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A Comparison of the Information Content of Insider Trading and Management Earnings Forecasts

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Abstract

In this paper, insider trading is viewed as a signal of managements' assessments of firms' future prospects and its information content is compared to that in managements' earnings forecasts. These forecasts are explicit statements of managements' assessments of future prospects. A number of measures of insider trading designed to capture the information aspect of trading are investigated. The results indicate that the insider trading measures do not capture the information conveyed in earnings forecasts, although there is evidence that insider trading measures that take into account the timing of trades relative to the date of the release of the forecast are informative.

I. Introduction

Corporate managements, because of their positions within firms, presumably have superior information-gathering opportunities. Thus their utterances and actions may convey information about the values of their firms. It is well documented, for example, that their forecasts of earnings convey information that affects stock prices,[1] as do their announcements of dividends.[2] These corporate officers also trade in their firms' securities. It is quite plausible that these trades also reveal their inside information. Indeed, some investment services track insider trading for "buy" and "sell" signals. A number of papers[3] have investigated the profitability of insider trading and have concluded that insiders on average earn superior returns from trading relative to outsiders, a result suggesting that they use their inside information in trading.

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1. See [19], [16], [18], and [20], for example.
2. See [23], [6], [1], and [22], for example.
3. Among these papers are [25], [17], [15], [12], [13], [3], and [21].

This paper investigates the information content of insider trading and compares it to that of management earnings forecasts. While papers referred to above have analyzed the profitability of insider trading (which suggests information content), little formal work has been done on the information that insider trading conveys, despite the wide following of insider trading by analysts. This paper begins to fill that gap. The comparison with earnings forecasts provides particular insights. Earnings forecasts are explicit statements by managements of their assessments of their firms' prospects. Insider trading is an action taken by management (on private account) that also may be based on their assessments of those prospects. We make the comparison in order to assess whether the information about firms' prospects that is expressed in forecasts is also reflected in insiders' trades (and vice versa). The issue is the extent to which insiders use the information expressed in their forecasts in trading (and the extent to which information used in trading is expressed in their public forecasts). In carrying out the analysis, we examine a variety of measures of insider trading to discover what aspects of insider trading best capture managements' (forecast) information.

The paper is organized as follows. In the second section, we describe the data sources and the criteria applied in selecting the sample. In Section III, the insider trading data and forecast data are summarized and then in Section IV, a number of measures of insider trading that stress different aspects of trading are defined. Section V reports on the tests of the relative information content of the alternative trading measures and forecasts. The main conclusions from these tests are summarized in Section VI.

II. Data Sources and Sample Selection

The composition of the sample was determined largely by the availability of earnings forecasts. Managements make these forecasts voluntarily and so there is not necessarily an annual earnings forecast for every firm in every year. Available management forecasts of annual earnings were collected from the *Wall Street Journal* for the years 1968 to 1973. To be selected, the forecasts had to be a point or interval estimate, a definite projection (not a target or goal of the company), and explicitly attributable to the company or one of its officers. To achieve consistency over firms, we required that all forecasts be for primary earnings-per-share (or such that this number could be calculated) and be the first forecast issued by the firm for the relevant fiscal year (not a revision of a previous forecast). To be included in the tests, the firms further had to have sufficient returns' data available on the University of Chicago's CRSP Daily Returns File for a period long enough to carry out estimations—namely, six years before and including the calendar year of the forecast. For reasons that will become apparent in Section V, we excluded firms whose fiscal year-end for the forecasted year occurred prior to the end of the calendar year of the forecast. Of the 2217 forecasts collected over the six-year period, 737 remained in the test sample. Most industry groups are well represented relative to their representation on COMPUSTAT's Primary, Secondary, and Tertiary Industry File, with the exception of chemical firms and utilities that are over-represented, and metals, textiles, and financial corporations that are slightly under-represented. Approximately 15 per-

cent of the forecasts were made in the first fiscal quarter, 33 percent in the second, 20 percent in the third, and 33 percent in the fourth. The 737 forecasts in the sample comprise 350 firms making only one forecast in the six-year period, 107 firms making two, 34 making 3, 15 making 4, 1 making 5, and 1 making 6.

Details of insider trading for the 737 firms were gathered from the *Official Summary of Security Transactions and Holdings* published by the SEC. Section 16(a) of the Securities and Exchange Act of 1934 requires corporate officers, directors, and holders of more than 10 percent of any type of security to report transactions in their holdings to the SEC within 10 days of the end of the month in which the transaction takes place. The *Official Summary* contains these reports. It is published monthly on the basis of reports that are filed in the previous month and that usually are made with respect to trades in the month before. Along with the number of shares traded, the *Official Summary* gives the class of shares traded, the date of the trade, the name of the trader and his or her relationship to the corporation, the nature of the ownership of securities (''direct'' or indirect''—through a trust, family member, or other intermediary), the trader's month-end holdings, and descriptive footnotes indicating the character of the transaction. Prior to August 1972, the *Official Summary* omitted reports with less than 100 shares traded during a month.

