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Characteristics of a firm's information environment and the information asymmetry between insiders and outsiders ☆

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Abstract

We examine how financial statement informativeness, analyst following, and news relate to the information asymmetry between insiders and outsiders. Corporations' timely disclosures of value relevant information and information collection by outsiders reduce information asymmetry, limiting insiders' ability to trade profitably on private information. We use the profitability and intensity of insider trades to proxy for information asymmetry. We find that increased analyst following is associated with reduced profitability of insider trades and reduced insider purchases. Financial statement informativeness is negatively associated with the frequency of insider purchases. However, company news, good or bad, is positively associated with insider purchase frequency.

JEL classification: M41; G10

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1. Introduction

The information asymmetry between managers and investors is a fundamental issue for investors and market observers. In equilibrium, cross-sectional variation in

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the benefits and costs associated with gathering and disclosing information leads to variation in information asymmetry. We examine three significant sources of information, financial statements, analyst following, and news, to assess the marginal effect of each on the information asymmetry between managers and investors. We use the predictive power of insider trades and insider trading intensity as proxies for the level of information asymmetry. Thus, this paper integrates the existing literature on insider trading with the literature seeking to understand factors that influence information asymmetry.

Reducing information inequities has long been a regulatory goal in the United States. Indeed, a desire to reduce information asymmetry guided the 1934 Securities Act. As Benston (1973) notes,

> Underlying the disclosure requirements of the '34 Act is the belief that required disclosure of financial data is necessary for the fair and efficient operation of capital markets…Perhaps even more important is the concept of "fairness," the belief that all investors, big and small, insiders and outsiders, should have equal access to relevant information. (p. 134.)

The need to reduce asymmetry in order to strengthen markets is acknowledged by former Securities and Exchange Commission (SEC) chair Arthur Levitt, who states that the SEC is "working with similarly interested parties from around the globe to advance the cause of efficient and transparent markets." (SEC, 2000) The International Accounting Standards Board and some financial executives share this opinion.[1] Lev (1988) cites the potential adverse liquidity consequences of information asymmetry to argue for mandated disclosure of financial information. While some emphasize regulation to reduce information asymmetry, investors' demand for information and entrepreneurs' desire for capital motivate private information production and disclosure, providing an alternative means to reduce information asymmetry.[2]

This study contributes to the literature in a number of ways. First, we provide evidence on the relation between the informativeness of financial reports and information asymmetry. Accounting researchers generally recognize the role of financial reporting in reducing information asymmetry between managers and investors (e.g., Healy and Palepu, 2001). Indeed, one argument for allowing managers the discretion inherent in accrual accounting is that such flexibility allows managers to better communicate their knowledge of the firm's economic position in financial reports (Dechow, 1994). We use the *R*-squared from a time-series regression of price on earnings and book value as a measure of accounting informativeness. Cross-sectional *R*-squares are widely used in research to evaluate the quality of accounting information (Collins et al., 1997; Ely and Waymire, 1999; Francis and

[1] See the International Accounting Standards Board Constitution. For financial executives, see the Financial Executives International 25 January 2001 news release from PR Newswire, "Transparent and meaningful financial information is often a key missing link in struggling economies."

[2] In addition, insider trading can lead prices to more rapidly impound insiders' information (e.g., Manne, 1966; Meulbroek, 1992).

Schipper, 1999). Yet, Brown et al. (1999) raise questions about the interpretability of R-squares produced by cross-sectional levels regressions. Our analysis provides evidence on the relation between R-squares derived from time-series regressions and the extent of information asymmetry between managers and outsiders.

Second, our investigation provides insight into the role of sell-side analysts as information intermediaries in the capital markets. Events, such as the bankruptcy of Enron and the decline in the market values of Internet companies, have led some to allege that incentives to generate investment banking and trading revenues bias analysts' recommendations (Thorton et al., 2002; Munk, 2002). In fact, the Securities and Exchange Commission has launched a formal inquiry into these potential conflicts of interest (White and Day, 2002). According to this view, analysts do little to reduce the information asymmetry between managers and investors. On the other hand, Hong et al. (2000) finding of reduced price momentum in stocks followed by more analysts is consistent with the hypothesis that analysts increase the speed of diffusion of firm-specific information across market participants. Our study provides additional evidence on the relation between the intensity of analyst activity (analyst following) and the information asymmetry between managers and investors.

Finally, we study an additional component of the firm's information environment: articles in the popular press and corporate news releases. These articles are a significant source of firm-specific information, but their relation to information asymmetry has only begun to be examined (e.g., Chan, 2003). Like analyst following, news articles can proxy for the resources devoted to private information collection. Thus, we include news to provide a more comprehensive analysis of the primary sources of firm-specific information and to investigate the relation between this important source of firm-specific information and information asymmetry.

To explore the information asymmetry that exists between managers and investors, we begin with a sample of trades made by managers and directors between January 1, 1982 and December 31, 1997. Within this sample, we investigate the profitability of insider trades or more specifically, the relation between managers' trades in a given firm in a given month and subsequent returns. We then examine whether the profitability of insider trades is related to the price relevance of financial statements, analyst following, and the number of news items on Dow Jones News Retrieval.

This analysis yields several interesting results. First, we find that analyst following and news available each substitutes for financial statement informativeness. That is, firms with financial statements that are less value relevant tend to have higher analyst following and more news coverage. Further, we find that the profitability of insider trades declines as the number of analysts following the firm increases. News and R^2 are not significantly related to insider trading profits after controlling for the variance of returns.

This return-based analysis has reduced ability to distinguish variation in information asymmetry across firm-months. We can only measure profits conditional on trade. Insiders will not trade unless they can earn a profit that covers trading costs (including legal liability). The exclusion of unprofitable *potential* trades reduces cross-sectional variation in the profitability of *observed* trades. Therefore, we

also examine cross-sectional variation in insider buying activity under the assumption that buying activity, in particular, is precipitated by the existence of a profitable trading opportunity, and the frequency of profitable trading opportunities is related to information asymmetry. We find that insider buying is significantly less for firms with large analyst following. This result reinforces the inference that outside investors in firms with greater analyst following face less information asymmetry. In addition, management share purchases are less frequent for firms with higher accounting R^2, indicating a negative relation between financial statement informativeness and the frequency of profitable insider buying opportunities. Interestingly, we find that increased news coverage is associated with greater insider buying activity. Greater news coverage is likely to occur in uncertain times. This result supports the intuition that greater news coverage also proxies for increased opportunities for information-based trade.

The remainder of the paper is organized as follows: In Section 2, we discuss our proxy for information asymmetry, insider trading profits. Section 3 analyzes each of our three information sources and develops our hypotheses. Section 4 describes the sample, our variables, and gives summary statistics. In Section 5, we provide results for the predictive ability of insider trades and explore the relation between this predictive power and the firm's information environment. Section 6 concludes the study.

2. Insider trading profits as a measure of information asymmetry

The logic behind the use of insider trading as a proxy for information asymmetry is as follows. Insiders profit when they trade on value-relevant information before public disclosure leads to its full incorporation into stock prices. Thus, insider trading profits are related to the degree of information asymmetry between managers and outside investors. Intuitively, insider trading profits should be zero if market participants have the same information as managers. Indeed, Kyle (1985) demonstrates that insider profits increase in insiders' information advantage. In his model, only the insider knows the liquidation value of the risky asset. Thus the insider's information advantage can be defined as the variance of this liquidation value. In a model that incorporates financial disclosure into Kyle's (1985) setting, Baiman and Verrecchia (1996) show that insider profits decrease as public information becomes more precise. Their model explicitly links disclosure incentives, information asymmetry, and insider trading profits.

Kyle's model does not fully capture market characteristics that limit insider profits. For example, uninformed traders aware of information asymmetry may limit the losses sustained at the hands of insiders. Uninformed traders are likely to alter their trading behavior (Admati and Pfleiderer, 1988) or, in the extreme, leave the market (Merton, 1987). Uninformed traders can also respond to information asymmetry by gathering information either themselves or via intermediaries. For example, Barth et al. (2001) suggest that high information asymmetry makes private information acquisition more profitable and thus increases the number of analysts

following the firm. In their study, they find increased analyst following for firms with more intangible assets. Incentives to gather information reduce the profits of information gathering so in equilibrium the degree of information asymmetry and the amount of information gathering are such that information gatherers earn only a normal rate of return on their activities (Grossman and Stiglitz, 1980; Verrecchia, 1982). Holden and Subrahmanyam (1992) find that competition among insiders also reduces the profitability of their trades.

