful collinearity. We find that VIFs for both equations are below 2 so that a mulitcollinearity problem is unlikely.

The two-equation model we estimate examines the joint decisions of analysts and institutions. Both analyst's and institution's decisions are viewed as endogenous. Empirical support for this assumption is provided by Hausman's (1978, 1983) test. The evidence supports endogeneity in both directions with t-values of 67.32 for the analyst's equation and 106.96 for the institution's equation.

We estimate the pooled cross-sectional, time series model

$$\Delta OPT_{i,t} = \alpha_0 + \sum_{j=2}^{12} \alpha_j D_{j,t} + \beta_1 \Delta Inst_{i,t} + \beta_2 \Delta MV_{i,t} + \beta_3 \Delta \# Est_{i,t} + \beta_4 \Delta StdF_{i,t} + e_{i,t} \qquad \textbf{(2)}$$

and

$$\Delta Inst_{i,t} = \phi_0 + \sum_{j=2}^{12} \phi_j D_{j,t} + \gamma_1 \Delta OPT_{i,t} + \gamma_2 \Delta MV_{i,t} + \gamma_3 \Delta \# Est_{i,t} + \gamma_4 \Delta \ P/E_{i,t} + \varepsilon_{i,t} \qquad \textbf{(3)}$$

where $D_{j,t}$ is a dummy variable taking the value of one for month j and zero otherwise. The intercepts, α_0 and ϕ_0, reflect the average sample return in January and the coefficients of the remaining dummy variables, α_j and ϕ_j, j = 2, ..., 12, measure differences in monthly returns from the January base, after taking into account the effects of the remaining independent variables. The other independent variables in the analysts' optimism regression (2) are first differences of the natural logarithms of firm characteristics including market value ($\Delta MV_{i,t}$), number of analysts providing earnings estimates or visibility ($\Delta \# Est_{i,t}$), and one plus the scaled standard deviation of these earnings estimates ($\Delta StdF_{i,t}$). The institutional holdings regression (3) replaces one plus the scaled standard deviation of the earnings estimates ($\Delta StdF_{i,t}$) with the price to earnings ratio ($\Delta P/E_{i,t}$). The variable selection (inclusion and exclusion) is motivated by earlier literature. Exclusion of a variable from each equation allows the system to be identified. The system is exactly identified because each equation has one exogenous variable which is constrained to have a zero coefficient in the other regression. The model is estimated using single equation Ordinary Least Squares (OLS) and simultaneously using Two-Stage Least Squares (2SLS).[8]

Table 3 reports Ordinary Least Squares (OLS) estimates of equations (2) and (3), as well as simultaneous regression estimates of the two equations using Two-Stage Least Squares (2SLS). Panel A of the table reports estimates of the seasonal dummies and Panel B the coefficients of the firm characteristics variables. 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. Both equations are highly significant with p-values for all F-statistics less than 0.001. The 2SLS regressions explain about 2 percent of the variation in optimism and 6 percent of the variation in institutional holdings.

Consistent with the findings of O'Brien and Bhushan (1990) and Alford and Berger (1999), comparison of the OLS and 2SLS estimates suggests that the use of a simultaneous equations approach is very important, especially with respect to inferences based on the endogenous influences. The OLS estimates suggest that analysts' optimism and institutional holdings respond negatively to each other so that institutions react to higher optimism by lowering their holdings and analysts react to higher institutional demand by lowering their optimism for a firm. However, the 2SLS estimates have opposite, statistically significant signs. Consistent with our expectations, analysts and institutions function in a joint information environment in which institutions increase holdings in firms for which analysts are optimistic and analysts increase their forecasts for firms when institutions increase their holdings.

For the first equation in our simultaneous model, we also see some differences in OLS and 2SLS estimates of the effects of firm characteristics on analysts' behavior. The 2SLS estimates of the effects of $\Delta MV_{i,t}$ and $\Delta \#Est_{i,t}$ on analyst behavior are negative and significant, though the OLS estimates are insignificant. The results are (are not) consistent with our directional hypothesis regarding the effect of $\Delta \#Est_{i,t}$ ($\Delta MV_{i,t}$) on analysts' optimism. Finally, the effect of $\Delta StdF_{i,t}$ is significantly positive using either estimation method, as expected.

