ABSTRACT

This study examines the relation between analysts' incentives to cover firms and the extent of their intangible assets. Because intangible assets typically are unrecognized and estimates of their fair values are not disclosed, absent analyst coverage firms with more intangible assets likely have less informative prices. Accordingly, we expect analysts have greater incentives to cover firms with more intangible assets and, thus, predict they have higher analyst coverage. As predicted, we find that analyst coverage is significantly greater for firms with larger research and development and advertising expenses relative to their industry, and for firms in industries with larger research and development expense. We also predict and find that analyst coverage is increasing in firm size, growth, trading volume, equity issuance, and perceived mispricing, and is decreasing in the size of the firm’s analysts’ brokerage houses and the effort analysts expend to follow the firm. These findings indicate that analyst coverage depends on private benefits and costs of covering a firm. We also test hypotheses related to analyst effort. We predict and find that analysts expend greater effort to follow firms with more intangible assets, after controlling for...
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other factors associated with analyst effort. Our evidence indicates that intangible assets, most of which are not recognized in firms’ financial statements, are associated with greater incentives for analysts to cover such firms, and greater costs of coverage. An open question is whether financial statement recognition of intangible assets could more efficiently provide information about such assets to investors.

1. Introduction

This study examines the relation between analyst coverage and firms’ intangible assets. We assume that firms with substantial intangible assets, most of which are not recognized in firms’ financial statements, have more information asymmetry between managers and investors and more inherent uncertainty about firm value than do other firms. These factors suggest that in the absence of private information acquisition and processing by information intermediaries, such as analysts, share prices of high intangibles firms would less precisely reflect their fundamental values. The possibility of less informative prices suggests opportunities for profitable private information acquisition activities. For analysts, such activities can yield more profitable investment recommendations and higher trading commissions. Thus, we first hypothesize that analyst coverage is higher for firms with more intangible assets. To test this hypothesis, we develop an empirical model of analyst coverage that depends on proxies for important classes of intangible assets, such as research and development and brand names, at the firm and industry levels. We also control for analysts’ incentives to cover firms, other than those associated with intangibles. We focus on intangible assets because they are increasingly large for many firms, most are not recognized as assets under current financial accounting rules, and they are associated with substantial information asymmetry and inherent uncertainty, making it nontrivial to acquire and process information about them. Thus, intangibles represent an economically important and powerful setting in which to test our hypotheses.\footnote{Our hypotheses could relate to any number of assets or liabilities for which financial statements or other sources of information about the firm do not provide reliable summary information, thereby necessitating information acquisition activity by analysts.}

We also hypothesize that analysts expend greater effort to cover firms with more intangible assets. A distinctive feature of our research design is the development of a proxy for and an empirical model of analyst effort. Our proxy for the effort analysts expend to cover a given firm is the average number of firms followed by the firm’s analysts. We hypothesize that analysts expend greater effort to follow firms with more intangible assets, and therefore follow fewer other firms. We test this hypothesis by estimating the relation between analyst effort and our proxies for intangible assets, after controlling for other variables likely associated with analyst effort. Because analyst coverage can influence analyst effort and vice versa, we also estimate
a simultaneous equations specification in which analyst coverage and analyst effort are jointly determined endogenous variables.

Our analysis of analyst coverage indicates that, as predicted, coverage is significantly greater for firms with larger research and development and advertising expenses relative to their industry, and for firms in industries with larger research and development expense. Estimated coefficients on firm- and industry-level recognized intangible assets and depreciation expense have unpredicted signs, although they are not always significantly different from zero. We also find, as predicted, that analyst coverage is greater for firms requiring less effort to follow. Furthermore, we predict and find that analyst coverage is positively related to firm size, growth, trading volume of the firm’s shares, and whether the firm accesses public debt and equity markets, and negatively related to the size of the firm’s analysts’ brokerage houses. In addition, our evidence indicates that analyst coverage is greater for firms that analysts perceive to be mispriced.

Our analysis of analyst effort provides strong evidence that analysts expend greater effort to follow firms with intangible assets. The coefficients on all of our accounting proxies have predicted signs, and most are significantly different from zero. We also predict and find that analyst effort is increasing in firm size, growth, and extent of perceived mispricing, and decreasing in the extent of analyst coverage, the number of firms in the industry, and the average size of the firm’s analysts’ brokerage houses. Based on prior research, we expect that analyst effort is increasing in earnings variability. However, after controlling for other factors associated with analyst effort, we find that analyst effort is decreasing in earnings variability.

To control for simultaneity in analysts’ coverage and effort decisions, we estimate our coverage and effort equations as a simultaneous system. The findings from this estimation reveal inferences similar to and somewhat stronger than those from the single equation estimation for analyst coverage and effort. Thus, the evidence indicates that our primary findings are not attributable to simultaneity bias. Results of additional analyses also indicate that our findings are robust.

This study contributes to two streams of literature. The first is the literature on intangible assets, to which we contribute by providing evidence of an association between intangible assets and analysts’ incentives to cover firms. Although greater analyst coverage of firms with intangible assets likely results in production of information about these firms, the private provision of this information incurs potentially avoidable costs. Furthermore, descriptive statistics indicate that many firms are not covered by analysts. For these firms, it is less likely that private information search supplements information included in financial statements about intangible assets. However, our study leaves unanswered the question of whether financial statement recognition of intangible assets could more efficiently provide information about such assets to investors.

The second stream of literature is that on analyst coverage, to which we contribute primarily by documenting an association between analyst
coverage and intangible assets, most of which are not recognized in financial statements. Although it is well recognized that the role of financial statements depends on the functioning of competing information providers, the relation between the ability of financial statements to reflect a firm’s underlying economics and analysts’ coverage incentives has been little studied. Our findings are consistent with analysts having greater incentives to cover firms whose value is less well captured by accounting amounts. This suggests that analysts provide information that at least partially compensates for information not provided by the financial accounting system.

Our findings also relate to Lang and Lundholm’s [1996] finding that firms with more precise disclosures, as measured by financial analysts’ ratings, have more analyst coverage. Lang and Lundholm’s [1996] sample firms are widely followed by analysts and, thus, likely are relatively homogeneous with respect to the benefits analysts expect to receive from following them. Therefore, their findings suggest that improved disclosure lowers the costs to analysts of following a firm. Diamond’s [1985] model of disclosure suggests that firm-provided disclosures reduce the benefits of following a firm, thereby reducing private incentives to collect information. Our findings suggest that the costs and benefits to analysts of covering a firm are lower for firms with smaller intangible assets, and result in lower net benefits.2

We also contribute to the literature on analyst coverage by identifying several additional explanatory factors. Specifically, we document significant explanatory power of analyst effort and analyst-perceived mispricing. We also document that analyst coverage is significantly positively associated with trading volume and frequency of access to capital markets, after controlling for other factors identified in prior research. These findings highlight the private incentives of analysts to seek out and process information, in that analyst coverage is associated with both private benefits, e.g., trading and investment banking fees, and costs, i.e., the effort required to follow a firm. Our study also is distinctive in the analyst literature in testing hypotheses related to factors associated with analyst effort, including intangible assets.

2 This study also relates indirectly to studies of disclosure and deficiencies in financial reporting. For example, Amir and Lev [1996] show that without inclusion of nonfinancial growth and performance measures, financial accounting summary measures are largely valuation-irrelevant, yet, incremental to the nonfinancial measures, financial measures provide incremental explanatory power. Tasker [1998] examines whether firms are more likely to conduct conference calls following earnings announcements if their financial statements are less informative, as reflected in industry-level market and growth measures. Francis, Hanna, and Philbrick [1997] find an increase in analyst following and a decrease in mispricing, as measured by earnings-to-price, cash flow-to-price, and book-to-market ratios, following firm-provided voluntary disclosures in the form of corporate analyst presentations. Healy, Hutton, and Palepu [1999] find changes in information intermediation after sustained increases in firm-provided disclosures. In contrast to these studies, we examine how analysts’ incentives to cover firms are affected by intangible assets, most of which are unrecognized, and consider both benefits and costs to covering such firms, using primarily firm- and industry-level accounting measures.
The paper is organized as follows. Section 2 develops the hypotheses and section 3 specifies the estimation equations and variables we use to test them. Section 4 describes the data and sample firms and section 5 presents the findings. Section 6 provides a summary and concluding remarks.

2. Hypotheses and Proxies for Intangible Assets

We assume that analysts’ coverage decisions maximize their expected utility, which depends on the benefits and costs of following a firm. A primary reason analysts collect and process information about firms is to identify mispriced securities. Analysts’ assessments are disclosed to clients of the analyst’s brokerage house in the form of investment recommendations to buy, hold, or sell shares. The brokerage house benefits when analysts’ clients execute trades with the firm, and directly or indirectly compensates analysts for generating such trades (Eccles and Crane [1988]).

A premise of this study is that in the absence of analyst coverage, firms with substantial intangible assets would be more likely than other firms to have share prices that fail to reflect precisely their fundamental values. Thus, the potential for analysts to identify mispriced securities through private information acquisition is greater for these firms. As explained above, this potential derives from the information asymmetry and inherent uncertainty associated with intangible assets. Thus, we hypothesize that firms with more intangible assets attract more analysts and, thus, that analyst coverage is greater for such firms. Such greater coverage continues despite its assumed salutary effects on mispricing for two primary reasons. First, a decrease in coverage could result in increased mispricing, again providing incentives for increased coverage. Second, the values of firms’ intangible assets are not static, suggesting the need for ongoing analyst coverage.

This reasoning suggests our first hypothesis, stated in alternative form:

\[ H_{COV}: \text{Firms with more intangible assets have greater analyst following.} \]

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4 This prediction is consistent with findings in Barth, Clinch, and Shibano [2001], assuming intangible assets have more uncertain payoffs than other assets of the firm. In particular, in the model in Barth, Clinch, and Shibano [2001] the fraction of expert investors, e.g., analysts, always increases with increases in uncertainty about the firms’ payoff associated with an item that is disclosed but not recognized. The fraction of expert investors decreases with increases in payoff uncertainty, when the item is recognized as well as disclosed. See also Grossman and Stiglitz [1980].

5 Although we expect that the observed level of analyst coverage reduces mispricing, uncertainty about firm value, information asymmetry, and analysts’ cost/benefit calculus suggests some residual mispricing can remain. This observation motivates us to include a proxy for analyst-perceived mispricing in our estimation equations.
Analysts’ coverage decisions depend on their cost/benefit tradeoffs. As explained above, benefits to analysts primarily derive from identifying mispriced securities, trading commissions, and brokerage fees. Costs derive primarily from the effort required to follow the firm. We expect that for firms with more intangible assets, not only are the benefits to analysts greater, but also are the costs in terms of effort required to cover such firms. This results from the information asymmetry analysts must overcome and the uncertainty inherent in the values of intangible assets. Few, if any, markets exist for intangible assets and, thus, analysts must rely on alternative valuation techniques that require costly collection and analysis of unstructured data. Thus, we predict that analysts covering firms with large intangible assets expend more effort to do so.

This reasoning suggests our second hypothesis, stated in alternative form:

$H_{EFF}$: Analysts expend greater effort to follow firms with more intangible assets.

Testing our hypotheses requires identifying proxies for intangible assets. Generally Accepted Accounting Principles (GAAP) in the U.S. permit, with limited exceptions—most notably computer software costs—recognition of only purchased intangible assets. For example, firms’ research and development and advertising expenditures that potentially create intangible assets related to technology and brand names are expensed as incurred. Moreover, even recognized intangibles are measured at amortized cost, not at an estimate of their value. Thus, accounting assets do not reflect many firms’ valuable intangible assets, a situation that has become more pervasive with the evolution from a manufacturing to an information-based economy (AICPA [1993]), forcing us to look elsewhere for our intangible assets proxies.