Aside from private information acquisition and trader competition, other actions limit the profits of insiders with superior private information. For example, corporate policies or governmental regulations restrict inside trades. In addition, specialists can increase spreads or reduce depth as information asymmetry increases, limiting insider profits (Glosten and Milgrom, 1985; Bettis et al. 2000).

Finally, and perhaps most importantly, organizational economics suggests that individuals will strive to create efficient organizations because such organizations produce greater gains to be shared (Coase, 1937, 1960). The ability to profit from information asymmetry can lead managers to make production/investment decisions that create private information even if they are less efficient. Incentive signaling theory (Ross, 1979) suggests that in the presence of competitive labor and capital markets, managers' salaries will be reduced by expected insider profits and that managers will be penalized for the loss in efficiency associated with retaining the ability to profit from private information. Thus managers have a strong incentive to reduce information asymmetry. In short, numerous factors affect managers' ability to garner profits from private information.

Nonetheless, previous research finds that insider trades are profitable. Jaffe (1974), Finnerty (1976), Seyhun (1986, 1992), Rozeff and Zaman (1988), and Jeng et al. (1999) find insiders earn abnormal returns.[3] More recently Lakonishok and Lee (2001) find that insider purchases in smaller firms predict future returns but that this predictive power does not hold for larger firms. Similarly, Finnerty (1976) and Seyhun (1986) find insider profits are larger for smaller firms.[4] Research suggests that size proxies for the amount of prior information available about a firm (e.g., Grant, 1980; Atiase, 1985; Collins et al., 1987; Freeman, 1987; Bhushan, 1989). Indeed, Elliot et al. (1984) hypothesize that because fewer analysts follow smaller firms, small firms' prices do not "completely reflect information," and insiders can more successfully use private information (p. 522). If firm size is a proxy for information asymmetry and information asymmetry is greater in smaller firms, then the results of Lakonishok and Lee (2001), Seyhun (1986), and Finnerty (1976) suggest insider profits are larger when greater information asymmetry is present.

Aboody and Lev (2000) provide further evidence on the relation between insider trading profits and the superiority of insider information. They study the effect of R&D investment on insider trading profits and find that insider trading profits are higher for firms with R&D expenditures. Aboody and Lev contend that this relation results from the information asymmetry induced by R&D investment. They argue

[3] Eckbo and Smith (1998) find no abnormal performance for insiders on the Oslo Stock Exchange.
[4] Jeng et al. (1999) find no size effect.

that lack of organized markets for R&D projects, their uniqueness, and the inability of financial reporting to measure their value all contribute to the information advantage of insiders. The present study examines this conjecture by directly examining whether the value relevance of financial reporting is related to insider trading profits.

To summarize, empirical evidence suggests that Kyle's (1985) model of insider profits is descriptive. Moreover, research finds that insider profits are more significant in smaller firms and firms with R&D spending. These results imply an inverse relation between the availability of information to outsiders and the profitability of inside information. We test this notion by identifying specific sources of information utilized by investors and by examining the marginal contribution of each to the reduction of information asymmetry. In doing so, we directly illuminate the link between financial statements, analysts, and news outlets and one of their key objectives—providing investors with information about what is going on inside the firm.

3. Sources of information and hypothesis development

In this section we develop our hypotheses on the relation between financial statement informativeness, analyst following, and news and information asymmetry. We also discuss the use insider trading as a measure of information asymmetry.

3.1. Hypothesis development

This study focuses on three potential sources of information about a firm's future profitability: financial statements, analysts, and firm-related material generated by news outlets. These sources proxy for the degree of information asymmetry between market participants and insiders and thus affect the magnitude of insiders' profits.

According to the efficient contracting perspective, managers choose accounting methods to minimize 'contracting' costs (Holthausen, 1990; Watts and Zimmerman, 1990). In this framework, managers have an incentive to reduce information asymmetry, when the adverse effect of insider trading on firm value exceeds disclosure costs (Watts and Zimmerman, 1986; Diamond and Verrecchia, 1991). Consistent with this intuition, firms requiring external financing tend to issue earnings forecasts more frequently (Frankel et al., 1995; Ruland et al., 1990). If managers have an incentive to reduce information asymmetry, managers of firms with larger insider profit opportunities will take steps to reduce them. Aside from issuing forecasts, these steps could include attempts to increase analyst following or the value relevance of financial statements.

Endogeneity in the relation between information asymmetry and information sources is likely to be most problematic in the case of voluntary disclosures by the firm. By definition, managers have direct control over this information channel. Moreover, voluntary disclosure can supplement deficient financial statements, limited analyst following, and sparse news coverage.

Within the framework of efficient contracting and efficient capital and labor markets, the existence of cross-sectional variation in the level of information asymmetry can be driven by cross-sectional variation in disclosure costs (Verrecchia, 1983). Insider trading profits thus proxy for the costs (e.g., proprietary costs) associated with reducing information asymmetry. Alternatively, one can assume that the parties involved do not instantaneously adjust in response to a shock to the information environment. As this adjustment occurs, cross-sectional variation in insider trading opportunities will result. Finally, one can assume that individuals take existing contracts as given and do not explicitly consider future periods. This 'opportunistic behavior perspective' (Holthausen, 1990) supports our research design, and is the basis for much research, including, for example, studies of earnings management (e.g., DeFond and Jiambalvo, 1994; McNichols and Wilson, 1988; Jones, 1991; Healy, 1985).[5]

Financial statements. Financial statements are an important source of information for outsiders. According to the SEC, "The annual report to security holders has long been recognized as the most effective means of communication between management and security holders." (SEC Handbook, Section 102, para. 38,025) Beginning with Ball and Brown (1968), researchers have focused considerable attention on the value relevance of financial statement information. In addition, many note the central importance of "high quality" financial accounting information to robust and effective capital markets (Sutton, 1997; Beresford, 1997). Despite this consensus regarding the importance of financial statements, few researchers have examined the relation between value relevance and the extent of insiders' information advantage.[6]

To assess the value relevance of financial statement information, we use the R^2 from a regression of stock price on earnings and book value. Many studies use this measure to assess the value relevance of financial statement information. We use it as a proxy for cross-sectional differences in the informativeness of financial statements.[7] Yet, some have begun to question the relevance of value-relevance research (e.g., Holthausen and Watts, 2001). Our examination of the R^2 proxy provides evidence on the implications of this measure for information asymmetry.

Given greater information asymmetry implies larger insider trading profits and value relevant financial statements, ceteris paribus, reduce information asymmetry, we expect a negative relation between the value relevance of financial statements and insider trading profits.

[5] Baiman and Verrecchia (1996) offer yet another reason for cross-sectional variation in information asymmetry. Firms incur increased agency costs as more disclosure means price impounds less information about managers' observable but noncontractible actions. These agency costs act to limit disclosure in equilibrium even when it can reduce cost of capital.

[6] Aboody and Lev (2000) examine the effect of R&D investments on insider profits. Summers and Sweeney (1998) find increased insider selling in the presence of accounting fraud. Bartov and Bodnar (1996) and Heflin et al. (2000) examine the relation between accounting quality and bid/ask spreads, a measure of information asymmetry.

[7] See for example, Collins et al. (1997), Ely and Waymire (1999), and Francis and Schipper (1999). See also Brown et al. (1999).

H1: Insider trading profits are decreasing in value relevance of financial statements.

Analyst following. Analysts play a significant role as intermediaries between managers and investors. For example, Givoly and Lakonishok (1979) and Lys and Sohn (1990) find that markets react to the release of individual analyst forecasts. Devoting more resources to information gathering should, ceteris paribus, reduce information asymmetry, leading to a negative relation between analyst following and insider trading profits.

However, the market's response to analyst reports may reflect 'hype.' Indeed, some allege analysts' recommendations are misleading, because of incentives to generate profits for their employers. Examining the relation between insider trading profits and analyst following contributes to this debate, by providing evidence on the relation between analyst activities and information asymmetry between investors and managers. Under market efficiency, prior findings of a market reaction to the release of analyst reports (e.g., Givoly and Lakonishok, 1979) imply that they are informative. Thus we state our second hypothesis in the following alternative form.

H2: Insider trading profits are negatively associated with analyst following.

Testing H2 requires controlling for the fact that analysts' incentives may be affected by required disclosures of financial information. Bhushan (1989) models the supply of and the demand for analyst services and concludes that supply decreases as costs increase. If financial statements are an important source of information for analysts, then reducing the usefulness of financial statements should increase the costs of processing information and reduce the supply of analyst information. However, reduced financial statement informativeness may increase investor demand for the services of experts, including financial analysts.