For the second equation of our system, OLS and 2SLS estimates of the effects of firm characteristics on institutional holdings are consistent. All coefficient estimates provide support for our directional expectations. Institutional investors react positively to changes in $\Delta MV_{i,t}$ and $\Delta \#Est_{i,t}$, and negatively to changes in $\Delta P/E_{i,t}$.

The estimates reported in Panel A of Table 3 also document strong seasonality in analysts' optimism after controlling for the remaining independent variables. 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, while generally increasing throughout the year, are not increasing monotonically. However, the significance of the estimated dummies for the last three months of the year, in particular, suggest that gamesmanship may be important.

To further understand how the relationship between analysts and institutions has evolved over time, we re-estimated our model (equations (2) and (3)) for two sub-periods. Table 4 reports the estimates for the 1981-1989 sample period, an inflationary time period that preceded the last recession experienced in the U. S. economy. Table 5 provides results for the more recent sub-sample which includes data from 1990-1996, a period of historically low and stable inflation. Focusing on the 2SLS estimates, the relationship between analysts and institutions has strengthened over time. For the earlier sample period Table 4 reports a positive response of analysts to institutions, but no significant response in the other direction. For the more recent time period Table 5 reports significant, positive responses for analysts to institutions and institutions to analysts. We also report instability in the estimated coefficient of market value, which actually changes signs in both regressions. Note that the seasonal pattern in analysts' optimism is strong in both sub-periods, whereas there are differences in the estimated seasonal dummy variables for the institutional holdings equation. For the more recent sample period, we do not find consistent evidence that institutional demand increases for our sample firms as the year progresses.

5. Discussion of Results and Conclusion

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. Analysts respond to increases in institutional holdings by increasing their optimism for a firm's earnings. Likewise, institutions increase their holdings in a firm when analysts revise their earnings expectations upward.

We also find that behavioral considerations are important when we examine analysts' and institutions' decisions. For the most part, the 2SLS results are consistent with our expectations. The effects of the characteristics we study are summarized as follows. We find that analysts' optimism is negatively related to the number of analysts following the firm so that the quality of analysts' reports is enhanced by private information acquisition. 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. The holdings of institutional investors increase with increases in firm size and analyst following because there is lower uncertainty surrounding larger firms who are highly followed. Institutional holdings decrease with increases in risk as measured by the price to earnings ratio. We also report a strong seasonal pattern in analysts' optimism after controlling for endogenous and exogenous influences. Finally, though estimated seasonals in the institutional investment equation provide some support for the gamesmanship hypothesis for the earlier time period, the estimates using the more recent data do not provide clear support for the notion that institutions systematically rebalance holdings over the year in response to agency considerations.

The estimated effect of changes in market value on analysts' optimism is also noteworthy.[9] 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 analysts' optimism to increase with firm size, we found 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 accuracy should be high, and thus optimism low. Furthermore, low uncertainty in large firm's information environment suggests that analyst following will not increase with firm size as O'Brien and Bhushan conclude. With low uncertainty there is little payoff to private information acquisition and an analyst has little to gain by joining an already crowded playing field. 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. However, for the more recent sample sub-period, the estimated effect of size on optimism is positive, as expected. Future research might further examine the effect of firm size on analysts' decision-making.

Endnotes

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 accuracy, and trading volume.

2. Tests for endogeneity are presented subsequently.

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.

4. Following Givoly (1985) we exclude firms with non-December year ends to ensure convenient and appropriate inter-temporal comparisons over the cross-section.

5. See the July 1993 Chicago Board of Trade Supplement.

6. In fact, 38.87% of our sample firms had market capitalization of less than $1.461 billion in 1993.

7. 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.

8. We use 2SLS rather than 3SLS because 3SLS is more sensitive to model misspecification (Alford and Berger [1999]).

9. O'Brien (1999) discusses the troublesome interpretation of size in empirical research. We re-estimated our model replacing market value with stock price and number of shares outstanding, both in first differences, and inferences were unchanged.