We first consider intangible assets related to technology and brand names, two important specific intangible assets. The importance of these assets is evidenced by their recognition in financial statements in countries outside the U.S., e.g., in Australia and the U.K. (Barth and Clinch [1998], Aboody, Barth, and Kasznik [1999]). They are not recognized under U.S. GAAP, primarily because of measurement difficulties associated with their inherently uncertain value. We base our proxies for these two assets on research and development and advertising expenses because, although these expenditures are expensed in financial statements, such expenditures often represent long-term investments in intangible assets. Consistent with this, prior research finds that research and development and advertising expenses are positively associated with market value of equity (Abdel-Khalik [1975], Hirschey and Weygandt [1985], Bublitz and Ettredge [1989], Sougiannis [1994], and Lev and Sougiannis [1996]).

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$^6$ Also consistent with this line of reasoning, Barth, Beaver, and Landsman [1998] provide evidence that book value of equity, as the primary summary measure from the balance sheet, is significantly less associated with market value of equity than net income for firms in the pharmaceuticals industry, which likely have large, unrecognized, intangible assets associated with research and development activities.
We also identify proxies intended to capture a variety of other intangible assets. We base the first on depreciation expense, as a measure of the extent to which the firm’s operations use tangible rather than intangible assets. We expect that firms with less depreciation as a fraction of operating expenses depend less on long-term tangible assets for income production. Thus, it is more likely these firms’ long-lived income generating assets, e.g., human capital and contractual rights, are intangible. Also, recognized accounting assets capture better the economic values of tangible assets. Although also stated at amortized cost, firms typically purchase tangible assets more frequently than intangible assets and, thus, their recognized amounts are likely more closely related to value than recognized amounts for intangibles. Furthermore, the values of tangible assets are less likely subject to information asymmetry and inherent uncertainty. This is because tangible asset values are less than intangible asset values to be firm-specific, resulting in fewer incentives for private information acquisition. We base the second proxy on recognized intangible assets, which not only is a direct measure of intangible assets, but also captures situations such as CUC International (Healy and Palepu [1995]) in which the firm indicates its intangible assets are economically significant by recognizing intangible assets. However, the assumption underlying this proxy is that firms with recognized intangible assets have greater intangible assets, which is difficult for us to validate, and that the recognized amount does not capture well the value of the intangible.

Our proxies for intangible assets derive from accounting amounts, because we implicitly assume that sources outside financial statements do not provide summarized reliable information about the value of intangible assets. To the extent this assumption is invalid, incentives for private information search are reduced and our tests are biased against finding a significant relation between analyst coverage and our proxies for intangible assets.

Analogously, a smaller ratio of recognized long-term tangible assets to recognized total assets indicates that a larger proportion of the firm’s recognized assets are current, suggesting its long-term income generating assets are unrecognized and, thus, likely intangible. Using the ratio of recognized long-term tangible assets to recognized total assets as an alternative proxy for intangibles does not alter our findings.

Recognized intangibles could capture well the value of intangible assets if the assets were purchased relatively recently and, thus, the recognized amount reflects relatively current values, or if recognized capitalized costs associated with intangibles reflect resolution of some valuation uncertainty, such as product feasibility. Note that we do not focus on intangible assets directly related to growth options because, although they also are potentially important for firm value, growth options are less likely to meet the definition of an asset, at least as articulated by the accounting profession. SFAS No. 3 (FASB [1980]) requires that the associated expected future economic benefits of an asset result from past transactions or events. However, we include a growth proxy as an additional explanatory variable in our estimation equations.

For example, for several years *FinancialWorld* published estimates of value for the world’s largest brands (see Barth, Clement, Foster, and Kasznik [1998]). To the extent these estimates reflect brand value and obviate the need for analysts’ services to estimate brand value, we will not observe a positive relation between analyst coverage and advertising expenses, after controlling for the presumably lower analyst effort.
3. Estimation Equations and Variable Definitions

3.1 Analyst Coverage

Our first hypothesis, \( H_{COV} \), predicts that analyst coverage is greater for firms with more intangible assets. To test this hypothesis, we estimate (1) separately for each year and pooled across time using fixed-year effects estimation. All variables are calculated each year for each firm and industry; we suppress firm and year subscripts.

\[
COV = a_0 + a_1EFF + a_2RD_F + a_3ADV_F + a_4INTAN_F + a_5DEPR_F \\
+ a_6RD_I + a_7ADV_I + a_8INTAN_I + a_9DEPR_I + a_{10}RESAVP_P \\
+ a_{11}RESAVP_N + a_{12}MV + a_{13}GROWTH + a_{14}BROKER + a_{15}VOL \\
+ a_{16}DISSUE + \epsilon_1
\]

(1)

Consistent with prior research, we define analyst coverage, \( COV \), as the number of analysts covering the firm, measured as the number of analysts with earnings forecasts for the current fiscal year in the month closest to, but preceding, the annual earnings announcement. Because we expect fewer analysts to cover firms that require greater effort, we include in (1) our proxy for analyst effort, \( EFF \), which is defined in section 3.2. Recall that we predict positive relations between intangible assets and analyst coverage and effort, yet we predict a negative relation between analyst effort and analyst coverage. Thus, by controlling for the costs to follow firms as reflected in analyst effort, inclusion of this variable enhances our ability to detect a positive relation between intangibles and analyst coverage.

Predicting that intangible assets are positively associated with analyst coverage and analyst effort, and predicting analyst coverage and analyst effort are negatively associated may seem contradictory. However, we posit costs and benefits to analysts associated with intangible assets. These counter-vailing effects motivate us to test \( H_{COV} \) and \( H_{EFF} \) separately. In particular, separately testing the two hypotheses permits us to focus our test of \( H_{COV} \) on the benefits associated with following a firm, including those related to intangible assets, while controlling for the costs of following a firm as reflected in analyst effort. By including analyst effort in the analyst coverage equation, we control for the costs of coverage associated with intangible assets and predict positive incremental coefficients for the intangible asset proxies consistent with benefits to covering firms with intangible assets. Analogously, separately testing \( H_{COV} \) and \( H_{EFF} \) permits us to focus our test of \( H_{EFF} \) on the costs of following a firm, including those related to intangible assets, while controlling for the benefits of covering a firm. As explained below, because of the potential endogeneity between analyst coverage and effort, we also test our hypotheses jointly.

Following Barth and Kasznik [1999], we use eight accounting variables to identify firms with potentially substantial intangible assets, four measured at
the firm level and four measured at the industry level. These variables are the focus of our tests. Because analysts tend to concentrate on particular industries using firm- and industry-level proxies permits us to test whether the relation between analyst coverage and intangible assets is firm- or industry-specific.

The first two firm-level variables relate to technology and brand names. They are the ratios of research and development expense and advertising expense to total operating expenses for a given year, less the respective value-weighted industry average ratio for that year, $RD_F$ and $ADV_F$, respectively. We deflate these variables by total operating expenses to obtain a measure of the extent of the firm’s activities related to research and development and advertising. The second two firm-level variables relate to sundry other intangibles. They are the ratio of depreciation expense to total operating expenses, less the industry median ratio, and the ratio of recognized intangible assets including goodwill to total assets, less the industry median ratio, $DEPR_F$ and $INTAN_F$, respectively.

The research and development and advertising industry-level variables, $RD_I$ and $ADV_I$, are the sums of the respective expenses for firms in the industry divided by the sum of total operating expenses of industry firms. The depreciation and other intangibles industry-level variables, $DEPR_I$ and $INTAN_I$, are the yearly industry median ratios of depreciation expense and recognized intangible assets, deflated by total operating expenses and total assets, respectively. We use four-digit SIC codes to identify industries, provided there are at least 50 firm-year observations in the industry over the prior five years. This data requirement ensures a reasonable number of industry observations.

As explained above, because of uncertainty of firm values, information asymmetry, and costly information gathering and processing, we expect some mispricing to persist even with equilibrium analyst coverage. Thus, we include a proxy for residual analyst-perceived mispricing unrelated to intangible assets, $RESAVP$, in the analyst coverage tests. Although we expect analysts to have incentives to follow mispriced firms regardless of the direction of mispricing, the relation likely differs for firms analysts perceive as undervalued versus overvalued. Thus, we permit different coefficients on positive and negative $RESAVP$, which we label as $RESAVP_P$ and $RESAVP_N$, respectively. The appendix provides details on how we construct $RESAVP$. As an overview, following Frankel and Lee [1998], we begin by comparing

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10 Using similar proxies, Barth and Kasznik [1999] find that, as predicted, firms with potentially substantial intangible assets are more likely to repurchase shares in the open market. Barth and Kasznik [1999] also find that repurchases associated with intangible assets convey favorable information to investors, after controlling for other factors likely associated with share repurchase decisions and the market reaction to repurchases.

11 We use value-weighted industry average ratios for research and development and advertising expenses because the industry median ratio is zero for approximately one-half of the industries. Nonetheless, our inferences are unaffected by using the industry median ratio for $RD_I$ and $ADV_I$. 


an accounting-based value estimate (Ohlson [1995]) with market value of equity. Because this estimate of firm value is based on analysts’ earnings forecasts, we interpret it as analysts’ assessment of the firm’s equity value, which can differ from equity market value. \textit{RESAVP} is the portion of the percentage difference between these two value estimates that is orthogonal to our proxies for intangible assets. We orthogonalize the variable to the intangibles proxies to facilitate drawing inferences from the coefficient estimates.

Equation (1) includes controls for size and growth based on prior analyst coverage research (Bhushan [1989], O’Brien and Bhushan [1990], Brennan and Hughes [1991], and Lang and Lundholm [1996]). The size proxy is the logarithm of market value of equity, \( MV \); we use the logarithm of market value to capture nonlinearities in the relation between analyst coverage and firm size. The growth proxy is \( \text{GROWTH} \), the firm’s five-year sales growth, measured as \((\text{sales}_{t-1}/\text{sales}_{t-6})^{1/5} - 1\), where year \( t \) is the current year.\(^{12}\) Our inferences are robust to using market-to-book ratios and analysts’ long-term earnings growth forecasts as alternative proxies for growth. \( \text{GROWTH} \) also can be interpreted as a proxy for growth opportunities, a form of intangible asset. Thus, including \( \text{GROWTH} \) in the estimation equation helps ensure our findings are not attributable to correlation between growth and our accounting proxies.\(^{13}\) We also include as a control variable \( \text{BROKER} \), which is the average number of analysts employed by the brokerage houses that employ the firm’s analysts. This variable controls for the mechanical negative relation between coverage and size of the firm’s analysts’ brokerage houses.\(^{14}\)

Our tests of analyst coverage include two additional variables not considered in prior analyst coverage research. We include these variables to capture additional potential benefits to analysts of covering firms specifically related to brokerage commissions and fees. First, because brokerage house trading commissions are based on trading volume, and analysts likely are compensated indirectly for covering stocks that generate trades, we expect analyst coverage to be positively associated with trading volume. \( \text{VOL} \) is

\(^{12}\) If a firm does not have available data from five years prior to year \( t \), we compute sales growth over four or three years, if available.

\(^{13}\) Prior analyst coverage research, e.g., Lang and Lundholm [1996], hypothesizes that it is more difficult to forecast earnings for firms with greater earnings variability, and documents a negative association between analyst coverage and earnings variability. We do not include earnings variability in our analyst coverage tests because we include a proxy for analyst effort. Consistent with this expectation, untabulated findings reveal that earnings variability has no significant explanatory power for analyst coverage incremental to analyst effort and the other variables in (1). However, we expect earnings variability to explain analyst effort, and thus include it in our analyst effort tests below.