Empirical evidence on the relation between analyst activities and financial statement informativeness is mixed. Results depend on the proxies used for analyst activities and financial statement informativeness. Results in Lang and Lundholm (1996) suggest that more informative financial statements are associated with an increase in the net benefits available to information intermediaries and increased resources devoted to information discovery. They find a positive relation between disclosure quality and analyst following. On the other hand, Frankel et al. (2003) find a negative relation between analyst informativeness and the value relevance of book value and earnings (i.e., they are substitutes). Frankel et al. (2003) focus on the market reaction to analyst reports while Lang and Lundholm (1996) use analyst following as a proxy for analyst activities. In contrast to Frankel et al. (2003), Francis et al. (2002) find that the informativeness of analysts' reports is not negatively related to price reaction at earnings announcements (i.e., they are not substitutes). Moreover, unlike Lang and Lundholm (1996), they do not find systematic evidence that they are complements. Whether, analyst activities are positively or negatively correlated with financial statement informativeness, the correlation between financial statement information and the intensity of analyst activities can lead one to incorrectly attribute cross-sectional variation in insider profits to the value relevance of financial statement information when it is related to analyst activities. Because of the potential for correlation between analyst activities

and financial statement informativeness it is necessary to include both factors in any regression analysis designed to understand the marginal effect of either factor on the information asymmetry between managers and investors.

News coverage. The final source of information that we study is news coverage of firms. News unrelated to the announcement of financial statement information and analyst disclosures provides information to market participants and thus is expected to affect the degree of information asymmetry between managers and outsiders (Thompson et al., 1987; Mitchell and Mulherin, 1994). For example, pre-emptive news releases affect the market's reaction to earnings announcements and thus the information asymmetry between managers and investors prior to earnings announcements (Atiase, 1985). In addition, news analysis stories can directly affect companies' stock prices (Foster, 1979). Thus news coverage can reduce information asymmetry and affect the predictive ability of insider trades.

Moreover, news coverage should be considered when one attempts to understand the relation between other information sources (e.g., financial statements and analysts) and insider trading profits. News coverage is driven by the demands of market participants. This demand should be related to the availability of other information suggesting the need to control for all important sources of information when assessing the link between any one source and information asymmetry.

Demand for information by outsiders and the existence of profitable insider trading opportunities are both likely to be related to uncertainty. Therefore, uncertainty may act as a correlated omitted variable. We control for uncertainty when we examine the association between news and information asymmetry.

Like analysts, reporters' interests are not necessarily aligned with investors. To sell their services, reporters must convince investors that they provide useful information. Ross (1979) notes that the costs of entry in the information market are generally low and that individuals have an incentive to profit by selling false information. Uninformed investors are aware of these incentives and will discount investment advice. Yet, these incentives create the possibility that reporters' activities will, at times, accentuate the information gap between managers and uniformed investors who have difficulty identifying useful information. However, our priors are that more news coverage, like increased analyst following, reduces information asymmetry. Our third hypothesis, stated in alternative form, is as follows.

H3: Insider trading profits are negatively associated with news coverage.

3.2. Measures of insider trading profits

While theory guides our search for insider profit proxies, it does not delineate the choice. In particular, Baiman and Verrecchia (1996) and Fishman and Hagerty (1992) model trade taking place in a single round so that insider profits are not a function of insiders' trading frequency. In Kyle (1985), insider information is gradually incorporated into price as insiders submit orders and earn profits.

Intuitively insider trading profits are an increasing function of the profitability of each trade and the number of trades executed. This logic suggests two measures of insider trading profits: (1) the profitability of an individual insider trade and

(2) the frequency of insider trades. Measuring the frequency of insider trading is important for another reason. If insiders incur a fixed cost when executing a trade, then they will not trade unless the expected profits of the trade exceed this cost. If this cost is cross-sectionally constant, then we should see fewer trades when insiders' private information is less valuable (e.g. situations of low information asymmetry).[8] Thus trading frequency can serve as an important measure of information asymmetry. We discuss our measures these variables in more detail in Section 4.

4. Data and sample selection

4.1. Data

The source of our insider trading data is the SEC's Ownership Reporting System (ORS) data file. The ORS data file contains all transactions by insiders after 1975 that are subject to disclosure under Section 16(a) of the Securities and Exchange Act of 1934. According to Section 16(a), insiders include any director or officer of the issuer as well as any beneficial owners of more than 10% of any class of the issuer's equity securities (para. 23,711 of the Exchange Act Rules). Such individuals are required to file a Form 4 on or before the tenth day after the end of the month in which a trade has occurred.[9]

Following Lakonishok and Lee (2001), we apply several filters to the data to ensure our insider transactions are both meaningful and consistent with the information we obtain from the Center for Research in Security Prices (CRSP). First, following our focus on the information asymmetry between managers and investors we eliminate non "management" insider transactions from our sample. "Management" transactions refer to those trades made by CEOs, CFOs, presidents, officers, vice presidents, treasurers, divisional officers, general partners, and controlling persons. These filters as well as their effects on the total number of trades in our sample are listed in Table 1. The requirement that transactions represent open market purchases and/or data problems results in a large number of lost observations. After deleting duplicate observations, approximately 1.2 M observations remain. Sixty percent of these (approximately 800,000) are then deleted because prices are outside of acceptable ranges or share amounts exceed the daily volume. While these results are similar to those of Lakonishok and Lee (2001), they indicate the potential for errors in the SEC's insider trading database.

The stock return data are obtained from the 2000 CRSP tapes. Financial data are obtained from the 2000 Compustat tapes. News data are from Dow Jones News Retrieval (DJNR), and analyst data are from I/B/E/S summary tape.

[8] The potential legal liability associated with insider trading is an example of this cost.

[9] In accordance with the Sarbanes–Oxley Act of 2002, as of August 29, 2002, the SEC requires trades to be reported before the end of the second business day following the day of the trade.

Table 1
Sample selection and number of observations removed by each filter

This table reports the sequential filters applied to obtain the final sample of insider trades. We begin with insider trades in the Security and Exchange Commission's Ownership Reporting System data file; this file covers the period from 1975 to 1997. The sample is constructed as follows. First, we limit our sample to relevant transactions, such as common shares and meaningful trades. We define "Purchases" and "Sales" as open market or private purchases and sales respectively. "Option" refers to the purchase of shares through the exercise/conversion of options, warrants, or convertible bonds and sales of those shares acquired through options. Second, we compare the prices and volume data on *ORS* to similar data on *CRSP* and discard transactions with suspect values.

Number of transactions in the original *ORS* database	4,422,216
Eliminate:	
Non-common shares, i.e., *CUSIP* class code other than "10" or "11"	(429,237)
Missing date of transaction	(268,209)
Transaction types are not "Purchases", "Sales" and "Option"	(1,993,497)
Transaction price is less than $2 a share	(332,022)
Number of transaction shares is less than 100 shares	(106,379)
Duplicate transaction by all the common variables	(51,648)
Number of transaction shares is more than *CRSP* daily volume	(306,293)
Transaction price falling out of bidlo and askhi of *CRSP* daily file	(494,934)
Transaction type is "Option" and/or insiders are not "Management"	(231,639)
Total remaining transactions	208,358

4.2. Dependent variable

Any study of the relation between information sources and information asymmetry must utilize an appropriate event window. The post-trade return window should provide a measure of the insider's information advantage at the time of the trade. A short-window may not allow sufficient time for the insider's information to become incorporated in the stock price. In this case, returns measured over a short-window will not reflect the full extent of their information advantage. However, a long-window can extend beyond the time horizon of the insiders' informational advantage and simply add noise. The proper window depends on the time necessary for insider information to become incorporated in price.

Prior research indicates two qualities of insider trades that are helpful for choosing the proper event window. First, evidence suggests that insiders take positions based on longer-term information. For example Elliott et al. (1984) and Shivakumar and Waymire (1994) are unable to find a relation between insider trading activity/profits and specific information releases. These results as well as those of Noe (1999) and Ke et al. (2001) suggest that insiders' information advantage is not related to advance knowledge of upcoming announcements. Second, evidence suggests that insiders' trades predict returns for up to a year following the trade, but that the majority of the abnormal return occurs in the first six months after the trade (Seyhun (1998)). These results suggest the use of a six-month return-window to measure the extent of insiders' private information.

Table 2
Descriptive statistics for variables
This table provides descriptive statistics for variables used in subsequent tests. To be included in this table, a firm-month observation must be accompanied by sufficient data to compute the variables displayed below. The statistics for all variables are based on 47,266 firm-month observations. Firm-months with no management trading activity are excluded because NPR cannot be computed. Firm-month observations are drawn from the period between 1982 and 1997.