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Table 1
Summary Statistics on Sample Firms
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 institutions holding the firm's stock, market value of equity, stock price, the number of analysts providing earnings estimates, price to earnings ratio, and the standard deviation of forecasted earnings scaled by price.

		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
# 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	85.293	9.51
	Maximum	268.68	129,636.52	129,636.52
	Std. Deviation	16.63	14,332.14	8,744.41
# 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
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
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

Table 2
Pairwise Correlations

The variables include first differences of optimism in analysts' earnings forecasts ($\Delta OPT_{i,t}$) and the natural logarithms of the number of institutional investors ($\Delta Inst_{i,t}$), market value ($\Delta MV_{i,t}$), number of analysts providing earnings estimates ($\Delta \#Est_{i,t}$), price to earnings ratio ($\Delta P/E_{i,t}$), and one plus the standard deviation of these earnings estimates scaled by price ($\Delta StdF_{i,t}$). The table reports correlation coefficients with the p-value for a test of the null hypothesis of zero correlation in parentheses.

	$\Delta OPT_{i,t}$	$\Delta Inst_{i,t}$	$\Delta MV_{i,t}$	$\Delta \#Est_{i,t}$	$\Delta P/E_{i,t}$	$\Delta StdF_{i,t}$
$\Delta OPT_{i,t}$	1	-0.0063 (0.1301)	-0.0061 (0.1381)	0.0027 (0.4678)	-0.0103 (0.0173)	0.0087 (0.0197)
$\Delta Inst_{i,t}$		1	0.0603 (0.0001)	0.3103 (0.0001)	0.0450 (0.0001)	-0.0093 (0.0257)
$\Delta MV_{i,t}$			1	0.1937 (0.0001)	0.0339 (0.0001)	-0.0112 (0.0065)
$\Delta \#Est_{i,t}$				1	0.0235 (0.0001)	-0.0212 (0.0001)
$\Delta P/E_{i,t}$					1	0.0029 (0.5084)
$\Delta StdF$						1

Table 3
Regressions of Institutional Holdings and Analyst Optimism on Seasonal Dummies and Firm Characteristics
The dependent variables are the first differences of optimism in analysts' earnings forecasts ($\Delta OPT_{i,t}$) 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 ($\Delta MV_{i,t}$), number of analysts providing earnings estimates or visibility ($\Delta\#Est_{i,t}$), price to earnings ratio ($\Delta P/E_{i,t}$), and one plus the scaled standard deviation of these earnings estimates ($\Delta StdF_{i,t}$). The model is estimated using single equation, Ordinary Least Squares (OLS) and simultaneously using two-stage least squares (2SLS). 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.

Panel A: Seasonal Dummies

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
Intercept	0.2981 (17.60)***	0.2997 (17.07)***	0.0004 (0.28)	-0.0017 (-1.03)
February	-0.3187 (-13.53)***	-0.2951 (-11.94)***	-0.0090 (-4.11)***	-0.0067 (-2.91)***
March	-0.3237 (-13.72)***	-0.3739 (-14.49)***	0.0166 (7.64)***	0.0190 (8.26)***
April	-0.3224 (-13.63)***	-0.3161 (-12.88)***	-0.0035 (-1.58)	-0.0011 (-0.47)
May	-0.3200 (-13.58)***	-0.3680 (-14.34)***	0.0143 (6.54)***	0.0167 (7.21)***
June	-0.3170 (-13.67)***	-0.3601 (-14.37)***	0.0142 (6.63)***	0.0165 (7.30)***
July	-0.3096 (-13.38)***	-0.3450 (-13.98)***	0.0116 (5.43)***	0.0138 (6.15)***
August	-0.3255 (-14.07)***	-0.3257 (-13.58)***	-0.0008 (-0.37)	0.0015 (0.68)
September	-0.3099 (-13.29)***	-0.2433 (-9.16)***	-0.0243 (-11.34)***	-0.0221 (-9.77)***
October	-0.3244 (-14.16)***	-0.4030 (-14.91)***	0.0264 (12.48)***	0.0287 (12.83)***
November	-0.3227 (-14.10)***	-0.3483 (-14.46)***	0.0082 (3.86)***	0.0105 (4.68)***
December	-0.3047 (-13.24)***	-0.3125 (-13.08)***	0.0023 (1.07)	0.0045 (2.03)**