\(^{14}\) This relation arises because firms covered by many analysts typically are covered by analysts from large and small brokerage houses, whereas firms covered by fewer analysts typically are covered by analysts from larger brokerage houses. However, our primary motivation for including \( \text{BROKER} \) in (1) is to control for brokerage house size effects on the effort variable, as explained below.
trading volume for the current year, in millions of shares. Second, following similar reasoning, we expect analyst coverage to be greater for firms that access capital markets more frequently, because such firms are more likely to generate investment banking fees for the brokerage house. \textit{DISSUE} is an indicator variable that equals one if the firm issues public debt or equity in the prior, current, or subsequent year, and zero otherwise.

\( H_{COV} \) predicts that the associations between \( COV \) and \( RD_F, RD_I, ADV_F, ADV_I, INTAN_F, \) and \( INTAN_I \) are positive, and the associations between \( COV \) and \( DEPR_F \) and \( DEPR_I \) are negative. As explained above, we predict that the association between \( COV \) and \( EFF \) is negative. We also predict that the associations between \( COV \) and \( RESAVP_P, MV, GROWTH, VOL, \) and \( DISSUE \) are positive, and the associations between \( COV \) and \( RESAVP_N \) and \( BROKER \) are negative.

### 3.2 Analyst Effort

Our second hypothesis, \( H_{EFF} \), predicts that the effort expended by a firm’s analysts is greater for firms with more intangible assets. To test this hypothesis, we estimate (2). As with (1), we estimate (2) separately for each year and pooled across time using a fixed-year effects estimation, and suppress firm and year subscripts.

\[
EFF = b_0 + b_1 COV + b_2 RD_F + b_3 ADV_F + b_4 INTAN_F + b_5 DEPR_F \\
+ b_6 RD_I + b_7 ADV_I + b_8 INTAN_I + b_9 DEPR_I + b_{10} RESAVP_P \\
+ b_{11} RESAVP_N + b_{12} MV + b_{13} GROWTH + b_{14} BROKER + b_{15} EVAR \\
+ b_{16} NFIRMS + \varepsilon_2
\]  

We define \( EFF \) as the negative of the average number of firms followed by the firm’s analysts, i.e., the sum of the number of firms covered by a firm’s analysts in a particular year divided by the number of analysts covering the firm in that year. For example, if a firm is followed by 3 analysts who cover 5, 6, and 7 firms, respectively, \( EFF \) equals \(-6\). We multiply the average number of firms by \(-1\) so that \( EFF \) is increasing in effort. This proxy reflects the notion that analysts have a common capacity limit and expend effort up to that capacity. Thus, if covering a particular firm requires more effort, then that firm’s analysts will cover fewer firms in total.

To test our hypothesis that analysts expend greater effort to follow firms with more intangible assets, we employ the same proxies as in tests of \( H_{COV} \) in (1): \( RD_F, ADV_F, INTAN_F, DEPR_F, RD_I, ADV_I, INTAN_I, \) and \( DEPR_I \). We include the industry variables because we expect that if it is more difficult to cover a particular firm, it is also more difficult to cover similar firms, e.g., firms in the same industry. Thus, as with (1), including the industry variables permits us to test whether the relation between analyst effort and intangibles is firm- or industry-specific.

We include additional variables to control for factors that are likely associated with analyst effort. The first is analyst coverage, \( COV \), because it likely
requires less effort to follow firms that are covered by other analysts. Such coverage suggests that information about the firm is more readily available, e.g., in the form of reports by other analysts, making it less difficult to forecast earnings or to develop an analyst report. The second two are RESAVP_P and RESAVP_N, our proxies for positive and negative residual analyst-perceived mispricing, because we expect that analysts expend greater effort to follow mispriced firms. As with (1), we estimate separate coefficients for RESAVP_P and RESAVP_N because analyst effort likely is not symmetric for firms analysts perceive are undervalued versus overvalued.

The remaining variables capture firm characteristics associated with costs to analysts of following the firm, and thus reflected in the level of analyst effort, other than those associated directly with intangible assets. The first of these is MV, the logarithm of the market value of equity, to control for size because we expect it is more difficult for analysts to follow larger, and presumably more complex, firms. As in (1), we use the logarithm of equity market value to capture nonlinearities in the relation between analyst effort and firm size. The second is GROWTH, the firm’s five-year sales growth. We include GROWTH because we expect it requires more effort to follow growing firms, and the reasons for the required additional effort might not be captured by the other included variables. As explained above, GROWTH also could be a proxy for intangible assets. Under either interpretation, we expect effort to increase with GROWTH.

The third is BROKER, the average number of analysts employed by the brokerage houses that employ the firm’s analysts. We include this variable because we expect that analysts at larger brokerage houses have greater resources, including assistants whose names do not appear on the analyst report, and therefore can follow a larger number of firms. Thus, its inclusion controls for systematic cross-sectional differences in our effort measure that are unrelated to intangible assets. The fourth is EVAR, the coefficient of variation in earnings. Each firm’s coefficient of variation is the standard deviation of annual earnings from continuing operations divided by the absolute value of the mean. Both are calculated over the previous five years, provided there are at least three available earnings observations. We include EVAR because we expect it is more difficult for analysts to predict earnings for firms with greater earnings variability and, therefore, analysts expend more effort to follow such firms. The fifth is NFIRMS, the number of firms in the industry. NFIRMS captures possible scale economies to analysts covering multiple firms in a single industry, i.e., it is less costly to follow a particular firm in an industry with more firms because analysts can spread the costs of industry-specific knowledge over more firms.

HEFF predicts that the associations between EFF and RD_F, RD_I, ADV_F, ADV_I, INTAN_F, and INTAN_I are positive, and the associations between EFF and DEPR_F and DEPR_I are negative. We also predict that the associations between EFF and RESAVP_P, MV, GROWTH, and EVAR are positive, and the associations between EFF and COV, RESAVP_N, BROKER, and NFIRMS are negative.
Because we expect analyst effort to affect analyst coverage and vice versa, we also estimate (1) and (2) as a simultaneous equation system with analyst coverage and analyst effort identified as jointly determined endogenous variables. Comparison of (1) to (2) reveals that the system is overidentified in that each equation has two identifying variables. Trading volume and activity in the capital market, \( VOL \) and \( DISSUE \), identify (2) and earnings variability and number of firms in the industry, \( EVAR \) and \( NFIRMS \), identify (1). Below we present results from estimating (1) and (2) separately using OLS estimation and jointly using two-stage least squares.

4. Data and Sample Firms

The initial sample includes all firms in the 1995 COMPSTAT Merged Annual Industrials, Full Coverage and Primary-Supplementary-Tertiary files with sales greater than $1 million, other than financial institutions and utilities. We impose the size criterion to avoid potential outliers attributable to very small firms. We eliminate financial institutions and utilities not because they have inconsequential intangible assets, but because the accounting proxies we use to test our hypotheses, notably research and development, advertising, and depreciation expenses, are not as relevant for firms in these two industries.\(^\text{15}\) The sample period begins in 1983, when the I/B/E/S database became reasonably comprehensive, and ends in 1994. The number of analysts issuing earnings forecasts for a firm is from I/B/E/S.

Table 1 presents descriptive statistics on sample composition through time. It reveals that, on average, there are 2,977 COMPSTAT sample firms in each year, with the number ranging from 2,420 in 1983 to 3,900 in 1994. Table 1 also reveals that there are, on average, 126 industries represented in the sample, where the number of industries ranges from 113 to 139 over the sample period. The average number of firms in each industry ranges from 21.40 to 28.06 across years. The average of the yearly means (medians) is 23.72 (17.17).

Relating to analyst coverage, table 1 reveals that the number of firms included in the I/B/E/S database as having at least one analyst issuing an earnings forecast, ranges from 1,205 in 1983 to 2,549 in 1994; the average is 1,708. The table also shows that the average number of analysts covering sample firms with at least one analyst on I/B/E/S ranges from 6.41 in 1994 to 8.50 in 1985. The average of the yearly means (medians) is 7.27 (4.17).

Table 2 presents statistics relating to the distribution of regression variables for the 10,631 firm-year observations with complete data. The mean (median) of \( COV \) is 10.00 (7.00), indicating that on average (at the median) firms are followed by 10 (7) analysts. The mean (median) of \( EFF \) is \(-14.79\) \((-14.71\), indicating that the average firm has analysts who follow, on average, approximately 15 firms. The positive means for most of the firm-level

\(^{15}\) Section 5.4 reports results from estimating (1) and (2) including financial institutions and utilities.
TABLE 1
Sample Composition Descriptive Statistics. Sample of COMPUSTAT Firms from 1983–1994

<table>
<thead>
<tr>
<th>Year</th>
<th>COMPUSTAT</th>
<th>I/B/E/S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firms</td>
<td>Number of Firms</td>
</tr>
<tr>
<td></td>
<td>#</td>
<td>per Industry</td>
</tr>
<tr>
<td>1983</td>
<td>2,420</td>
<td>113</td>
</tr>
<tr>
<td>1984</td>
<td>2,513</td>
<td>116</td>
</tr>
<tr>
<td>1985</td>
<td>2,547</td>
<td>119</td>
</tr>
<tr>
<td>1986</td>
<td>2,674</td>
<td>118</td>
</tr>
<tr>
<td>1987</td>
<td>2,860</td>
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<td>1988</td>
<td>2,908</td>
<td>126</td>
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<td>1989</td>
<td>2,942</td>
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<td>1990</td>
<td>2,995</td>
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<td>1991</td>
<td>3,076</td>
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<td>1992</td>
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<td>1993</td>
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<td>1994</td>
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<td>139</td>
</tr>
<tr>
<td>Mean</td>
<td>2,977</td>
<td>126</td>
</tr>
</tbody>
</table>

Analyst Coverage is the number of analysts on I/B/E/S providing earnings forecasts for the firm. Industries are four-digit SIC codes with at least 50 firm-year observations over the prior five years.

accounting variables, which exceed their respective medians, indicate substantial concentration in specific firms’ levels of the underlying variables, relative to the industry. The exception is firm-level advertising, $ADV_F$, whose mean is approximately equal to its median, indicating symmetry in firm-level advertising expense relative to the industry ratio.

The mean of $RD_I$ indicates that firms in the average industry incur research and development expense of 3.50% of operating expenses; the smaller median is 1.64%, consistent with concentration of research and development spending in certain industries. The mean of $ADV_I$ indicates that firms in the average industry incur advertising expenses of 1.77% of operating expenses. Similar to $RD_I$, the median of 0.87% is lower than the mean, consistent with concentration of advertising spending in certain industries. The mean of $INTAN_I$ indicates that for the average industry, the median ratio of recognized intangible assets including goodwill to total assets is 5.88%. The mean of $DEPR_I$ indicates that for the average industry, the median ratio of depreciation expense to total operating expenses is 5.31%.