Dependent variable	Mean	Standard deviation	$Q1$	Median	$Q3$
RET	−0.79%	28.55%	−16.98%	2.89%	12.12%
Independent variables					
NPR	−0.54	0.80	−1.00	−1.00	−0.33
R^2	31.75%	27.64%	11.13%	30.04%	51.18%
LnNews	−2.16	1.15	−3.01	−2.29	−1.48
LnAnalyst	2.10	1.05	1.39	2.30	2.94
MB	2.95	7.86	1.31	1.98	3.20
LnMV	6.10	1.77	4.82	6.05	7.38
LnHold	10.91	4.25	9.46	12.01	13.74
Rdind	0.62	0.49	0.00	1.00	1.00
StdRet	0.03	0.01	0.02	0.02	0.03

Variable definitions:
RET: 6-month buy and hold return after the date of the last transaction in the event month, adjusted for Fama-French 5×5 size-B/M portfolio return.
NPR: For each firm each month, (number of purchase transactions − number of sales transactions)/(number of purchase transactions + number of sales transactions).
R^2: Time-series adjusted-R^2 of model (1) [i.e., $P_{it} = a + b_1E_{it} + b_2BV_{it} + \varepsilon_{it}$]. This variable is set to missing if fewer than 5 yearly observations are available between 1960 and 1999.
LnNews: Log of number of articles per available day for the firm in year $t-1$.
LnAnalyst: Log of one plus the number of analysts following the firm at year $t-1$ (after 1990, if analyst following is unavailable, number of analysts following the firm is set to zero.)
MB: Market value at the end of calendar year $t-1$ to book value at the end of fiscal year $t-1$.
LnMV: Log of calendar year $t-1$market value, denominated in millions of dollars.
LnHold: Log of the average value of shares (dollar amount) held by the insiders who trade in each month for each firm.
Rdind: R&D expense indicator, which is equal to 1 for a firm if the firm has reported R&D expense in any available firm year on Compustat and equal to 0 otherwise
StdRet: Standard deviation of daily stock returns for the firm in year $t-1$.

We compute buy-and-hold returns beginning on the date of the last insider transaction for a firm in a given event-month. Raw returns are adjusted by subtracting the buy and hold return of the relevant Fama-French book-to-market and size quintile portfolio obtained from Ken French's web site.[10] Descriptive statistics for returns and the independent variables discussed below can be found in Table 2. These statistics are weighted by the number of months containing insider

[10] We compute the delisting return in the following way: if a firm is delisted in the measurement period and the delisting return is available from CRSP, we use it as the last return for compounding. If the delisting return is –100%, we set the holding period return to be –100%.

transactions, because we include only those firm-months containing insider transactions in our tests.

4.3. Independent variables

R-squared. We measure the informativeness of financial statements using the adjusted R^2 from a firm-specific time-series regression. The regression model used is

$$P_{it} = a + b_1 E_{it} + b_2 BV_{it} + \varepsilon_{it}, \quad (1)$$

where P_{it} is the price-per-share of firm i three months after fiscal year-end t, E_{it} is the earnings-per-share of firm i during year t, BV_{it} is the book-value-per-share of firm i at the end of year t, and ε_{it} is the regression residual.

We require firms to have a minimum of 5 yearly observations to compute the R^2. To prevent overlap between prices used in the R^2 estimation and the adjusted-returns used as the dependent variable in the main estimation, the yearly observations corresponding to the year of the event-month and the year after the event-month are deleted from the observations used to estimate R^2. Thus, the R^2 measure may differ across years for a given firm. As shown in Table 2, the average and median R^2s are 31.75% and 30.04%.

Analyst activity. Our proxy for the intensity of analyst activity in a given firm-year is number of analysts following the firm. Number of analysts is a widely-used proxy for analyst activity in the accounting literature. For example, Bhushan (1989) uses analyst following as a proxy for the total resources spent on private information collection. Note that if analyst following reflects the broader concept of information collection, as Bhushan (1989) assumes, then we must be careful in attributing the effects of analyst following on insider information solely to the activities of analysts.[11] However, if analyst following proxies for information collection, then we can use it to better measure the marginal effects of financial statement informativeness. In other words, analyst following can provide a control for the interaction between financial reporting and information collection for a broader group of market participants.

We measure analyst following using the I/B/E/S Summary Tape. For each firm-calendar-year we use the maximum number of analysts making one-year-ahead forecasts. The number of analysts following a firm is positively related to the firm's market value (Bhushan, 1989). Thus, analyst following may increase when stock price increases. To prevent look-ahead bias from affecting this variable, we use analyst coverage in the year prior to the year of the insider trading firm-month.

To avoid unnecessary deletion of observations with all other necessary data, we code firms missing from the I/B/E/S database after 1990 as having zero analysts. Prior to 1991 we code firms missing from the I/B/E/S database as having missing analyst data. Thus, we exclude such firms from the sample. This cut-off was chosen because I/B/E/S coverage has become more comprehensive over time. Thus, firms

[11] Shores (1990) also uses analyst following to proxy for a broader concept—the level of interim information available.

with no data after 1990 likely have no analyst following.[12] The distribution of the analyst following variable is presented in Table 2. Note that the mean (median) number of analysts predicting earnings in year $t-1$ for a firm-month with insider trading activity is approximately eight (10).

Company news. To measure voluntary disclosure and press coverage for a firm, we search the "all news" category of the DJNR to identify the number of company-specific news stories. For each firm-year we examine CRSP for availability of returns data between January 1, 1980 and December 29, 2000. We then search DJNR for all news articles on that company over the subinterval containing CRSP returns for that firm-year. Searches for a given company during a given firm-year are done using the company ticker symbol found in the CRSP database for that company during that time. The "all news" category of DJNR contains articles from approximately 6000 magazines, newspapers, and trade journals and includes the major business publications as well as the news wires generally used by companies to release news (i.e., PR News Wire and Business Wire). Thus, this measure incorporates both firm initiated disclosures such as new product announcements as well as reporter-initiated news items.

The time interval searched in a given firm-year may differ across companies, and more articles are likely to be found over longer time-intervals.[13] To adjust for this potential bias, we standardize our measure by dividing the number of articles found in the firm-year by the number of days in the firm-year.[14] To avoid potential look-ahead bias, we match our standardized news measure in year $t-1$ to the event month in year t. Table 2 shows that the mean (median) number of articles per day in the year prior to the event-month year is 0.12 (0.10) in our sample.

Our news variable focuses on the quantity rather than the quality of disclosure. In addition, this variable is a noisy measure of unique stories because it counts rebroadcasts of stories carried by multiple news services. Thus the measure is susceptible to the criticism that 1) it can be inflated for firms and/or 2) the same story is 'over-hyped' by the press. In these situations, more news may lead to an increase in profitable trading opportunities by insiders. On the other hand, rebroadcasts are more likely to occur when an article is viewed as relevant to many investors and thus can measure of the importance or "quality" of a story.[15]

Insider trading activity. We compute a net purchase ratio (*NPR*) similar to that of Lakonishok and Lee (2001) to measure the direction of insider trading (i.e., whether they buying or selling) in a given firm-month. *NPR* is computed by dividing the net purchases by managers in a given month by the total number of manager transactions over the same period. Net purchases are computed by subtracting the number of sale transactions from the number of purchase transactions in a given

[12] We use the log of analyst following in our estimation. To perform this operation on firms with no analyst following, we first add one to analyst following in all firm-years in our sample.

[13] Some firms have CRSP data only for part of a year.

[14] This variable was coded as missing if no articles were found.

[15] Using a similar method of selecting news stories Chan (2003) finds momentum following news while stocks with out news do not show momentum. His findings are consistent with the market being slow to reflect news.

month. In our sample, 44 percent of firm-month observations contain only one transaction. Further, the majority of transactions are insider sales. Table 2 shows that the third quartile of the *NPR* distribution is negative, indicating that in at least 75 percent of firm-months, managers sell more often than buy. Our sample contains 10,281 firm-months with more buy than sell transactions and 36,985 firm-months with more sell than buy transactions. Lakonishok and Lee (2001) using management transactions from the ORS database between 1975 and 1995 find 1.7 times more sell transactions than buy transactions. We have relatively more sell transactions because we use a later time period (1982–1997). Option and stock-based compensation has increased over time. We expect selling to increase over time as managers attempt to diversify the increasing large percentages of their wealth held in their company's securities.