III. Description of Insider Trading and Forecast Data

Table 1 summarizes insider transactions in the common stock of firms in the sample. The first panel of the table gives the major types of trades reported in the *Official Summary* and the total number of each type of trade for all firms in each year of the sample period. Transaction type codes (given in the *Official Summary*) are explained in the footnotes to the table. The majority of transactions (78 percent, overall) are direct purchases or sales but a significant number of acquisitions (24 percent) are made through exercise of options and rights. In the bottom panel of the table, some further summary measures are given. The average number of trades per year for firms in the sample, although varying from year to year, is approximately 20.5 overall, and the average number of traders per firm is about 9.5. This means that the average trader traded a little over twice in his or her firm's stock in a year. The figure for average number of traders does not include insiders who did not trade at all, of course, so this figure refers to those who actually traded, not all insiders.

Analysts of insider trading regard a 1 to 2 ratio of direct purchases to sales as normal and a neutral indicator.[4] This ratio, given in the last line of Table 1, varies over years but is .90 on average over all years. If insider trades are indicators and if the norm is valid, this indicates these traders view their firms' prospects as relatively good. To see if a similar inference can be made from management forecasts, we summarize the predictions of these forecasts in Table 2. In the first panel of the table, the forecast is compared with two models forecasting annual earnings-per-share.

[4] See ''Analysts Think Selling Spree May Mean Early End to Bull Market,'' *Wall Street Journal* (October 8, 1980), p. 29. Also see ''Insiders' Signals on Sales Cause Some Concern as Ratio to their Buys is Again on Upswing,'' *Wall Street Journal* (June 15, 1981), p. 43.

TABLE 1

Summary of Insider Transactions in Common Stock: 1968-1973

Transaction Type	Number of Transactions						
	1968	1969	1970	1971	1972	1973	Total
P	558	716	419	403	1089	2377	5562
S	1149	834	825	822	1370	1188	6188
1	489	328	186	222	645	158	2028
2	59	144	79	8	11	0	301
3	19	99	64	3	24	0	209
4	107	82	34	32	207	376	838
Total	2381	2203	1607	1490	3346	4099	15126
No. of Firms	125	129	102	96	154	131	737
Firm Average	19.1	17.1	15.5	15.5	21.7	31.3	20.5
No. of Traders	1250	1127	846	791	1527	1525	7066
Average Traders	10.0	8.7	8.3	8.2	9.9	11.6	9.6
P/S	.49	.86	.51	49	.79	2.00	.90

Notes: Transaction types are P = purchases; S = sales; 1 = exercise options or rights; 2 = received as compensation or bonus; 3 = received under employee incentive plan or stock purchase plan; 4 = other types (of which there are 34).

Model 1 (martingale with drift)

$$E(\tilde{Y}_{it}) = Y_{it-1} + \delta_i$$

where $\tilde{Y}_{it}$ is the earnings-per-share for firm i in fiscal year t, the forecast year. Y_{it-1} is the prior year's earnings-per-share, and δ_i is the drift constant.

Model 2 (market index model)

$$E(\Delta\tilde{Y}_{it}) = \alpha_i + \beta_i \Delta M_t$$

where $\Delta\tilde{Y}_{it}$ is the change in earnings-per-share for firm i in year t over the previous year's earnings, and ΔM_t is the change in a market index of earnings in year t measured by Standard and Poors' Composite Quarterly Index of Earnings-per-Share summed to an annual index. The parameters of these models were estimated for each firm from a time series of earnings data prior to the forecast year. Both models seem to perform well against competitors on average.[5] The first panel of Table 2 partially summarizes the cross-sectional distribution of

$$(1) \qquad f_{it}^{k} = \left[Y_{it}^{F} - E_k(\tilde{Y}_{it})\right] / \hat{\sigma}(\Delta\tilde{Y}_i), \quad \text{for} \quad k = 1 \quad \text{and} \quad 2$$

where Y_{it}^{F} is management's forecast for firm i for year t, $E_k(\tilde{Y}_{it})$ is the forecast from model k, $k = 1$ or 2, and $\hat{\sigma}(\Delta\tilde{Y}_i)$ is the estimated standard deviation of earnings-per-share changes for firm i (estimated from the historical time-series of earnings-per-share). The mean and median values of these standardardized dif-

[5] See [4], [9], and [24].

ferences in forecasts are positive in every year and overall for both models, and large relative to the cross-sectional standard deviations of the differences, as measured by t for the means. In the second panel of the table, the median percentage change in earnings forecasted over the prior year's earnings is given, by year, and compared with a measure of the average percentage change in corporate profits of all firms in the economy. This comparison also reveals that the forecasts project earnings that are above the market average, at least at the median. Thus, it appears that the direction of the insider trading ratio indicator and the direction of the forecast are consistent on the average. Note, however, that there does not appear to be a relationship between the level of the forecast differences in the first panel of Table 2 and the ratio of insider purchases to sales in the bottom line of Table 1 over the various years in the sample period.