Table 2 also shows that the mean (median) of $RESAVP$ is 19.17% (0.33%), consistent with analysts perceiving firms to be undervalued, on average, after controlling for effects associated with the eight proxies for intangible assets. The median firm has a log market value of equity of $5.59$, which is equivalent to market value of $268$ million, and sales growth of 12.43%. Also, the median firm is covered by analysts from brokerage houses that employ approximately 48 analysts. Table 2 also indicates that approximately one-third of sample firms issued public debt or equity in the three-year
Table 2

Table 2 presents correlations among the variables included in the estimation equations. It reveals significantly positive Pearson and Spearman...
### Table 3

<table>
<thead>
<tr>
<th></th>
<th>COV</th>
<th>EFF</th>
<th>RDJF</th>
<th>ADVJF</th>
<th>INTANJF</th>
<th>DEPRJF</th>
<th>RDJ</th>
<th>ADVJ</th>
<th>INTAN</th>
<th>DEPR</th>
<th>RESAVP</th>
<th>MV</th>
<th>GROWTH</th>
<th>BROKER</th>
<th>VOL</th>
<th>DISSUE</th>
<th>EVAR</th>
<th>NEFRMS</th>
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</thead>
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<tr>
<td>COV</td>
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<td>−0.10</td>
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<td>0.13</td>
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<td>0.01</td>
<td>−0.02</td>
<td>−0.04</td>
<td>−0.05</td>
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<td>RDJF</td>
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<td>−0.08</td>
<td>0.07</td>
<td>0.14</td>
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<td>−0.03</td>
<td>0.00</td>
<td>0.15</td>
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<td>0.03</td>
<td>0.05</td>
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<tr>
<td>INTANJF</td>
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<td>−0.01</td>
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<td>0.01</td>
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<td>−0.02</td>
<td>−0.01</td>
<td>−0.02</td>
<td>0.06</td>
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<tr>
<td>VOL</td>
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<tr>
<td>DISSUE</td>
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<td>0.09</td>
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<tr>
<td>EVAR</td>
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<td>0.11</td>
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<td>−0.32</td>
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</tr>
<tr>
<td>NEFRMS</td>
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<td>0.00</td>
<td>−0.03</td>
<td>−0.01</td>
<td>0.07</td>
<td>0.31</td>
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<td>−0.01</td>
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<td>−0.08</td>
<td>0.13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correlations significantly different from zero at p-values less than 5% are in boldface type.

**COV** = Number of analysts on J/B/E/S providing earnings forecasts for the firm.

**EFF** = Negative of the average number of firms covered by the firm’s analysts.

**RDJF** = Research and development expense divided by total operating expenses minus **RDJ**.

**ADVJF** = Advertising expense divided by total operating expenses minus **ADVJ**.

**INTANJF** = Ratio of recognized intangible assets to total assets minus **INTANJ**.

**DEPRJF** = Depreciation expense divided by total operating expenses minus **DEPRJ**.

**RDJ** = Sum of research and development expenses for firms in the industry divided by sum of total operating expenses of industry firms.

**ADVJ** = Sum of advertising expense for firms in the industry divided by sum of total operating expenses of industry firms.

**INTANJ** = Median ratio of industry firms’ recognized intangible assets to total assets.

**DEPRJ** = Median ratio of industry firms’ depreciation expense to operating expenses.

**RESAVP** = The difference between estimated value of equity based on analysts’ earnings and growth forecasts and market value, per share, deflated by price, minus the predicted value of this difference based on **RDJF, ADVJF, INTANJF, DEPRJF, RDJ, ADVJ, INTANJ, and DEPRJ**. In the regression estimations we permit different coefficients on positive and negative RESAVP, which we label as RESAVP_P and RESAVP_N, respectively.

**MV** = Logarithm of market value of equity.

**GROWTH** = (sales_{t−1}/sales_{t−2})^{1/2}, where 3 ≤ t ≤ 5.

**BROKER** = Average number of analysts employed by the brokerage houses that employ the firm’s analysts.

**VOL** = Trading volume in millions of shares.

**DISSUE** = An indicator variable that equals one if the firm issues debt or equity securities during years t − 1, t, or t + 1, and zero otherwise.

**EVAR** = Coefficient of variation of earnings, measured over no more than five, but at least three, years.

**NEFRMS** = Number of firms in the industry.

All variables except for **COV, EFF, MV, BROKER, VOL, and NEFRMS** are expressed as percentages. Industry is defined as four-digit SIC code with at least 50 firm-year observations over the prior five years.
correlations between \textit{COV} and firm-level research and development expense, \textit{RD}_F, and advertising expense, \textit{ADV}_F, consistent with our hypothesis that analyst coverage is positively associated with intangible assets. However, it also reveals mixed correlations between \textit{COV} and \textit{INTAN}_F and \textit{INTAN}_I and, contrary to our predictions, a positive correlation between \textit{COV} and \textit{DEPR}_F and \textit{DEPR}_I. All of the Pearson correlations between \textit{EFF} and the accounting variables have the hypothesized signs, and most are significant. The Spearman correlations are generally consistent, in that all four industry-level accounting variables have the hypothesized signs and significantly differ from zero. However, only two of the firm-level variables have Spearman correlations of the hypothesized sign, and only one is significantly different from zero. The table reveals relatively weak correlations among the accounting variables, and many of the correlations between the control variables and either \textit{COV} or \textit{EFF} are inconsistent with our predictions.\textsuperscript{16} Findings from the regression analyses below provide evidence of the associations after controlling for all of the posited effects.

5. Findings

5.1 ANALYST COVERAGE

Table 4 presents regression summary statistics from estimating (1) separately by year and pooled using a fixed-year effects model.\textsuperscript{17} For the separate-year estimation, we present two \textit{Z}-statistics to test coefficient estimate significance across years. The first, \textit{Z1}, assumes residual independence, and the second, \textit{Z2}, relaxes this assumption.\textsuperscript{18} Regarding our proxies for intangible assets related to developed technology and brand names, consistent with predictions, the pooled estimation coefficients on \textit{RD}_F, \textit{ADV}_F, \textit{RD}_I, and \textit{ADV}_I are positive, and all but that on \textit{ADV}_I are significantly so. These findings indicate that firms and industries with higher research and development expense and firms with higher advertising expense have greater analyst coverage, after controlling for other factors documented in prior research or hypothesized to be associated with analyst coverage.

Regarding other sundry intangible assets, the coefficients on \textit{DEPR}_F and \textit{DEPR}_I in the pooled estimation are significantly positive, and those on \textit{INTAN}_F and \textit{INTAN}_I are significantly negative, contrary to predictions.

\textsuperscript{16} Consistent with more uncertainty associated with firms with more intangibles, there is a significantly positive correlation between \textit{EVAR} and \textit{RD}_F, \textit{RD}_I, and \textit{INTAN}_F. Untabulated correlations between both \textit{RD}_F and \textit{RD}_I and the variance of daily stock returns, measured annually for firms with returns for at least 100 trading days, are significantly positive.

\textsuperscript{17} Although tabulated test statistics are based on OLS standard errors, all inferences are insensitive to using White [1980] heteroscedasticity-consistent standard errors.

\textsuperscript{18} \textit{Z1} equals \( (1/\sqrt{T}) \sum_{j=1}^{T} (t_j/\sqrt{k_j/(k_j-2)}) \), where \( T \) is the number of years, \( t \) is the \textit{t}-statistic, and \( k \) is the degrees of freedom for year \( j \) (see Healy et al. [1987]). \textit{Z2} equals (mean \( t \))/(std deviation \( t/\sqrt{T-T} \)) (see White [1984] and Bernard [1987]).
### Table 4

Summary Statistics from Regression of COV, Number of Analysts Following the Firm, on Firm- and Industry-Level Accounting and Control Variables. Sample of COMPUSTAT Firms from 1983–1994

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effects</th>
<th>Separate-year regressions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-statistic</td>
</tr>
<tr>
<td>Intercept</td>
<td>−10.17 1.98</td>
<td>−9.31 1.57</td>
</tr>
<tr>
<td>EFF</td>
<td>−0.07 −5.63</td>
<td>−0.08 0.05</td>
</tr>
<tr>
<td>RD, F</td>
<td>5.67 6.63</td>
<td>6.66 3.40</td>
</tr>
<tr>
<td>ADV, F</td>
<td>5.39 3.48</td>
<td>5.75 4.35</td>
</tr>
<tr>
<td>INTAN, F</td>
<td>−2.91 −8.33</td>
<td>−2.81 1.86</td>
</tr>
<tr>
<td>DEPR, F</td>
<td>2.35 2.36</td>
<td>2.76 3.43</td>
</tr>
<tr>
<td>RD, J</td>
<td>11.17 10.26</td>
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<tr>
<td>ADV, J</td>
<td>1.26 0.65</td>
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</tr>
<tr>
<td>RESAVP, N</td>
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<tr>
<td>MV</td>
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<td>3.15 0.38</td>
</tr>
<tr>
<td>GROWTH</td>
<td>0.67 3.07</td>
<td>0.65 1.15</td>
</tr>
<tr>
<td>BROKER</td>
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<td>−0.03 0.01</td>
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<tr>
<td>VOL</td>
<td>0.06 42.52</td>
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</tr>
<tr>
<td>DISSEUE</td>
<td>1.04 10.37</td>
<td>0.97 0.57</td>
</tr>
<tr>
<td>N</td>
<td>10,631 870</td>
<td>120</td>
</tr>
</tbody>
</table>

Fixed effects refers to estimation with fixed year effects. \( Z_1 = (1/\sqrt{T}) \sum_{t=1}^{T} (t_j/\sqrt{T} - (T_j - 2)) \) where \( t \) is t-statistic, \( T \) is number of years, and \( k \) is degrees of freedom for regression in year \( j \). \( Z_2 \) equals mean \( t \) / (stddev \( t \) / \( \sqrt{T} \)).

- **COV** = Number of analysts on I/B/E/S providing earnings forecasts for the firm.
- **EFF** = Negative of the average number of firms covered by the firm’s analysts.
- **RD, F** = Research and development expense divided by total operating expenses minus **RD, J**.
- **ADV, F** = Advertising expense divided by total operating expenses minus **ADV, J**.
- **INTAN, F** = Ratio of recognized intangible assets to total assets minus **INTAN, J**.
- **DEPR, F** = Depreciation expense divided by total operating expenses minus **DEPR, J**.
- **RD, J** = Sum of research and development expenses for firms in the industry divided by sum of total operating expenses of industry firms.
- **ADV, J** = Sum of advertising expense for firms in the industry divided by sum of total operating expenses of industry firms.
- **INTAN, J** = Median ratio of industry firms’ recognized intangible assets to total assets.
- **DEPR, J** = Median ratio of industry firms’ depreciation expense to operating expenses.
- **RESAVP** = The difference between estimated value of equity based on analysts’ earnings and growth forecasts and market value, per share, deflated by price, minus the predicted value of this difference based on **RD, F**, **ADV, F**, **DEPR, F**, **RD, J**, **ADV, J**, **INTAN, J**, and **DEPR, J**. In the regression estimations we permit different coefficients on positive and negative **RESAVP**, which we label as **RESAVP, P** and **RESAVP, N**, respectively.
- **MV** = Logarithm of market value of equity.
- **GROWTH** = \((sales_{t-1}/sales_{t-1+j})^{1/3}\), where \( 3 \leq j \leq 5 \).
- **BROKER** = Average number of analysts employed by the brokerage houses that employ the firm’s analysts.
- **VOL** = Trading volume in millions of shares.
- **DISSEUE** = An indicator variable that equals one if the firm issues debt or equity securities during years \( t-1, t, \) or \( t+1 \), and zero otherwise.