5. Results

5.1. Correlation analysis

Pearson and Spearman correlation coefficients presented in Table 3 show that the different information sources are correlated.[16] For example, we find that both analyst following and the number of news releases about a firm are higher when financial statements are less value relevant. This finding is consistent with the intuition that growth firms tend to have less informative financial statements, but are more news worthy and attract greater interest. This negative correlation suggests that either (1) analyst following and news coverage substitute for financial statement information or (2) the resources devoted to analysis increase as financial statements become less informative. In either case, this result suggests that, in terms of investor informativeness, financial statements and analyst following or news coverage offset each other (i.e., they are substitutes).[17] Consequently, we must jointly control for these factor to determine the marginal effects of each.

In contrast to the negative correlation between financial statements and other information sources, the results in Table 3 show that analyst following and firm news coverage are positively correlated. This correlation suggests that these information sources are complementary. One interpretation is that our news measure, *LnNews*, can proxy for investor interest in a company. Analysts may find more demand for

[16] The table is constructed by using each insider trading firm-month as an observation. Similar results are found when using one observation per firm per year.

[17] This result does not necessarily contradict the findings of Lang and Lundholm (1996) who also use analyst following as proxy for the intensity of analyst activities and find a positive correlation between financial report informativeness and analyst following. Lang and Lundholm (1996) use Financial Analyst Federation scores to measure the informativeness of financial reports instead of *R*-squared measures from regressions of returns on earnings and book value. Thus we focus on the value relevance of bottom line accounting measures while they concentrate on the extent and clarity of disclosures. Our analysis indicates that these measures are negatively correlated. We compute the Pearson (Spearman) correlation between total AIMR (Association for Investment and Management Research) disclosure scores and R-square and find that it is significantly negative −0.042 (−0.052).

Table 3
Correlations among variables
This table provides the value of the correlation between each of the variables used in subsequent tests. Spearman (Pearson) correlations are above (below) the diagonal. To be included in this table, a firm-month observation must be accompanied by sufficient data to compute the variables displayed below. Therefore, the statistics for all variables are based on 47,266 firm-month observations. Firm-months with no management trading activity are excluded because *NPR* cannot be computed. Firm-month observations are drawn from the period between 1982 and 1997. Please see Table 2 for variable definitions. ***, **, and * denote two-tailed significance at the 0.01, 0.05, and 0.1 levels, respectively.

	6-month return	*NPR*	R^2	*LnNews*	*LnAnalyst*	*MB*	*LnMV*	*LnHold*	*Rdind*	*StdRet*
Six-month return		0.115***	−0.011**	0.003	0.023***	0.019***	0.038***	0.018***	−0.027***	−0.060***
NPR	0.120***		0.014***	−0.031***	−0.123***	−0.148***	−0.118***	−0.114***	−0.071***	−0.002
R^2	−0.002	0.019***		−0.101***	−0.114***	−0.003	−0.142***	−0.001	−0.062***	0.100***
LnNews	−0.009*	−0.056***	−0.097***		0.430***	0.122***	0.630***	0.094***	0.031***	−0.191***
LnAnalyst	−0.013***	−0.140***	−0.088***	0.375***		0.072***	0.763***	0.100***	0.025***	−0.427***
MB	−0.003	−0.039***	−0.014***	0.022***	−0.046***		0.237***	0.207***	−0.027***	0.088***
LnMV	−0.018***	−0.145***	−0.127***	0.663***	0.695***	0.030***		0.173***	0.208***	−0.580***
LnHold	0.017***	−0.087***	−0.010*	0.097***	0.107***	0.034***	0.175***		0.025	−0.041
Rdind	−0.007	−0.073***	−0.065***	0.036***	0.017***	−0.018***	0.072***	0.020		0.199***
StdRet	0.010**	0.022***	0.056***	−0.180***	−0.439***	0.084***	−0.561***	−0.072	0.181***	

their services in cases of higher investor interest and begin following these firms. However, if news coverage subsumes analyst forecast revisions, then the results merely reflect a mechanical relation between these two sources. To control for this possibility, we created a similar news variable using only firm-specific announcements from PR Newswire and Business Wire. Firms use these services to make public announcements. Though not as strong, the correlation between this news variable and analyst following continues to be significantly positive, suggesting that the two sources are complementary. The Pearson correlation is 0.40.[18] This result is not surprising given the high correlation between *LnNews* and a yearly article-count measure comprised only of news announcements from PR Newswire and Business Wire. The Pearson and Spearman correlations between these two news measures are 0.84 and 0.81, respectively.

To better understand the potential for opportunistic management earnings forecasts to affect inferences related to *LnNews*, we examine the correlation between *LnNews* and the likelihood of the firm to issue a management forecast. We create a variable, *Mfind*, equal to one if the firm issued a management forecast in a given year and zero otherwise. The First Call management forecast database is used to construct this variable. Controlling for firm size, we find no significant relation between *LnNews* and *Mfind*. These results indicate that earnings forecasts are unlikely to be a correlated omitted variable that confounds the interpretation of our *LnNews* results.

5.2. Predictive ability of insider trades

We first provide descriptive evidence on the univariate relation between the predictive ability of insider trades and our information environment variables. These results are shown in Table 4. In each firm-month containing insider trades, we form three portfolios based on *NPR*. Firm-months are placed into the 'High' *NPR* portfolio if *NPR* is equal to one and into the 'Low' *NPR* portfolio if *NPR* is equal to negative one. All remaining firm-months containing insider trades are placed in the 'Medium' *NPR* portfolio. Firm-months are also classified into three categories on the basis of R^2, analyst following, and news stories in panels A, B, and C, respectively. This three-by-three independent sort produces nine portfolios in each panel and we measure the returns on each of these portfolios over the next six months. We expect high *NPR* portfolios to produce higher returns than low *NPR* portfolios. Consistent with prior results (e.g., Seyhun, 1998), we find the High *NPR* portfolio outperforms the Low *NPR* portfolios by 8.7 percent over the subsequent six months.

Panel A shows that the differences between High *NPR* portfolios and Low *NPR* portfolios are not monotonically decreasing in R^2. Similarly, Panel B shows no monotonic relation between high and low *NPR* portfolio returns differences and analyst following categories. In contrast, Panel C provides evidence that the predictive ability of insider trades is decreasing in news. However, given the

[18] Note that PR Newswire and Business Wire are available on Dow Jones News Retrieval after 1988.

correlation among these information-environment variables as well as the need to control for other potentially correlated-omitted variables, we are reluctant to draw conclusions from these results and view them as descriptive statistics.

We present the main regression results of our study in Table 5. In our analysis of the relation between insider trading profits and information availability, the following regression model is estimated for all observations with manager trades

Table 4
Returns for portfolios formed based on insider trading, accounting R^2, analyst following, and news
This table presents average six-month portfolio returns. Observations are shown in parentheses. We construct portfolios each month of the sample period based on the net purchase ratio (*NPR*) of the firm in the prior month and another firm characteristic. Firms are placed into the "High" *NPR* category if $NPR = 1$, the "Medium" NPR category if $-1 < NPR < 1$, and "Low" *NPR* category if $NPR = -1$. Returns are the six-month buy and hold return adjusted for the Fama-French 5×5 size and book-to-market portfolio return. In panel A, we form portfolios based on *NPR* and R^2. In panel B, we form portfolios based on *NPR* and *LnAnalyst*. In panel C, we form portfolios based on *NPR* and *LnNews*. The sample period is 1982–1997.

Panel A: NPR–R^2

		R^2			
		High	Medium	Low	All
NPR	High	0.061 (3242)	0.043 (2964)	0.069 (2797)	0.058 (9003)
	Medium	0.019 (1207)	0.012 (1457)	0.024 (1562)	0.018 (4226)
	Low	−0.029 (11314)	−0.031 (11385)	−0.025 (11338)	−0.029 (34037)
	All	−0.007 (15763)	−0.013 (15806)	−0.003 (15697)	−0.008 (47,266)
High *NPR*–low *NPR*		0.09	0.074	0.094	0.087

Panel B: NPR–LnAnalyst

		LnAnalys			
		High	Medium	Low	All
NPR	High	0.038 (1851)	0.060 (3020)	0.065 (4132)	0.058 (9003)
	Medium	0.008 (1898)	0.017 (1206)	0.037 (1122)	0.018 (4226)
	Low	−0.026 (12005)	−0.025 (11576)	−0.035 (10456)	−0.029 (34037)
	All	−0.014 (12005)	−0.006 (15802)	−0.004 (15710)	−0.008 (47,266)
High *NPR* –low *NPR*		0.064	0.085	0.069	0.087

Table 4 (*continued*)

Panel C: NPR–News

		News			
		High	Medium	Low	All
	High	0.053	0.051	0.065	0.058
		(2041)	(3102)	(3860)	(9003)
NPR	Medium	0.012	0.025	0.020	0.018
		(1907)	(1350)	(969)	(4226)
	Low	−0.024	−0.032	−0.030	−0.029
		(11784)	(11347)	(10906)	(34037)
	All	−0.010	−0.011	−0.004	−0.008
		(15732)	(15799)	(15735)	(47,266)
High NPR–low NPR		0.077	0.083	0.095	0.087

Variable definitions:

NPR: For each firm each month, (number of purchase transactions−number of sales transactions)/(number of purchase transactions + number of sales transactions).