Panel B: Firm Characteristics

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
$\Delta OPT_{i,t}$	-	-	-0.0013 (-2.75)***	0.0045 (2.44)**
$\Delta Inst_{i,t}$	-0.1379 (-2.70)***	2.7313 (5.75)***	-	-
$\Delta MV_{i,t}$	0.0275 (0.55)	-0.4255 (-4.70)***	0.1632 (34.70)***	0.1631 (34.62)***
$\Delta \#Est_{i,t}$	-0.0578 (-0.78)	-0.3813 (-4.09)***	0.1110 (15.89)***	0.1112 (15.89)***
$\Delta P/E_{i,t}$	-	-	-0.0194 (-8.26)***	-0.0192 (-8.19)***
$\Delta StdF_{i,t}$	1.4306 (13.88)***	1.4377 (13.45)***	-	-
Adjusted R^2	0.0176	0.0169	0.0571	0.0568
F-statistic	51.63***	49.01***	172.37***	171.62***

*, **, *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4
Regressions of Institutional Holdings and Analyst Optimism on Seasonal Dummies and Firm Characteristics: January 1981 through December 1989

The dependent variables are the first differences of optimism in analysts' earnings forecasts ($\Delta OPT_{i,t}$) 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 ($\Delta MV_{i,t}$), number of analysts providing earnings estimates or visibility ($\Delta \#Est_{i,t}$), price to earnings ratio ($\Delta P/E_{i,t}$), and one plus the scaled standard deviation of these earnings estimates ($\Delta StdF_{i,t}$). The model is estimated using single equation, Ordinary Least Squares (OLS) and simultaneously using two-stage least squares (2SLS). 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.

Panel A: Seasonal Dummies

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
Intercept	0.3123 (10.87)***	0.3496 (11.02)***	-0.0138 (-6.96)***	-0.0147 (-6.88)***
February	-0.3358 (-8.45)***	-0.3338 (-8.23)***	0.0003 (0.12)	0.0013 (0.67)
March	-0.3251 (-8.15)***	-0.4026 (-8.42)***	0.0282 (10.12)***	0.0291 (9.98)***
April	-0.3196 (-7.94)***	-0.3719 (-8.37)***	0.0190 (6.77)***	0.0200 (6.79)***
May	-0.3293 (-8.27)***	-0.4170 (-8.40)***	0.0306 (10.91)***	0.0316 (10.74)***
June	-0.3278 (-8.31)***	-0.3824 (-8.69)***	0.0204 (7.43)***	0.0214 (7.41)***
July	-0.3341 (-8.54)***	-0.3912 (-8.89)***	0.0210 (7.70)***	0.0220 (7.66)***
August	-0.3162 (-8.07)***	-0.3650 (-8.49)***	0.0182 (6.62)***	0.0191 (6.65)***
September	-0.2890 (-7.31)***	-0.3690 (-7.69)***	0.0288 (10.45)***	0.0297 (10.33)***
October	-0.3350 (-8.82)***	-0.3839 (-9.16)***	0.0176 (6.62)***	0.0186 (6.63)***
November	-0.3380 (-8.87)***	-0.4166 (-8.96)***	0.0284 (10.65)***	0.0294 (10.46)***
December	-0.3186 (-8.36)***	-0.3441 (-8.65)***	0.0104 (3.93)***	0.0113 (4.07)**