All variables except for **COV**, **EFF**, **MV**, **BROKER**, and **VOL** are expressed as percentages. Industry is defined as four-digit SIC code with at least 50 firm-year observations over the prior five years.
These findings suggest either that analyst coverage is not greater for firms with sundry intangible assets, in contrast with technology and brand names, or that these proxies are not successful in capturing these assets.19

Regarding the other variables, in the pooled estimation the coefficient on $EFF$ is significantly negative, as predicted, indicating analyst coverage is greater for firms requiring less effort to follow. Also consistent with predictions, the coefficient on $RESAVP_P(RESAVP_N)$ is significantly positive (negative), indicating coverage is greater for firms with greater analyst-perceived residual mispricing. Consistent with an asymmetric relation between mispricing and analyst coverage, the coefficients on $RESAVP_P$ and $RESAVP_N$ are significantly different. The signs of the coefficients on $MV$, $GROWTH$, $BROKER$, $VOL$, and $DISSUE$ all are significantly different from zero in the predicted directions. Although prior literature on analyst coverage documents the significance of firm size and growth, the explanatory power of the average size of the firm’s analysts’ brokerage houses, trading volume, and whether the firm issues public debt or equity have not, to our knowledge, been documented.

The findings from the separate-year estimation generally corroborate the pooled estimation results. However, although the coefficient on industry advertising, $ADV_I$, is insignificantly different from zero as in the pooled estimation, its sign is opposite to predictions. The only other difference is that the $Z1$ and $Z2$ statistics indicate the coefficient on $RESAVP_P$ is insignificantly different from zero, suggesting that residual perceived undervaluation is not a significant factor in explaining equilibrium analyst coverage. However, findings reported in section 5.3 indicate that after controlling for potential simultaneity bias, the coefficient on $RESAVP_P$ in the separate-year estimations is significantly positive.

Thus far, our empirical analyses are based on firms covered by at least one analyst in the I/B/E/S database. To investigate the sensitivity of our findings to this requirement, we reestimate (1) for all sample firms with available data after setting $COV$ equal to zero for firms with no analyst following on I/B/E/S. We exclude $EFF$, $RESAVP_P$, $RESAVP_N$, and $BROKER$ from the estimation equation because they require the use of analyst data. Because the equation excludes $EFF$, we include available variables that we hypothesize explain analyst effort, $EVAR$ and $NFIRMS$.

Table 5 presents the results of estimating the revised analyst coverage equation. The findings indicate that our inferences about the association with intangibles and the control variables generally are similar to those obtained

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19 An alternative explanation for the significant negative coefficients on $INTAN_F$ and $INTAN_I$ that is consistent with our hypothesized motives for analyst coverage is that recognized intangibles are associated with less valuation uncertainty than unrecognized intangibles. However, this interpretation is inconsistent with the results of estimating (2) reported below, which indicate that analysts expend more effort to follow firms with greater recognized intangible assets.
from table 4. However, the pooled estimation coefficient on industry-level advertising expense, \(ADV, I\), is significantly positive in table 5, as predicted, although it is only marginally significant in the separate-year estimation. Also, the inferences regarding the association between analyst coverage and sundry intangibles are somewhat more consistent with predictions when we include firms with no analyst coverage. In particular, in table 5, in contrast to table 4, the coefficients on firm- and industry-level depreciation expense,
DEPR_\_F and DEPR_\_I are significantly negative, as predicted, in the pooled and separate-year estimation. These findings suggest that, after controlling for other factors in the equation, firms with higher depreciation expense are covered by fewer analysts.

Regarding the other variables, the coefficient on GROWTH is significantly negative, contrary to predictions, suggesting that, after controlling for other factors in the equation, higher growth firms are covered by fewer analysts. The coefficients on the two effort-related variables, EVAR and NFIRMS, are significant in the predicted directions.

5.2 ANALYST EFFORT

Before turning to findings from estimating (2), we report results of an untabulated analysis aimed at validating EFF as a proxy for analyst effort. In particular, we estimate the firm-specific relation between the absolute percentage analyst forecast error for each analyst and the number of firms followed by the analyst. We expect that if the number of firms followed by an analyst reflects the effort allocated to each firm, then analysts following more firms will have greater forecast errors, all else equal. The estimation equation controls for forecast horizon and the number of analysts employed by the brokerage house employing the analyst. We estimate firm-specific relations to control for differences across firms in the difficulty of forecasting earnings, which limits this analysis to firms with at least five analysts. Untabulated statistics reveal that the number of firms an analyst follows is significantly positively related to absolute earnings forecast errors. Specifically, the Z1 (Z2) statistic that tests for significance of the coefficient on the number of firms followed by an analyst across the 1,316 available firm-specific regressions is 3.94 (4.11). These findings support our use of the number of firms followed by an analyst as a basis for our analyst effort proxy.20

Table 6 presents summary statistics from estimating (2), the regression of EFF, analyst effort, on firm- and industry-level accounting and control variables. The findings are striking in that 14 of the 15 coefficients have signs consistent with predictions, with the single exception being the coefficient on earnings variability. Using a binomial test, the probability is less than 0.001 of observing this by chance. More importantly for our research question, in the pooled estimation the coefficients on all but one of the accounting variables, DEPR_\_F, are significantly different from zero. These

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20 To our knowledge, our analyst effort proxy is new to the analyst literature. The only proxy for analyst effort of which we are aware is in Grant and Rogers [1997], who measure analyst effort as the number of items in an analyst’s research report not in the company’s financial statements, arguing that these items require greater effort to obtain. However, processing financial statement information is also costly and the relevance and availability of non-financial statement information likely varies across industries and firms, which motivates us to develop an alternative proxy for analyst effort.
### TABLE 6
Summary Statistics from Regression of \( \text{EFF} \), the Negative of the Average Number of Firms Covered by the Firms’ Analysts, on Firm- and Industry-Level Accounting and Control Variables. Sample of COMPUSTAT Firms from 1983–1994

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effects</th>
<th>Separate-year regressions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-statistic</td>
</tr>
<tr>
<td>Intercept</td>
<td>−16.45</td>
<td>1.32</td>
</tr>
<tr>
<td>( \text{COV} )</td>
<td>−0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>( \text{RD}_F )</td>
<td>2.00</td>
<td>2.73</td>
</tr>
<tr>
<td>( \text{ADV}_F )</td>
<td>2.82</td>
<td>4.41</td>
</tr>
<tr>
<td>( \text{INTAN}_F )</td>
<td>0.80</td>
<td>1.53</td>
</tr>
<tr>
<td>( \text{DEPR}_F )</td>
<td>−0.16</td>
<td>3.58</td>
</tr>
<tr>
<td>( \text{RD}_I )</td>
<td>14.22</td>
<td>7.84</td>
</tr>
<tr>
<td>( \text{ADV}_I )</td>
<td>3.39</td>
<td>7.84</td>
</tr>
<tr>
<td>( \text{INTAN}_I )</td>
<td>2.38</td>
<td>4.24</td>
</tr>
<tr>
<td>( \text{DEPR}_I )</td>
<td>−1.31</td>
<td>4.03</td>
</tr>
<tr>
<td>( \text{RESAVP}_P )</td>
<td>0.01</td>
<td>0.25</td>
</tr>
<tr>
<td>( \text{RESAVP}_N )</td>
<td>−0.42</td>
<td>0.84</td>
</tr>
<tr>
<td>( \text{MV} )</td>
<td>0.28</td>
<td>0.25</td>
</tr>
<tr>
<td>( \text{GROWTH} )</td>
<td>1.53</td>
<td>0.49</td>
</tr>
<tr>
<td>( \text{BROKER} )</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>( \text{EVAR} )</td>
<td>−0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>( \text{NFIRMS} )</td>
<td>−0.01</td>
<td>−6.01</td>
</tr>
<tr>
<td>( N )</td>
<td>10,631</td>
<td>870</td>
</tr>
<tr>
<td>Adjusted ( R^2 )</td>
<td>0.07</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Fixed effects refers to estimation with fixed year effects. \( Z1 = \left( 1 / \sqrt{T} \right) \sum_{j=1}^{T} \left( t / \text{stddev} \right) \) where \( \text{t-statistic} \), \( T \) is number of years, and \( k \) is degrees of freedom for regression in year \( j \). \( Z2 \) equals mean \( t / ( \text{stddev} \). \)

- \( \text{COV} \) = Number of analysts on I/B/E/S providing earnings forecasts for the firm.
- \( \text{EFF} \) = Negative of the average number of firms covered by the firms’ analysts.
- \( \text{RD}_F \) = Research and development expense divided by total operating expenses minus \( \text{RD}_I \).
- \( \text{ADV}_F \) = Advertising expense divided by total operating expenses minus \( \text{ADV}_I \).
- \( \text{INTAN}_F \) = Ratio of recognized intangible assets to total assets minus \( \text{INTAN}_I \).
- \( \text{DEPR}_F \) = Depreciation expense divided by total operating expenses minus \( \text{DEPR}_I \).
- \( \text{RD}_I \) = Sum of research and development expenses for firms in the industry divided by sum of total operating expenses of industry firms.
- \( \text{ADV}_I \) = Sum of advertising expense for firms in the industry divided by sum of total operating expenses of industry firms.
- \( \text{INTAN}_I \) = Median ratio of industry firms’ recognized intangible assets to total assets.
- \( \text{DEPR}_I \) = Median ratio of industry firms’ depreciation expense to operating expenses.
- \( \text{RESAVP} \) = The difference between estimated value of equity based on analysts’ earnings and growth forecasts and market value, per share, deflated by price, minus the predicted value of this difference based on \( \text{RD}_F, \text{ADV}_F, \text{INTAN}_F, \text{DEPR}_F, \text{RD}_I, \text{ADV}_I, \text{INTAN}_I, \) and \( \text{DEPR}_I \). In the regression estimations we permit different coefficients on positive and negative \( \text{RESAVP} \), which we label as \( \text{RESAVP}_P \) and \( \text{RESAVP}_N \), respectively.
- \( \text{MV} \) = Logarithm of market value of equity.
- \( \text{GROWTH} \) = \((\text{sales}_{t−1}/\text{sales}_{t−(1+i)})^{1/3}\), where \( 3 \leq i \leq 5 \).
- \( \text{BROKER} \) = Average number of analysts employed by the brokerage houses that employ the firms’ analysts.
- \( \text{EVAR} \) = Coefficient of variation of earnings, measured over no more than five, but at least three, years.
- \( \text{NFIRMS} \) = Number of firms in the industry.

All variables except for \( \text{COV}, \text{EFF}, \text{MV}, \text{BROKER}, \) and \( \text{NFIRMS} \) are expressed as percentages. Industry is defined as four-digit SIC code with at least 50 firm-year observations over the prior five years.
findings suggest that intangible assets, including sundry intangibles, help explain analyst effort. They also suggest that firm- and industry-level measures are important in explaining analyst effort.

Regarding the other variables in the pooled estimation, the coefficients on COV, RESAVP_P, RESAVP_N, MV, GROWTH, BROKER, and NFIEMS are significantly different from zero in the predicted directions. The findings suggest that analysts expend greater effort to follow firms that are less widely followed by other analysts, firms that analysts perceive to be mispriced, larger firms, and firms with greater sales growth, and expend less effort to follow firms covered by analysts associated with smaller brokerage houses and firms in industries with more firms. Inconsistent with our predictions, the coefficient on EVAR is significantly negative, suggesting analysts expend less effort to follow firms with more variable earnings, after controlling for the other factors represented by proxies in the estimation equation. As with (1), the coefficients on RESAVP_P and RESAVP_N differ in absolute value, indicating an asymmetric relation between analyst effort and residual analyst-perceived mispricing.

The separate-year estimation results indicate similar inferences for the accounting variables. However, although the coefficients on industry-level advertising and depreciation expenses, ADV_I and DEPR_I, have the predicted signs and are significantly different from zero based on the Z1 statistic, they are insignificantly different from zero based on the Z2 statistic. Inferences regarding the control variables also are unchanged from the pooled estimation, except that the coefficient on RESAVP_P (BROKER) is insignificantly different from zero based on the Z1 and Z2 (Z2) statistics.