R^2: Time-series adjusted-R^2 of model (1) [i.e., $P_{it} = a + b_1E_{it} + b_2BV_{it} + \varepsilon_{it}$]. This variable is set to missing if fewer than 15 yearly observations are available between 1960 and 1999.

LnNews: Log of number of articles per available day for the firm in year $t-1$.

LnAnalyst: Log of one plus the number of analysts following the firm at year $t-1$ (after 1990, if analyst following is unavailable, number of analysts following the firm is set to zero).

in a given calendar month:

$$\begin{aligned} Ret = {} & \alpha + \beta_1 NPR + \beta_2 R^2 + \beta_3(R^2 \times NPR) + \beta_4 LnNews + \beta_5(LnNews \times NPR) \\ & + \beta_6 LnAnalyst + \beta_7(LnAnalyst \times NPR) \\ & + \beta_8 LnMV + \beta_9(LnMV \times NPR) + \beta_{10} LnHold \\ & + \beta_{11}(LnHold \times NPR) + \beta_{12} StdRet + \beta_{13}(StdRet \times NPR) \\ & + \beta_{14} MB + \beta_{15}(MB \times NPR) + \beta_{16} Rdind + \beta_{17}(Rdind \times NPR) + \varepsilon, \quad (2) \end{aligned}$$

where *Ret* is the Fama-French adjusted buy and hold return in the six months subsequent to the insider transaction, *NPR* is the net purchase ratio in the month of the transaction, R^2 is the R^2 from a regression of market value on earnings and book value, *LnNews* is the log of standardized news measure in year $t-1$, *LnAnalyst* is the log of the number of analysts in year $t-1$, *LnMV* is the log of the market value of equity in year $t-1$, *LnHold* is the log of the average market value stock holdings across all management/officer trades in the month of the transaction, *StdRet* is the variance of daily returns in year $t-1$, *MB* is the market value at the end of calendar year $t-1$ to book value at the end of fiscal year $t-1$, and *Rdind* is the R&D expense indicator, which is equal to 1 if the firm reported R&D expense in any available firm-year on Compustat and equal to 0 otherwise.

Table 5
Fama-MacBeth return regressions

$$RET = \alpha + \beta_1 NPR + \beta_2 R^2 + \beta_3 (R^2 \times NPR) + \beta_4 LnNews + \beta_5 (LnNews \times NPR) + \beta_6 LnAnalyst + \beta_7 (LnAnalyst \times NPR) + \beta_8 LnMV + \beta_9 (LnMV \times NPR) + \beta_{10} LnHold + \beta_{11} (LnHold \times NPR) + \beta_{12} MB + \beta_{13} (MB \times NPR) + \beta_{14} Rdind + \beta_{15} (Rdind \times NPR) + \beta_{16} StdRet + \beta_{17} (StdRet \times NPR) + \varepsilon.$$

This table presents the time-series means of coefficients and adjusted R^2 produced by monthly cross-sectional regressions using variations of the model shown above. Newey–West corrected time-series t-statistics are reported in the parentheses. We delete the month if there are fewer than 100 individual firm observations. Six-month return size and book-to-market adjusted return (*RET*) is the dependent variable. These results are based on monthly regressions using 47,266 total observations. This table uses values computed by taking the average over 177 calendar months. The time period is August 1982 to November 1997. ***, **, and * denote two-tailed significance at the 0.01, 0.05, and 0.1 levels, respectively when "Expected Sign" is a "?" and one-tailed otherwise.

Independent variables	Expected sign	Dependent variable—*RET*			
NPR	+	0.094***	0.087***	0.086***	0.046*
		(4.50)	(3.95)	(4.08)	(1.70)
R^2	?	−0.021***	−0.022***	−0.021**	−0.007
		(−2.63)	(−2.66)	(−2.43)	(−1.15)
R^2*NPR	−	−0.017**	−0.018**	−0.016**	−0.010
		(−1.87)	(−1.98)	(−1.83)	(−0.72)
LnNews	?	0.003	0.004	0.004	0.003
		(0.54)	(0.81)	(0.83)	(0.74)
*LnNews***NPR*	−	0.006*	0.006*	0.006*	0.004
		(1.71)	(1.70)	(1.84)	(1.08)
LnAnalyst	?	−0.005	−0.004	−0.004	−0.007
		(−0.65)	(−0.52)	(−0.54)	(−0.97)
*LnAnalyst***NPR*	−	−0.009**	−0.010**	−0.010**	−0.015***
		(−1.92)	(−1.94)	(−2.01)	(−2.72)
LnMV	?	−0.004	−0.007	−0.007	−0.002
		(−0.75)	(−1.23)	(−1.27)	(−0.62)
*LnMV***NPR*	−	−0.004*	−0.005*	−0.005*	0.001
		(−1.35)	(1.38)	(−1.45)	(0.30)
LnHold	?		0.002***	0.003***	0.002***
			(4.03)	(4.01)	(3.88)
*LnHold***NPR*	?		0.001	0.001*	0.001
			(1.63)	(1.87)	(1.31)
MB	?		0.005*	0.005	0.004
			(1.79)	(1.43)	(1.01)
*MB***NPR*	?		0.002	0.002	0.001
			(0.87)	(0.56)	(0.04)
Rdind	?			−0.001	−0.004
				(−0.19)	(−0.46)
*Rdind***NPR*	+			−0.001	−0.004
				(−0.25)	(−0.76)
StdRet	?				0.138
					(0.29)
*StdRet***NPR*	+				0.775**
					(2.21)
Average adjusted R^2		0.037	0.046	0.050	0.069

Table 5 (*continued*)

Variable definitions

RET: Six-month buy and hold return after the date of the last transaction in the event month, adjusted for Fama-French 5×5 size and book-to-market portfolio return.

NPR: For each firm each month, (number of purchase transactions−number of sales transactions)/(number of purchase transactions + number of sales transactions).

R^2: Time-series adjusted-R^2 of model (1) [i.e., $P_{it} = a + b_1E_{it} + b_2BV_{it} + \varepsilon_{it}$]. This variable is set to missing if fewer than 15 yearly observations are available between 1960 and 1999.

LnNews: Log of number of articles per available day for the firm in year $t-1$.

LnAnalyst: Log of one plus the number of analysts following the firm at year $t-1$ (after 1990, if analyst following is unavailable, number of analysts following the firm is set to zero.)

LnMV: Log of calendar year $t-1$market value, denominated in millions of dollars.

LnHold: Log of the average value of shares (dollar amount) held by the insiders who trade in each month for each firm.

MB: Market value at the end of calendar year $t-1$ to book value at the end of fiscal year $t-1$.

Rdind: R&D expense indicator, which is equal to 1 for a firm if the firm has reported any R&D expense in its history and equal to 0 otherwise.

StdRet: Standard deviation of daily stock return for the firm during year $t-1$.

Each observation corresponds to one firm-month. R^2, *LnNews*, *LnAnalyst*, *LnMV*, *StdRet* and *MB* are measured by firm in the prior year.[19] *Ret*, *NPR*, and *LnHold* are measured by firm by month. We eliminate observations with duplicate dependent variables by using only the last transaction for any given firm-month.[20]

The *LnHold* variable is included to control for cross-sectional variation in the stock holdings of management-insiders. Individuals may be motivated to trade for reasons other than private information. These reasons could include changes in risk preferences, consumption preferences, or wealth. If these reasons vary systematically with information availability, they may act as correlated-omitted variables. For example, insiders may trade as a result of their option or stock-based incentive compensation. Furthermore, this compensation may be tied to the level of information asymmetry between firm managers and investors. If insiders receive more stock compensation when information asymmetry is low, they may choose to sell more stock to diversify their holdings.[21] Thus, we could find a relation between information asymmetry and the predictive ability of insider trades that is driven by the firm's compensation plan instead of the characteristics of its information environment. We control for this effect by creating a control variable for the stock

[19] Recall that the R^2 measure uses all firm years but the current and subsequent years. Thus, it can vary by year.