Panel B: Firm Characteristics

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
$\Delta OPT_{i,t}$	-	-	-0.0024 (-4.63)***	-0.0002 (-0.10)
$\Delta Inst_{i,t}$	-0.4346 (-4.32)***	2.4095 (2.60)***	-	-
$\Delta MV_{i,t}$	0.0385 (0.49)	-0.7447 (-2.80)***	0.2793 (52.53)***	0.2794 (52.52)***
$\Delta \#Est_{i,t}$	-0.2460 (-1.96)*	-0.6781 (-3.57)***	0.1479 (16.50)***	0.1485 (16.52)***
$\Delta P/E_{i,t}$	-	-	-0.0158 (-4.97)***	-0.0157 (-4.94)***
$\Delta StdF_{i,t}$	1.6548 (9.97)***	1.7868 (10.22)***	-	-
Adjusted R^2	0.0181	0.0168	0.1721	0.1712
F-statistic	24.65***	22.91***	267.00***	265.33***

*, **, *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5

Regressions of Institutional Holdings and Analyst Optimism on Seasonal Dummies and Firm Characteristics: January 1990 through December 1996

The dependent variables are the first differences of optimism in analysts' earnings forecasts ($\Delta OPT_{i,t}$) 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 ($\Delta MV_{i,t}$), number of analysts providing earnings estimates or visibility ($\Delta \#Est_{i,t}$), price to earnings ratio ($\Delta P/E_{i,t}$), and one plus the scaled standard deviation of these earnings estimates ($\Delta StdF_{i,t}$). The model is estimated using single equation, Ordinary Least Squares (OLS) and simultaneously using two-stage least squares (2SLS). 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.

Panel A: Seasonal Dummies

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
Intercept	0.2818 (14.03)***	0.2547 (11.70)***	0.0107 (4.88)***	0.0075 (3.11)***
February	-0.3031 (-10.82)***	-0.2608 (-8.55)***	-0.0156 (-5.00)***	-0.0122 (-3.67)***
March	-0.3154 (-11.23)***	-0.3428 (-11.40)***	0.0075 (2.39)**	0.0110 (3.32)***
April	-0.3110 (-11.07)***	-0.2525 (-8.04)***	-0.0214 (-6.85)***	-0.0179 (-5.38)***
May	-0.3072 (-10.95)***	-0.3295 (-11.02)***	0.0040 (1.26)	0.0074 (2.23)**
June	-0.3005 (-10.95)***	-0.3253 (-11.09)***	0.0064 (2.10)**	0.0098 (3.02)***
July	-0.2868 (-10.44)***	-0.3027 (-10.38)***	0.0038 (1.24)	0.0071 (2.18)**
August	-0.3248 (-11.81)***	-0.2840 (-9.49)***	-0.0153 (-4.99)***	-0.0116 (-3.55)***
September	-0.3083 (-11.06)***	-0.1215 (-2.78)***	-0.0640 (-20.83)***	-0.0604 (-18.44)***
October	-0.3142 (-11.34)***	-0.4211 (-12.15)***	0.0343 (11.13)***	0.0379 (11.51)***
November	-0.3090 (-11.15)***	-0.3114 (-10.62)***	-0.0007 (-0.22)	0.0028 (0.85)
December	-0.2886 (-10.36)***	-0.2775 (-9.40)***	-0.0049 (-1.57)	-0.0015 (-0.47)

Panel B: Firm Characteristics

Independent Variables	$\Delta OPT_{i,t}$		$\Delta Inst_{i,t}$	
	OLS	2SLS	OLS	2SLS
$\Delta OPT_{i,t}$	-	-	0.0007 (0.92)	0.0100 (3.30)***
$\Delta Inst_{i,t}$	0.0460 (0.81)	3.0475 (5.82)***	-	-
$\Delta MV_{i,t}$	0.1839 (2.67)***	0.2128 (2.91)***	-0.0040 (-0.50)	-0.0057 (-0.71)
$\Delta \#Est_{i,t}$	0.1498 (1.69)*	0.0424 (0.44)	0.0356 (3.50)***	0.0339 (3.32)***
$\Delta P/E_{i,t}$	-	-	-0.0200 (-6.18)***	-0.0200 (-6.12)***
$\Delta StdF_{i,t}$	1.2007 (9.41)***	1.1078 (8.15)***	-	-
Adjusted R^2	0.0185	0.0179	0.0542	0.0543
F-statistic	30.29***	29.30***	90.00***	90.08***

*, **, *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.