5.3 SIMULTANEOUS ESTIMATION

Table 7 presents summary statistics from estimating (1) and (2) in a system of equations that treats analyst coverage, COV, and analyst effort, EFF, as jointly determined endogenous variables. Panel A (panel B) presents summary statistics from the second stage estimation where the independent variable EFF (COV) is replaced by PRD_EFF (PRD_COV), which is predicted analyst effort (analyst coverage) based on a first-stage regression of EFF (COV) on all of the exogenous variables in the system.

Panel A reveals that correcting for potential simultaneity bias does not have a dramatic effect on our inferences regarding analyst coverage, although the results are somewhat closer to our predictions. In particular, the coefficient on industry-level recognized intangibles, INTAN_I, is significantly positive in the separate-year estimation, consistent with predictions, although it is insignificantly different from zero in the pooled estimation. The coefficient on industry-level depreciation expense, DEPR_I, is insignificantly different from zero, whereas in table 4 it is significantly different from zero, but with a sign opposite to predictions. Lastly, the coefficient on RESAVP_P is significantly positive, as predicted, in the separate-year estimation, whereas it is insignificantly different from zero in table 4. Panel B
TABLE 7
Summary Statistics from Simultaneous Regressions (Two-Stage Least Squares) of EFF and COV on Firm- and Industry-Level Accounting and Control Variables. Sample of COMPUSTAT Firms from 1983–1994

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effects</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Mean</th>
<th>Std dev</th>
<th>Mean</th>
<th>Std dev</th>
<th>Z1</th>
<th>Z2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-52.02</td>
<td>15.50</td>
<td>- 3.15</td>
<td>1.43</td>
<td>-10.90</td>
<td>- 7.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRD_EFF</td>
<td>-1.24</td>
<td>-6.98</td>
<td>- 1.44</td>
<td>0.91</td>
<td>-2.29</td>
<td>1.32</td>
<td>- 7.93</td>
<td>- 5.78</td>
<td></td>
</tr>
<tr>
<td>RD_F</td>
<td>6.55</td>
<td>7.57</td>
<td>7.60</td>
<td>2.98</td>
<td>2.26</td>
<td>0.59</td>
<td>7.81</td>
<td>12.70</td>
<td></td>
</tr>
<tr>
<td>ADV_F</td>
<td>8.22</td>
<td>4.98</td>
<td>8.75</td>
<td>5.86</td>
<td>1.52</td>
<td>0.96</td>
<td>5.25</td>
<td>5.22</td>
<td></td>
</tr>
<tr>
<td>INTAN_F</td>
<td>-1.76</td>
<td>-3.33</td>
<td>-1.42</td>
<td>1.31</td>
<td>-0.72</td>
<td>0.71</td>
<td>-2.49</td>
<td>-3.37</td>
<td></td>
</tr>
<tr>
<td>DEPR_F</td>
<td>2.04</td>
<td>2.05</td>
<td>2.32</td>
<td>3.28</td>
<td>0.72</td>
<td>1.00</td>
<td>2.49</td>
<td>2.39</td>
<td></td>
</tr>
<tr>
<td>RD_I</td>
<td>22.25</td>
<td>11.12</td>
<td>27.51</td>
<td>11.02</td>
<td>3.61</td>
<td>1.14</td>
<td>12.51</td>
<td>10.47</td>
<td></td>
</tr>
<tr>
<td>ADV_I</td>
<td>3.69</td>
<td>1.86</td>
<td>2.17</td>
<td>6.62</td>
<td>0.30</td>
<td>0.91</td>
<td>1.05</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>INTAN_I</td>
<td>-0.41</td>
<td>-0.39</td>
<td>3.28</td>
<td>5.38</td>
<td>0.62</td>
<td>1.23</td>
<td>2.13</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>DEPR_I</td>
<td>1.44</td>
<td>1.28</td>
<td>1.50</td>
<td>4.52</td>
<td>0.32</td>
<td>1.15</td>
<td>1.10</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>RESAVP_P</td>
<td>0.34</td>
<td>4.65</td>
<td>0.13</td>
<td>0.49</td>
<td>0.62</td>
<td>1.19</td>
<td>2.14</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td>RESAVP_N</td>
<td>-1.58</td>
<td>-5.77</td>
<td>-1.50</td>
<td>1.76</td>
<td>-1.53</td>
<td>1.84</td>
<td>-5.29</td>
<td>-2.75</td>
<td></td>
</tr>
<tr>
<td>MV</td>
<td>3.44</td>
<td>73.37</td>
<td>3.39</td>
<td>0.45</td>
<td>20.14</td>
<td>2.18</td>
<td>60.69</td>
<td>30.65</td>
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</tr>
<tr>
<td>GROWTH</td>
<td>2.45</td>
<td>7.06</td>
<td>2.72</td>
<td>2.16</td>
<td>2.17</td>
<td>1.49</td>
<td>7.50</td>
<td>4.83</td>
<td></td>
</tr>
<tr>
<td>BROKER</td>
<td>-9.05</td>
<td>-20.30</td>
<td>-0.04</td>
<td>0.01</td>
<td>-4.54</td>
<td>1.29</td>
<td>-15.70</td>
<td>-11.62</td>
<td></td>
</tr>
<tr>
<td>VOL</td>
<td>0.05</td>
<td>36.76</td>
<td>0.07</td>
<td>0.02</td>
<td>11.15</td>
<td>2.71</td>
<td>38.58</td>
<td>13.62</td>
<td></td>
</tr>
<tr>
<td>DISSUE</td>
<td>0.94</td>
<td>9.31</td>
<td>0.87</td>
<td>0.50</td>
<td>2.45</td>
<td>1.31</td>
<td>8.48</td>
<td>6.22</td>
<td></td>
</tr>
</tbody>
</table>

N 10,631 870 120
Adjusted $R^2$ 0.70 0.72 0.02

reveals inferences almost identical to those reported in table 6 relating to analyst effort, indicating the table 6 results are not attributable to simultaneity bias.21

5.4 ADDITIONAL ANALYSES

5.4.1 Analyst Recommendations. McNichols and O’Brien [1997] document that the distribution of analyst recommendations associated with the analyst’s decision to initiate (drop) coverage is more (less) favorable than the distribution of recommendations for firms receiving continuous coverage. These findings suggest that analysts’ expectations of firms’ future prospects affect analyst coverage. Analysts’ recommendations to buy and sell stock in the firm also reflect their perceptions related to mispricing. Thus, we reestimate (1) and (2) after controlling for analysts’ recommendations. Specifically, we include in (1) and (2) the average across analysts of the recommendation for the firm issued closest to the end of each fiscal year. We code recommendations on a five-point scale, where 1 represents a “strong buy” and 5 represents a “strong sell.” Because our recommendation data span

21 Consistent with our finding that the coverage equation results differ somewhat, but the effort equation results are almost identical when estimated in the simultaneous system, the Hausman [1978] test of simultaneity rejects the null hypothesis of no simultaneity in the coverage equation (p-value = 0.01), but does not reject the null hypothesis of no simultaneity in the effort equation (p-value = 0.54).
### TABLE 7—Continued

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Mean</th>
<th>Std dev</th>
<th>Coefficient</th>
<th>t-statistic</th>
<th>Mean</th>
<th>Std dev</th>
<th>Z1</th>
<th>Z2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>1.64</td>
<td>-16.32</td>
<td>3.22</td>
<td>-56.45</td>
<td>-32.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRD_COV</td>
<td>-0.05</td>
<td>-2.88</td>
<td>-0.03</td>
<td>0.06</td>
<td>-0.48</td>
<td>1.13</td>
<td>-1.67</td>
<td>-1.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RD_F</td>
<td>+1.20</td>
<td>1.80</td>
<td>1.85</td>
<td>2.60</td>
<td>0.57</td>
<td>0.95</td>
<td>1.96</td>
<td>2.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADV_F</td>
<td>+2.57</td>
<td>2.06</td>
<td>2.64</td>
<td>4.47</td>
<td>0.58</td>
<td>0.98</td>
<td>1.99</td>
<td>1.96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTAN_F</td>
<td>+0.81</td>
<td>2.08</td>
<td>0.82</td>
<td>1.56</td>
<td>0.61</td>
<td>1.00</td>
<td>2.11</td>
<td>1.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPR_F</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.18</td>
<td>3.53</td>
<td>-0.08</td>
<td>1.32</td>
<td>-0.26</td>
<td>-0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RD_J</td>
<td>+12.10</td>
<td>13.31</td>
<td>13.80</td>
<td>7.56</td>
<td>3.79</td>
<td>1.19</td>
<td>13.10</td>
<td>6.05</td>
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<tr>
<td>ADV_J</td>
<td>+2.75</td>
<td>1.82</td>
<td>3.21</td>
<td>7.77</td>
<td>0.60</td>
<td>1.47</td>
<td>2.07</td>
<td>1.37</td>
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<tr>
<td>INTAN_J</td>
<td>+3.62</td>
<td>6.01</td>
<td>2.47</td>
<td>4.29</td>
<td>1.39</td>
<td>1.96</td>
<td>4.80</td>
<td>1.91</td>
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<td></td>
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<tr>
<td>DEPR_J</td>
<td>-1.56</td>
<td>-2.11</td>
<td>-1.38</td>
<td>3.96</td>
<td>-0.63</td>
<td>1.55</td>
<td>-2.19</td>
<td>-1.16</td>
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<tr>
<td>RESAVP_P</td>
<td>+0.17</td>
<td>3.25</td>
<td>0.01</td>
<td>0.25</td>
<td>0.72</td>
<td>1.16</td>
<td>0.11</td>
<td>0.12</td>
<td></td>
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<tr>
<td>RESAVP_N</td>
<td>-0.75</td>
<td>3.91</td>
<td>-0.37</td>
<td>0.88</td>
<td>-0.55</td>
<td>1.32</td>
<td>-1.91</td>
<td>-1.41</td>
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<tr>
<td>MV</td>
<td>+0.30</td>
<td>3.93</td>
<td>0.19</td>
<td>0.32</td>
<td>0.68</td>
<td>1.30</td>
<td>2.36</td>
<td>1.97</td>
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</tr>
<tr>
<td>GROWTH</td>
<td>+1.58</td>
<td>9.36</td>
<td>1.52</td>
<td>0.51</td>
<td>2.52</td>
<td>0.79</td>
<td>8.72</td>
<td>9.83</td>
<td></td>
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<tr>
<td>BROKER</td>
<td>-0.01</td>
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<td>0.00</td>
<td>0.02</td>
<td>-0.27</td>
<td>2.90</td>
<td>-0.95</td>
<td>0.00</td>
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<tr>
<td>EVAR</td>
<td>+0.03</td>
<td>-3.35</td>
<td>-0.03</td>
<td>0.05</td>
<td>-0.98</td>
<td>1.10</td>
<td>-3.41</td>
<td>-2.48</td>
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</tr>
<tr>
<td>NFIRMS</td>
<td>-0.01</td>
<td>-5.85</td>
<td>-0.01</td>
<td>0.01</td>
<td>-1.63</td>
<td>1.47</td>
<td>-5.63</td>
<td>-3.69</td>
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<tr>
<td>N</td>
<td>10,631</td>
<td></td>
<td>870</td>
<td>120</td>
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<tr>
<td>Adjusted R²</td>
<td>0.06</td>
<td></td>
<td>0.08</td>
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</tbody>
</table>

Fixed effects refer to estimation with fixed year effects. $Z_1$ equals $(1/\sqrt{T}) \sum_{j=1}^{T} (t_j/\sqrt{k_j} - 2)$ where $t$ is the t-statistic, $T$ is number of years, and $k$ is degrees of freedom for regression in year $j$. $Z_2$ equals mean $t/(\text{stddev} \sqrt{1/T})$.