[20] To ensure sufficient observations for reliable monthly regression estimates, months are only included if 100 firm-observations are available. This filter results in a loss of 2.2 percent of the original firm-month observations.

[21] In fact, as Smith and Watts (1992) suggest, the opposite situation may occur, i.e., incentive compensation increases as information asymmetry increases. Such a relation would reduce the our ability to find a negative relation between our information environment variables and the predictive ability of insider trades, because it could lead to relatively more diversification motivated trading when information asymmetry is larger.

holdings of insiders. For each firm-month observation, we compute the average market value of stock holdings across all management/officer trades for that firm. We include the log of this variable (*LnHold*) as an interactive term in our analysis.

The correlation results in Table 3 suggest that return variance, *StdRet*, can act as a correlated omitted variable. It is significantly correlated with *LnNews*, R^2, and, *LnAnalyst*. Moreover, return variance is potentially related to the profitability of insider trades. Given a manager can correctly (on average) predict the sign of future abnormal returns, an increase in the return variance implies an increase in the manager's expected payoff. Results in Table 5 confirm this result. The coefficient on the *StdRet* interaction term (i.e., *StdRet* $\times$ *NPR*) is significantly positive implying the profitability of insider trades is increasing in return variance. This result does not necessarily imply "abnormal" profits are available to insider in higher variance firms. If insiders cannot hedge their bets, the risks of trading on inside information will also be higher in these circumstances.

The coefficient on *NPR* in Table 5 is significantly positive in the regression. It means that insider buying earns significantly higher returns than insider selling. We interact the three information environment variables with *NPR* to determine their marginal effects on the ability of managers' trades to predict returns. The coefficient on the R^2 interactive term is significantly negative indicating that more informative financial statements tend to reduce insider trading profits. However, the significance of the R^2 interactive term is eliminated by the addition of *StdRet*, suggesting the explanatory power of R^2 is in part driven the its correlation with *StdRet*.

The coefficient on the analyst following interaction term is significantly negative in all specifications. The ability of insiders' trades to predict future returns is reduced for firms with larger analyst following. Further, this effect is incremental to firm size. Indeed, while the *LnMV* interaction term is significant in a univariate regression, it is insignificant in the presence of our information environment variables. Thus these information environment variables seem to better proxy for the underlying factors leading to cross-sectional variation in the predictive ability of insider trades than firm size.

The effect of news reports on insider profits is positive but insignificant after controlling for variance. Insider profits tend to increase when more news is generated about their firms. However, like R^2, this effect also seems to be related to an association between return variance and news. Untabulated regression results indicate that conditional on *LnMV*, *LnNews* is positively correlated with return variance. More news is associated with greater return variance and the insignificance of the coefficient on the news interaction term when *StdRet* is included in the regression suggests that this variance (or uncertainty) effect is driving the relation between news coverage and the profitability of insider trades.

In addition, we find that the coefficient on the insider holdings interactive term is positive and marginally significant indicating that information asymmetry is larger in situations where managers hold more stock. This result indicates that increased stock/option compensation is associated with greater information asymmetry. It can also indicate that information asymmetry is larger in situations where stock is closely held.

We include market-to-book and research and development variables in our regressions as indicators of the informativeness of financial statements. Companies with high market-to-book ratios and research and development expenditures tend to have relatively more unrecorded assets. We find no significant relation between these variables and insider trading profits.

In addition to these interactive effects two main effects are notable. First, firms with greater prior insider holdings are associated with higher future abnormal returns. When insiders trade, returns are more likely to positive when these insiders hold more stock. This result suggests a trading strategy that warrants future investigation. Second, when firms have high R^2, future returns are likely to be negative. Given the construction of our R^2 measure requires future as well as past prices, this result does not necessarily suggest a trading strategy.

5.3. Insider trading intensity

Our next tests use trading frequency as a proxy for the extent of insider trading profits. We estimate the following regression model:

$$TRANS = \alpha + \beta_1 R^2 + \beta_2 LnNews + \beta_3 LnAnalyst + \beta_4 LnMV + \beta_5 LnHoldYR + \beta_6 StdRet + \beta_7 MB + \beta_8 Rdind + \varepsilon, \quad (3)$$

where *TRANS* is the number of transactions in year t and *LnHoldYR* is the log of the average market value stock holdings across all management/officer trading in year $t-1$.[22]

Each observation corresponds to one firm-year. *TRANS*, R^2, *LnNews*, *LnAnalyst*, *LnMV*, *LnHold*, *StdRet*, *and MB* are measured by firm by year. The results are shown in Table 6.

We focus on buy transactions. In contrast to sell transactions, buy transactions are less likely to occur because of liquidity and portfolio rebalancing reasons. Thus buy transactions are more likely to reflect trading motivated by the insider's superior information. The coefficient on R^2 is significantly negative indicating that buying activity is significantly lower in high R^2 firms. In addition, the number of buy transactions is significantly lower for firms with a larger analyst following. These results are consistent with the presence of lower information asymmetry in situations of higher analyst following and higher R^2. There are fewer profitable trading opportunities for insiders in such firms. Interestingly, buying activity is higher in high-news situations. Insiders also trade more often in these "high-news" firms.

Taken together, the results in Tables 5 and 6 indicate that the trades of insiders in firms with large analyst following are less profitable and less frequent. If analyst following proxies for resources devoted into private information collection, this finding is consistent with less information asymmetry when more resources are devoted to private information collection.

[22] For remaining variable definitions, please see Eq. (2).

Table 6
Fama-MacBeth transaction regressions

$$TRANS = \alpha + \beta_1 R^2 + \beta_2 LnNews + \beta_3 LnAnalyst + \beta_4 LnMV + \beta_5 LnHoldyr + \beta_6 MB + \beta_7 Rdind + \varepsilon$$

This table presents the time-series means of coefficients and adjusted R^2s produced by 17 yearly cross-sectional regressions using the model shown above. Newey–West time-series t-statistics are reported in the parentheses. This table provides the results using 15,926 observations and three dependent variables: (1) total management-insider transactions for the firm in year t, (2) total management-insider buy transactions for the firm in year t, (3) total management-insider sell transactions for the firm in year t. The time period is 1981 to 1997. ***, **, and * denote two-tailed significance at the 0.01, 0.05, and 0.1 levels, respectively when "Expected Sign" is a "?" and one-tailed otherwise.

		Dependent variables		
Independent variables	Expected sign (buy transaction)	# of buy transactions	# of sell transactions	Total # of transactions
R^2	–	−0.463***	0.173	−0.290
		(−3.25)	(0.38)	(−0.62)
LnNews	–	0.554***	1.115***	1.669***
		(5.40)	(7.50)	(10.83)
LnAnalyst	–	−0.615***	0.203	−0.412
		(−4.21)	(0.43)	(−0.88)
LnMV	–	0.136	1.457***	1.593***
		(1.65)	(4.73)	(5.00)
LnHoldyr	?	0.144***	0.576***	0.720***
		(4.44)	(10.55)	(9.48)
MB	+	−0.112	0.478***	0.366***
		(−1.15)	(2.96)	(3.41)
Rdind	+	−0.448***	0.985***	0.537
		(−3.17)	(3.47)	(1.38)
StdRet	+	4.299	166.736***	171.034***
		(0.23)	(9.22)	(6.50)
Average adjusted R^2		0.018	0.127	0.111

Variable definition

TRANS: Number of insider transactions (buy, sell, or total) in a given year.

R^2: Time-series adjusted-R^2 of model (1) [i.e., $P_{it} = a + b_1 E_{it} + b_2 BV_{it} + \varepsilon_{it}$]. This variable is set to missing if fewer than 15 yearly observations are available between 1960 and 1999.

LnNews: Log of number of articles per available day for the firm in year $t-1$.

LnAnalyst: Log of one plus the number of analysts following the firm at year $t-1$ (after 1990, if analyst following is unavailable, number of analysts following the firm is set to zero.)

LnMV: Log of calendar year $t-1$market value, denominated in millions of dollars.

LnHoldyr: Log of the average value of shares (dollar amount) held by the insiders who trade in year $t-1$ for each firm.

MB: Market value at the end of calendar year $t-1$ to book value at the end of fiscal year $t-1$.

Rdind: R&D expense indicator, which is equal to 1 for a firm if the firm has reported any R&D expense in its history and equal to 0 otherwise.

StdRet: Standard deviation of daily stock returns for the firm during year $t-1$.