The median and mean values in the first panel of Table 2 are consistently positive. This could mean, of course, that managements consistently give biased (overly optimistic) predictions. In the bottom part of the table, managements' errors in predicting actual earnings (actual earnings − forecasted earnings) are summarized and compared with those of the two models above. The comparison with model 2 is unfair to the management forecasts because the market index incorporates information available after the date of the forecast, made before year-end. On the other hand, management forecasts are made after the beginning of the fiscal year and thus have possibly more earnings information available than incorporated in model 1. In any case, the management forecasts perform consistently better than both model forecasts on almost all criteria. The management forecast errors are negative at the mean (indicating a slight tendency to overestimate), but are close to zero. The median management error overall is indistinguishable from zero at three decimal places. Management forecasts appear to be superior to the others, and unbiased. We conclude that the positive mean and median values in the first panel of the table do not merely reflect management forecast error. Rather they reflect the fact that forecasting firms are those doing relatively well, on average, and the insider trading figures reflect this.

IV. Measures of Insider Trading

In the tests, we view insider trading as a signal about managements' assessments of their firms' prospects, similar to an earnings forecast. There is little theory to indicate what aspects of insiders' trades are related to the information they possess. Ostensibly insiders buy when they have "favorable" information and sell when they have "unfavorable" information. However, insiders also trade for portfolio adjustment and liquidity reasons and acquire and dispose of shares other than through direct purchase or sale. Results in [25] suggest that the differences between purchases and sales may be informative, while those in [15] suggest that the number of purchase and sale transactions may be relevant. As indicated above, analysts of insider trading follow the ratio of purchases to sales. In the tests reported in the next section, we examine a variety of insider trading measures in order to discover which is most informative. The following measures of insider trading were calculated for each firm in each year the firm appeared in the sample with a forecast. The definition of these measures draws

TABLE 2

Comparisons of Management Forecasts with Model Forecasts and Actual Earnings

Forecast – Model	1968	1969	1970	1971	1972	1973	All Years
Model 1.							
Median	382	541	.462	813	.803	859	633
Mean	.539	700	685	875	.888	1 383	854
t	4 550	6 921	4.551	6.341	6.475	8 999	1.525
Model 2.							
Median	292	683	1.056	.621	479	092	506
Mean	.416	933	1 250	725	526	093	.628
t	3.117	8.568	7 409	4 936	3 419	462	3 783
Median % Change of Forecast	17.7	17.5	11 0	18 3	20 0	19 4	15 6
Mean % Change in Corporate Profits	9.0	3 0	−8 0	13 0	17 0	19 0	—
Earnings – Forecast							
Model 1.							
Median	.090	051	−.006	170	.237	380	149
Mean	.100	.029	−.064	204	317	640	220
Mean Abs.	.675	749	731	477	.564	.766	.663
Std Dev.	1 503	3 239	1 995	770	1.055	1.015	1.821
Model 2.							
Median	042	103	133	127	155	038	103
Mean	014	100	.178	139	135	007	092
Mean Abs	657	779	738	.473	505	.825	664
Std. Dev	1.462	3.259	2.088	.842	1.662	1 548	1.892
Management							
Median	001	−.040	− 053	.000	010	020	000
Mean	− 114	− 391	− 366	−.019	032	073	− 121
Mean Abs.	281	469	.479	.183	.210	270	312
Std Dev.	570	2 382	1 067	356	.462	454	1 157

Notes:

The mean % changes in corporate profits are from "Survey of Annual Corporate Profits" in the April issues of *Monthly Letter* published by First National City Bank of New York

t = (mean/cross-sectional standard deviation). $\sqrt{N}$, where N is the number of forecasts.

largely on intuition, with reference to measures used by analysts of insider trading. The test results are not sensitive to the exclusion of particular transaction types, except direct purchases and sales. The measures used in the reported re-

sults are based on all types, with the exception of a few that we felt to be outside the discretion of the insider.[6]