- **COV**: Number of analysts on I/B/E/S providing earnings forecasts for the firm. **PRD_COV** is predicted value of **COV** from the first-stage regression.
- **EFF**: Negative of the average number of firms covered by the firms’ analysts. **PRD_EFF** is the predicted value of **EFF** from the first-stage regression.
- **RD_J**: Research and development expense divided by total operating expenses minus **RD_J**.
- **ADV_J**: Advertising expense divided by total operating expenses minus **ADV_J**.
- **INTAN_J**: Ratio of recognized intangible assets to total assets minus **INTAN_J**.
- **DEPR_J**: Depreciation expense divided by total operating expenses minus **DEPR_J**.
- **RD_J**: Sum of research and development expenses for firms in the industry divided by sum of total operating expenses of industry firms.
- **ADV_J**: Sum of advertising expense for firms in the industry divided by sum of total operating expenses of industry firms.
- **INTAN_J**: Median ratio of industry firms’ recognized intangible assets to total assets.
- **DEPR_J**: Median ratio of industry firms’ depreciation expense to operating expenses.
- **RESAVP**: The difference between estimated value of equity based on analysts’ earnings and growth forecasts and market value, per share, deflated by price, minus the predicted value of this difference based on **RD_J**, **ADV_J**, **INTAN_J**, **DEPR_J**, **RD_J**, **ADV_J**, **INTAN_J**, and **DEPR_J**. In the regression estimations we permit different coefficients on positive and negative **RESAVP**, which we label as **RESAVP_P** and **RESAVP_N**, respectively.
- **MV**: Logarithm of market value of equity.
- **GROWTH**: $(\text{sales}_{t-1} / \text{sales}_{t-(3+i)})^{1/3}$, where $3 \leq i \leq 5$.
- **BROKER**: Average number of analysts employed by the brokerage houses that employ the firms’ analysts.
- **VOL**: Trading volume in millions of shares.
- **DISSUE**: An indicator variable that equals one if the firm issues debt or equity securities during years $t-1$, $t$, or $t+1$, and zero otherwise.
- **EVAR**: Coefficient of variation of earnings, measured over no more than five, but at least three, years.
- **NFIRMS**: Number of firms in the industry.

All variables except for **COV**, **EFF**, **MV**, **BROKER**, **VOL**, and **NFIRMS** are expressed as percentages. Industry is defined as four-digit SIC code with at least 50 firm-year observations over the prior five years.
1987–1994, the sample size for this additional analysis is approximately one-half that in our primary analyses.

Untabulated statistics reveal that, as expected, the mean (median) of the recommendation variable is less than 2.5; it is 2.31 (2.29), reflecting more buy than sell recommendations. Untabulated correlations reveal that the recommendation variable is significantly positively correlated with analyst coverage and effort and, consistent with the recommendation variable reflecting analyst-perceived mispricing, significantly negatively correlated with RESAVP.

Regarding analyst coverage, untabulated statistics in the OLS estimation reveal that the coefficient on the recommendation variable is positive, but insignificantly so. In the 2SLS estimation, the coefficient on the analyst recommendation variable is significantly negative, indicating that after controlling for the other variables, analyst coverage is positively associated with favorable recommendations by analysts. More importantly, the untabulated statistics reveal that our inferences relating to intangible assets are unaltered by including this variable in either specification. Regarding analyst effort, the untabulated findings from including analyst recommendations in the OLS and 2SLS estimations reveal that the coefficients on the recommendation variable are significantly negative. This indicates that analysts expend more effort on firms for which they issue more favorable recommendations, consistent with McNichols and O’Brien’s [1997] finding that analysts forecast errors are smaller for firms whose coverage was recently initiated. Nonetheless, as with analyst coverage, our inferences relating to the relation between intangible assets and analyst effort are unaffected by including the recommendation variable.

5.4.2 Institutional Investors. O’Brien and Bhushan [1990] document that analyst coverage is associated with the number of institutional investors. To investigate whether our inferences regarding analyst coverage are sensitive to controlling for the effects of institutional investors, we reestimate (1) after including the percentage of the firm’s investors that are institutions as an additional explanatory variable. The institutional investor data, which we obtain from Laser Disclosure, are available only for 1989–1994, which reduces our sample by approximately one-half relative to the table 4 estimation. Untabulated statistics reveal that sample firms have a mean (median) of 43 (42) percent of institutional investors.

Untabulated statistics from estimating (1), including the institutional investor variable, reveal that its coefficient is significantly positive, as expected, indicating analyst coverage is positively related to institutional investment. However, inclusion of the institutional investor variable has no effect on our inferences regarding the relation between analyst coverage and intangible assets.22

22 As in section 5.4.1, the findings based on this subsample are somewhat more consistent with our predictions about the relation between analyst coverage and intangible assets than our primary findings.
5.4.3 Market-to-Book Ratio. The market-to-book ratio reflects aggregate unrecognized intangible assets. Thus, we assess the extent to which our findings for individual intangible asset proxies are sensitive to inclusion in (1) and (2) of this summary measure. Untabulated findings reveal that, as expected, market-to-book ratios are significantly positively correlated with coverage, effort, most of our proxies for intangible assets, size, and growth, and negatively correlated with earnings variability. They also are significantly positively (negatively) correlated with trading volume and frequency of capital market access (size of brokerage house). Thus, it would not be surprising for inclusion of the market-to-book ratio to erode the significance of the coefficients on any of the explanatory variables.

Regarding coverage, perhaps surprisingly, untabulated findings reveal that inclusion of the market-to-book ratio as an additional explanatory variable has no effect on our inferences from either the OLS or 2SLS estimations. Interestingly, the coefficient on the market-to-book ratio is significantly negative in the pooled OLS estimation, but significantly positive in the 2SLS estimation, consistent with simultaneity between coverage and effort affecting the coefficient on the market-to-book ratio more than the other coefficients. Regarding effort, untabulated findings reveal that in the OLS estimation, inclusion of the market-to-book ratio results in the same inferences as our tabulated findings, except that the coefficients on firm research and development, \( RD_F \), and industry advertising and depreciation, \( ADV_I \) and \( DEPR_I \), are insignificantly different from zero. In the 2SLS, the coefficient on firm advertising, \( ADV_F \), also is insignificantly different from zero in the separate-year estimation. Market-to-book ratios are significantly positively related to effort in both estimations.

5.4.4 Financial Institutions and Utilities. Section 4 explains that we exclude financial institutions and utilities because our proxies for intangible assets are not designed to capture intangible assets of firms in these industries, e.g., core deposits for banks and regulatory benefits for utilities. Nonetheless, as a sensitivity check we reestimate (1) and (2) including these firms, which results in approximately 3,000 additional firm-year observations. Untabulated findings reveal that our inferences largely are unaffected, especially those relating to intangibles associated with research and development and advertising. Specifically, regarding analyst coverage, for the OLS estimation, the only difference relating to the intangible asset proxies is that industry-level advertising, \( ADV_I \), is significantly negatively related to coverage. For the 2SLS estimation, the only difference is that industry-level depreciation, \( DEPR_I \), is significantly positively related to coverage. Regarding analyst effort, for both estimations, the only difference is that firm-level recognized intangibles, \( INTAN_F \), is not significantly related to effort.

5.4.5 Changes in Analyst Coverage. As an additional specification check, table 8 presents regression summary statistics from estimating (1) in change form, i.e., where each variable is defined as the difference in the variable
### TABLE 8
Summary Statistics from Regression of Change in Number of Analysts Following the Firm, $\Delta COV$, on Firm- and Industry-Level Accounting and Control Variables. $\Delta$ Denotes Change from Year $t−3$ to Year $t$.

Sample of COMPUSTAT Firms from 1983–1994

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fixed effects</th>
<th>Separate-year regressions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pred Coef</td>
<td>Coefficient</td>
</tr>
<tr>
<td>Intercept</td>
<td>– 0.06 4.32</td>
<td>−0.63 0.67</td>
</tr>
<tr>
<td>$\Delta EFF$</td>
<td>+ 4.35 2.70</td>
<td>0.06 0.05</td>
</tr>
<tr>
<td>$\Delta RD/FL$</td>
<td>+ 15.77 3.57</td>
<td>4.43 4.56</td>
</tr>
<tr>
<td>$\Delta INTAN/FL$</td>
<td>+ −0.36 −0.49</td>
<td>−0.73 2.03</td>
</tr>
<tr>
<td>$\Delta DEPR/FL$</td>
<td>− 3.01 1.89</td>
<td>2.42 3.38</td>
</tr>
<tr>
<td>$\Delta RD/I$</td>
<td>+ 11.94 2.21</td>
<td>13.54 11.50</td>
</tr>
<tr>
<td>$\Delta ADV/I$</td>
<td>+ 28.09 3.62</td>
<td>30.24 44.23</td>
</tr>
<tr>
<td>$\Delta INTAN/I$</td>
<td>+ −0.52 −0.19</td>
<td>0.98 7.51</td>
</tr>
<tr>
<td>$\Delta DEPR/I$</td>
<td>− 13.64 4.17</td>
<td>13.32 10.72</td>
</tr>
<tr>
<td>$\Delta RESAVP/P$</td>
<td>+ 0.13 1.84</td>
<td>0.13 0.28</td>
</tr>
<tr>
<td>$\Delta RESAVP/N$</td>
<td>− 0.33 −1.95</td>
<td>−0.34 0.46</td>
</tr>
<tr>
<td>$\Delta MV$</td>
<td>+ 2.27 26.87</td>
<td>2.33 0.40</td>
</tr>
<tr>
<td>$\Delta GROWTH$</td>
<td>+ 1.54 5.05</td>
<td>1.52 1.11</td>
</tr>
<tr>
<td>$\Delta BROKER$</td>
<td>− 0.02 −7.63</td>
<td>−0.02 0.01</td>
</tr>
<tr>
<td>$\Delta VOL$</td>
<td>+ 0.01 7.56</td>
<td>0.02 0.02</td>
</tr>
<tr>
<td>$\Delta ISSUE$</td>
<td>+ 0.04 0.53</td>
<td>0.07 0.24</td>
</tr>
</tbody>
</table>

|            | Adjusted $R^2$ | 0.24                      | 0.22 0.02 |

Fixed effects refers to estimation with fixed year effects. $Z1$ equals $(1/\sqrt{T})\sum_{t=3}^{T}(t_j/\sqrt{k_j/(k_j−2)})$ where $t$ is $t$-statistic, $T$ is number of years, and $k$ is degrees of freedom for regression in year $j$. $Z2$ equals $t/\sqrt{(\text{std dev } t/\sqrt{5})}$.