5.4. Robustness checks using bid-ask spread

To provide additional evidence that our insider trading measures and information environment variables are related to information asymmetry, we examine their relation to bid-ask spread. Prior research has used bid-ask spread as a measure of the information asymmetry between informed and uninformed traders (e.g., Neal and Wheatley, 1998; Huang and Stroll, 1997; Easly et al., 1996; Lee et al., 1993). In Table 7, we present results on the relation between profitability of insider trades and bid-ask spread and on the relation between insider trading activity and bid-ask spread. For each firm-month, we divide observations into three portfolios on the basis of *NPR* and three portfolios on the basis of a bid-ask spread measure. Our bid-ask spread measure is computed as follows. Between 1993 and 1997, we compute the median bid-ask spread for each firm-month based on all quotes available on the Trade and Quote (TAQ) database. Panel A shows the average returns over the next six months produced by portfolios formed via this independent three by three sort. We find a monotonic relation between insider trading profits and bid-ask spread. Indeed, the difference between 'High' *NPR* portfolios and 'Low' *NPR* portfolios is almost four times higher for 'High' bid-ask spread firms compared to the 'Low' bid-ask spread firms.

Results in Panel A also illustrate the positive relation between insider buying activity and information asymmetry. Of high bid-ask spread firm-months, 37 percent (2,559/6,918) are high *NPR* firm-months. In contrast, only 14 percent (974/6,902) of low bid-ask spread firm-months are high *NPR* firm-months. The number of high *NPR* firm-months is positively related to bid-ask spread.

Panel B indicates that the interactive effect between bid-ask spread and *NPR* is significant. Insider trading profits are increasing in bid-ask spread. We regress returns on *NPR*, bid-ask spread, and *NPR* $\times$ bid-ask spread. The coefficient on *NPR* $\times$ bid-ask spread is positive and significant. If bid-ask spread is a proxy for information asymmetry, this result provides support for the construct validity of insider trading profits as a measure for information asymmetry. The profitability of insider trades is amplified in periods of high information asymmetry (i.e., high bid-ask spread).

Panel C presents results of a regression of bid-ask spread on R^2, *LnAnalyst*, *LnNews*, and various control variables. The results reinforce our *LnAnalyst* results in Tables 5 and 6. *LnAnalyst* is negatively related to bid-ask spread implying analyst following is negatively related to information asymmetry. Consistent with the results in Table 6, news is positively related to bid-ask spread again indicating that news coverage is positively related to information asymmetry. These results fail to confirm the relation between R^2 and information asymmetry, suggesting that the relation between financial statement informativeness and information asymmetry is weak and/or sensitive to the proxy for information asymmetry.

Additional sensitivity analysis. We examine the sensitivity of the Table 5 results to variation in the return window and the number of insiders trading. Results are qualitatively similar when *Ret* is defined as the Fama-French adjusted buy and hold return in the twelve months subsequent to the insider transaction. However, the

analyst following/*NPR* interactive term becomes insignificant at a one-month return interval. When we confine our sample to firms where more that one insider is trading in a given month, the sample size shrinks and we find no association between the predictive ability of insider trades and returns.

Table 7
Bid-ask spread, insider trading profitability, and characteristics of the firm's information environment
This table presents results relating bid-ask spread to insider trading profitability and the characteristics of the firm's information environment. Panel A presents average six-month portfolio returns. Observations are shown in parenthesis. Portfolios are formed each month of the sample period based on the bid-ask spread and the NPR of the firm in the prior month. NPR is computed each firm-month as (number of purchase transactions—number of sales transactions)/(number of purchase transactions + number of sales transactions). Firms are placed into the "High" NPR category if NPR = 1, the "Medium" NPR category if $-1 < \text{NPR} < 1$, and "Low" NPR category if NPR $= -1$. *Bid-Ask Spread* is computed each firm-month by taking the median bid-ask spread from all quotes for the firm-month recorded in the TAQ database. Returns are six-month buy and hold returns adjusted for Fama-French 5×5 size and book-to-market portfolio return. Panel B presents the time-series means of coefficients and the adjusted R^2 produced by 60 monthly cross-sectional regressions using 20,766 observations. In each month we regress returns on the three NPR and *Bid-Ask Spread* ranks as well as the product of these ranks. Newey–West time-series *t* statistics are shown in parenthesis. Panel C presents the time-series mean coefficients from yearly cross-sectional regressions using 6,857 observations. In each year, we regress, *Bid-Ask Spread* on R^2, *LnAnalyst*, *LnNews*, and various control variables. (Please see prior tables for variable definitions.) Time-series t-statistics are shown in parenthesis. The sample period is 1993–1997.

Panel A: portfolio returns

		Bid–ask spread			
		High	Medium	Low	All
	High	0.041	0.033	0.016	0.034
		(2559)	(1713)	(974)	(5246)
NPR	Medium	0.029	−0.003	0.029	0.019
		(455)	(539)	(779)	(1773)
	Low	−0.040	−0.018	−0.005	−0.019
		(3904)	(4694)	(5149)	(13747)
	All	−0.006	−0.004	0.002	−0.003
		(6918)	(6946)	(6902)	(20,766)
High *NPR*–Low *NPR*		0.081	0.051	0.021	0.053

Panel B: return regression

Independent variables	Expected sign	Dependent variable—*RET*
NPR rank	+	0.013**
		(2.22)
Spread rank	?	−0.016**
		(−2.27)
NPR rank* spread rank	+	0.013***
		(2.46)
Adjusted R^2		0.022*
		(1.65)

Table 7 (*continued*)

Panel C: Bid–ask spread regression

Independent variables	Expected sign	Dependent variable—*bid–ask spread*		
R^2	−	0.001	0.001	0.001
		(0.65)	(0.21)	(0.26)
LnNews	−	0.002***	0.002***	0.002***
		(5.92)	(6.18)	(5.46)
LnAnalyst	−	−0.001***	−0.001***	−0.001***
		(−4.65)	(−5.86)	(−5.64)
LnMV	−	−0.009***	−0.008***	−0.008***
		(−13.68)	(−11.62)	(−11.21)
LnHoldyr	?		−0.001	−0.001*
			(−1.62)	(−1.66)
MB	?		−0.001	−0.001
			(−0.45)	(−0.55)
Rdind	+			0.001**
				(1.83)
Adjusted R^2		0.410***	0.408***	0.408***
		(9.93)	(7.06)	(7.02)

Finally, we examine the relation between management forecasting and insider trading profitability. We use the First Call management forecast database for this analysis and define an indicator variable, *Mfind*, as equal to one if the firm has a management forecast in this database in the prior firm-year and zero otherwise. Unfortunately, we lose a substantial number of observations because while the insider trading database spans 17 years, the First Call database overlaps with our insider trading database in only five of these years. We repeat the Table 5 (Table 6) estimation adding a $Mfind \times NPR$ (*Mfind*) term. The coefficients on these management forecast variables are insignificant.

6. Conclusion

This paper analyzes the relation between key characteristics of a firm's information environment and information asymmetry between managers and investors. We first analyze the relations between each of our information environment variables and find that analyst activity and news reports are reduced as the informativeness of a firm's financial statements is increased. Controlling for the potentially confounding relations among our independent variables, we find the relation between analyst following and the predictive power of insider trades is negative and statistically significant. Further, analyst following subsumes the ability of firm size to explain cross-sectional variation in the predictive ability of insider

trades. Controlling for return variance, we find no significant relation news coverage (or R^2) and the ability of managers' trades to predict returns.

These results provide evidence that increased analyst following is associated with reduced information asymmetry between managers and investors. However, the coefficients on financial statement informativeness and news in these return regressions are only marginally significant and become insignificant when we add return variation as an independent variable. We posit that these weak results are due to bounds on the profitability of insider trades. Thus we examine the frequency of information-motivated insider trading activity to provide an alternative measure of information asymmetry. We find that the frequency of insider buy transactions is significantly lower when financial statements are more informative and when more analysts follow the firm. Interestingly, increased news coverage is associated with more frequent insider buying suggesting a positive relation between news coverage and frequency of profitable trading opportunities.

The fundamental contribution of this research is that we use insider trading profits as a measure of cross-sectional variation in information asymmetry and thus cross-sectional variation in the costs of information collection. Our results indicate that analyst following, a widely used measure of resources devoted to information collection, is closely related to insider trading profits. Future research can attempt to use insider trading profits as a means to identify the drivers of information costs. Future research can also use the profitability of insider trading to examine the effect of regulation (e.g., regulation FD or new FASB standards) on the costs of information collection.

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