- $COV$ = Number of analysts on I/B/E/S providing earnings forecasts for the firm.
- $EFF$ = Negative of the average number of firms covered by the firms’ analysts.
- $RD/FL$ = Research and development expense divided by total operating expenses minus $RD/I$.
- $ADV/FL$ = Advertising expense divided by total operating expenses minus $ADV/I$.
- $INTAN/FL$ = Ratio of recognized intangible assets to total assets minus $INTAN/I$.
- $DEPR/FL$ = Depreciation expense divided by total operating expenses minus $DEPR/I$.
- $RD/I$ = Sum of research and development expenses for firms in the industry divided by sum of total operating expenses of industry firms.
- $ADV/I$ = Sum of advertising expense for firms in the industry divided by sum of total operating expenses of industry firms.
- $INTAN/I$ = Median ratio of industry firms’ recognized intangible assets to total assets.
- $DEPR/I$ = Median ratio of industry firms’ depreciation expense to operating expenses.
- $RESAVP$ = The difference between estimated value of equity based on analysts’ earnings and growth forecasts and market value, per share, deflated by price, minus the predicted value of this difference based on $RD/FL$, $ADV/FL$, $INTAN/FL$, $DEPR/FL$, $RD/I$, $ADV/I$, $INTAN/I$, and $DEPR/I$. In the regression estimations we permit different coefficients on positive and negative $RESAVP$, which we label as $RESAVP/P$ and $RESAVP/N$, respectively.
- $MV$ = Logarithm of market value of equity.
- $GROWTH$ = $\left(\text{sales}_{t-1}/\text{sales}_{t-(1+3)}\right)^{1/3}$, where $3 \leq i \leq 5$.
- $BROKER$ = Average number of analysts employed by the brokerage houses that employ the firms’ analysts.
- $VOL$ = Trading volume in millions of shares.
- $ISSUE$ = An indicator variable that equals one if the firm issues debt or equity securities during years $t−1$, $t$, or $t+1$, and zero otherwise.

All variables except for $COV$, $EFF$, $MV$, $BROKER$, and $VOL$ are expressed as percentages. Industry is defined as four-digit SIC code with at least 50 firm-year observations over the prior five years.
between year \( t \) and year \( t - 3 \). The findings are consistent with those reported in table 4. In particular, changes in intangible assets associated with changes in firm- and industry-level research and development and advertising expenses, \( \Delta RD_F \), \( \Delta ADV_F \), \( \Delta RD_I \), and \( \Delta ADV_I \), are significantly positively related to changes in analyst coverage, \( \Delta COV \). Although the coefficients on changes in firm- and industry-level recognized intangibles and depreciation expense, \( \Delta INTAN_F \), \( \Delta DEPR_F \), \( \Delta INTAN_I \), and \( \Delta DEPR_I \), have unpredicted signs, only those related to depreciation are significantly different from zero. The insignificance of the coefficients on recognized intangibles is not surprising given that, for many firms, intangibles are purchased infrequently, resulting in \( \Delta INTAN_F \) and \( \Delta INTAN_I \) reflecting primarily amortization expense, which likely has little effect on analysts’ incentives to change coverage.

Changes in all of the control variables are significantly associated with changes in analyst coverage in the predicted directions, with the exception of \( DISSUE \). This is not surprising, given that \( DISSUE \) is an indicator variable that equals one if the firm issues debt or equity securities during years \( t - 1 \), \( t \), or \( t + 1 \). Thus, it has little variation over the three-year difference window.

The only notable difference between the table 8 and table 4, findings is that changes in analyst coverage are significantly positively associated with changes in analyst effort. This indicates that analysts expend more effort when they initiate coverage, which is consistent with McNichols and O’Brien’s [1997] finding that for newly covered firms, analysts revise their buy and sell recommendations and earnings forecasts more frequently and forecast earnings more accurately. Table 8 indicates that this effect dominates the effect associated with our prediction that analysts follow firms that require less effort, all else equal.

6. **Summary and Concluding Remarks**

This study hypothesizes and finds that analyst coverage is significantly positively associated with intangible assets. Because intangible assets are not typically recognized and estimates of fair values for these assets are not disclosed, firms with more intangible assets likely would have less informative prices in the absence of analyst coverage. For this reason, we expect analysts have greater incentives to cover firms with more intangible assets and, thus, predict higher analyst coverage for such firms. We base our tests on eight proxies that reflect the extent of industries’ and firms’ intangible assets.

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23 Untabulated findings using year \( t - 1 \) or year \( t - 2 \) as the base year yield similar inferences, although, the year \( t - 1 \) based findings are somewhat less significant. We focus on intervals greater than one year because the variables we use do not change markedly from one year to the next.

24 Possibly as a result of this, untabulated findings from estimating (2) using differenced variables reveal that the coefficient on change in coverage, \( \Delta COV \), is significantly positive, but almost none of the other coefficients is significantly different from zero.
related to research and development and advertising activity, and sundry other intangible assets as captured by depreciation expense and recognized intangible assets.

As predicted, we find that analyst coverage is significantly greater for firms with larger research and development and advertising expenses relative to their industry, and for firms in industries with larger research and development expense, after controlling for other factors posited to explain analyst coverage. We also predict and find that analyst coverage is greater for firms that require less analyst effort to follow and firms that analysts perceive to be mispriced, where our mispricing proxy is based on the Ohlson [1995] valuation model and analyst earnings forecasts.

Consistent with prior research, we find that analyst coverage is increasing in firm size and growth. We contribute to the analyst coverage literature by documenting that analyst coverage also is significantly positively associated with trading volume and whether the firm accesses the capital markets, and negatively associated with the size of the firms’ analysts’ brokerage houses, after controlling for factors identified in prior research. These findings support the notion that analysts’ decisions to cover firms depend on private benefits, such as trading and investment banking fees, and costs, such as the effort required to follow a firm. Because these private benefits and costs differ across firms, the findings suggest analysts’ greater incentives to cover firms with intangible assets may not result in greater coverage for all such firms.

We also predict and find strong evidence that analysts expend greater effort to follow firms with more intangible assets, after controlling for other factors we hypothesize are associated with analyst effort. These include analyst coverage, perceived mispricing, size, growth, earnings variability, size of the firm’s analysts’ brokerage houses, and number of firms in the industry. All of these factors are significantly associated with analyst effort in the predicted direction, except for earnings variability. Our tests of hypotheses relating to analyst effort are distinctive and, thus, also contribute to the analyst literature.

Because analyst effort affects analyst coverage and vice versa, we also test our hypotheses using a simultaneously estimated system of equations that treats analyst coverage and analyst effort as jointly determined endogenous variables. Our inferences generally are unaffected by using this estimation technique, although some of the findings are closer to our predictions, suggesting our primary findings are not attributable to simultaneity bias. Results from other sensitivity checks also indicate that our findings are robust.

Taken as a whole, our evidence points to an important potential implication of non-recognition of intangible assets. In particular, intangible assets, most of which are not recognized as assets in firms’ financial statements, are associated with greater incentives for analysts to cover such firms and greater costs of coverage. An unanswered question is whether financial statement recognition of intangible assets could more efficiently provide information about such assets to investors.
APPENDIX

This appendix describes how we calculate our proxy for residual analyst-perceived mispricing, \( RESAVP \), which is orthogonal to our proxies for intangible assets. First, following Frankel and Lee [1998], we construct a measure of analysts’ perceived mispricing based on the difference between firm value estimated based on analysts’ earnings forecasts and share price. Second, we estimate a regression of this estimate on our accounting proxies for intangible assets. The proxy for mispricing that we include in our hypothesis tests, \( RESAVP \), is the residual from this regression plus the intercept and, thus, the portion of analysts’ perceived mispricing that is orthogonal to our accounting proxies.

Specifically, we first set \( VDIF = (AV_t - P_t) / P_t \), where \( P_t \) is share price and

\[
AV_t = BVE_t + \sum_{i=1}^{4} \frac{E_t(\text{EPS}_{t+i}) - rE_t(BVE_{t+i-1})}{(1 + r)^i} + \frac{E_t(\text{EPS}_{t+5}) - rE_t(BVE_{t+4})}{(1 + r)^4}. \tag{A1}
\]

\( E_t(\text{EPS}_{t+i}) \) equals time \( t \) mean analyst forecast of earnings per share for year \( t + i \), for \( i = 1, 2 \). Most analysts do not forecast earnings beyond two future years, but often issue a three-to-five year earnings growth estimate. Thus, we set \( E_t(\text{EPS}_{t+i}) \) equal to the time \( t \) mean analyst long-term earnings growth forecast times \( \text{EPS}_{t+i-1} \), for \( i = 3 \) through 5. \( E_t(BVE_{t+i}) \) equals \( BVE_{t+i-1} + E_t(\text{EPS}_{t+i}) - E_t(DIV_{t+i}) \), where \( DIV_t \) is dividends in year \( t \). We set \( E_t(DIV_{t+i}) \) equal to \( E_t(\text{EPS}_{t+i}) \times \text{PAYOUT} \), where \( \text{PAYOUT} \) is the firm’s dividend payout ratio.\(^{25}\) The firm’s cost of equity capital, \( r \), equals the greater of \( R_f + \beta (R_m - R_f) \) or \( R_f \), where \( \beta \) is estimated from the market model, \( R_f \) is the 10-year Treasury Bill rate, and \( (R_m - R_f) \) is 7.6%, following Ibbotson Associates [1996].\(^{26}\) If \( AV_t \) is negative, we set it to zero.\(^{27}\)

To validate that \( VDIF \) reflects mispricing, we replicate Frankel and Lee’s [1998] finding that the difference between valuations based on analysts’ forecasts and price, specifically, \( (AV_t - P_t) / P_t \), is positively associated with

\(^{25}\) We define the dividend payout ratio as the average of the prior three years ratio of dividends-to-net income. Consistent with Frankel and Lee [1998], among others, if net income in a particular year is negative, for purposes of this calculation, we set it equal to 6% of total assets.

\(^{26}\) Botosan’s [1997] findings suggest that our estimates of cost of capital potentially are too low for firms with substantial unrecognized intangibles. This implies that \( AV \) is too high for such firms, although the effect on \( VDIF \) is not unambiguous. Botosan infers the cost of equity capital from price-earnings ratios, assuming prices are correct. We do not adopt Botosan’s approach because we admit the possibility that a firm’s share price can differ from its value. Thus, we estimate the cost of equity capital using the market model, which permits us to compare estimates of value to price.

\(^{27}\) Measures similar to \( VDIF \) have been used by Francis, Olsson, and Oswald [2000] and Sougiannis and Yaekura [1997] to compare the reliability of alternative models of equity valuation.
subsequent returns. Untabulated statistics from a regression of cumulative market-adjusted returns over the 12 months following the analysts’ forecast on \((AV_t - P_t)/P_t\) indicate a significantly positive association, suggesting that when analysts perceive greater (smaller) value relative to the current price, subsequent returns are greater (smaller).\(^{28}\)

We next estimate the following relation between \(VDIF\) and the intangible asset proxies.

\[
VDIF = \alpha_0 + \alpha_1 RD_F + \alpha_2 ADV_F + \alpha_3 INTAN_F + \alpha_4 DEPR_F \\
+ \alpha_5 RD_I + \alpha_6 ADV_I + \alpha_7 INTAN_I + \alpha_8 DEPR_I + \varepsilon_{A2} \quad (A2)
\]

Our proxy for residual mispricing, \(RESAVP\), equals \(VDIF\) minus the predicted \(VDIF\) based on the intangibles proxies, i.e., the sum of the intercept and estimated residual from the untabulated regression in \((A2)\), \(\hat{\alpha}_0 + \hat{\varepsilon}_{A2}\).\(^{29}\)

Our motivation for orthogonalizing \(VDIF\) and the accounting variables is to facilitate interpreting the coefficients on the intangibles proxies in (1) and (2).

REFERENCES


\(^{28}\) Untabulated statistics indicate that the Pearson (Spearman) correlation between \(AV_t\) and \(P_t\) is 0.32 (0.71), indicating that the accounting-based value estimate is highly positively correlated with market value, but not perfectly.

\(^{29}\) When estimating \((A2)\), we include year fixed effects, so \(\hat{\alpha}_0\) actually represents a vector of intercepts.