The first measure relates insider trading to total common shares outstanding for the firm

$$T_i^1 = \left(P_i - S_i\right) / O_i$$

where P_i is total purchases of common stock by insiders of firm i during the year, S_i is the total sales of common stock by insiders of firm i for the year, and 0_i is average shares outstanding during the fiscal year most closely corresponding to the calendar year. All shares are adjusted to the same basis, of course. All levels of insider trading may differ across firms for other than information reasons, O_i is a means of standardizing trades. However, this standardization also gives a natural interpretation to the measure: T_i^1 is the proportion of the firm's equity (net) purchased by insiders from outsiders during the year. It has been reported that insider purchases are more informative than sales.[7] Thus, the second measure is based on purchases only

$$T_i^2 = P_i / O_i.$$

This measures the proportion of the outstanding common stock acquired by insiders. The third measure is simply the ratio of purchases to sales, measuring the relative intensity of trading in each direction

$$T_i^3 = P_i / S_i.$$

This is the measure most often referred to by analysts of insider trading.

The next measure relates trades to holdings by investors. For each trader, j, reporting in the *Official Summary* for firm i we defined

$$t_{ij} = \left(P_{ij} - S_{ij}\right) / H_{ij}$$

where P_{ij} and S_{ij} are purchases and sales, respectively, by insider j in firm i and H_{ij} is the holdings by the insider of common stock at the beginning of the year. This standardizes by holdings and measures the intensity with which a given insider changes his or her position in the firm's shares. For the firm, the following measure is defined

$$T_i^4 = \sum_{j=1}^{N_i} t_{ij} / N_i$$

[6] The exceptions were shares received or disposed of in a merger, exchange or conversion, shares received in a liquidation, distribution, stock dividend, and shares sold pursuant to registration or pursuant to an underwriting agreement.

[7] See the first article referenced in footnote 4 above.

where N_i is the number of traders reporting for firm i.[8]

All the above measures ignore a particular feature of the data—insiders who are trading also are issuing earnings forecasts. These insiders may be timing their trades to take advantage of the forecast announcement. Round-trip trading within six months incurs potential penalties, but incentives do exist for insiders to take market positions prior to the release of information and reverse themselves after its release. If insiders do not trade round-trip, they still may time their trades relative to the forecast date. For example, a trader profits from buying prior to a forecast carrying "good news" and deferring sales until after, or from selling before a "bad news" forecast and deferring purchases until after. Not only will the above measures not capture this aspect, all except T_i^2 will obscure it completely because a purchase followed by a sale will cancel out in the calculations. If insiders are timing their purchases and sales rather than round-trip trading, this also will not be picked up. Because the measures are at the firm level, purchases (sales) by some insiders before the forecast will cancel out sales (purchases) after it by others. The evidence in [21] does suggest that insiders do time their trades relative to the release of forecasts. To capture this phenomenon, we defined the following group of measures for each firm

$$T_{ti}^5 = \left[\sum_{m=-t}^{-1} T_{mi} + T_{bi}\right] - \left[\sum_{m=1}^{t} T_{mi} + T_{ai}\right], \quad t = 1,\ldots,4$$

where T_{mi} is purchases minus sales in month m relative to the month in which the forecast was published, T_{bi} is purchases minus sales in the month of the forecast but before the day of the forecast, and T_{ai} is purchases minus sales in the month of the forecast but on or after the day of the forecast. Negative values of m refer to months prior to the forecast month, positive values to months after. All trades are standardized by shares outstanding for the firm. As an example, for $t = 3$ this index measures purchases minus sales in the three months prior to the forecast month and in the forecast month prior to the forecast, and compares this with purchases minus sales in the three months after the forecast month and within the forecast month after the forecast. The measure captures the difference between trading before and after the forecast date. Sales after the forecast enter into the calculation in exactly the same way as purchases before the forecast, and purchases after in exactly the same way as sales before. Thus, by signing trades to take into account the timing, the measures capture all aspects of trading with respect to the forecast date. A similar measure based on the number of transactions rather than shares purchased or sold is defined as

$$T_{ti}^6 = \left[\sum_{m=-t}^{-1} K_{mi} + K_{bi}\right] - \left[\sum_{m=1}^{t} K_{mi} + K_{ai}\right], \quad t = 1,\ldots,4$$

[8] While the relative changes in insiders' holdings may indicate the information they possess, this measure suffers from the fact that it captures trades relative only to holdings of insiders who reported—the holdings of nontraders (which are not reported in the *Official Summary*) are not weighted into the mean over traders. Also the firm value of the measure can be significantly affected by extreme values of t_{ij} when traders are trading with low holdings (in the extreme, with zero beginning-of-period holdings).

where K is the number of purchase transactions minus the number of sale transactions, standardized by shares outstanding.

V. Tests of Relative Information Content

The perspective here differs from that in the studies on the profitability of insider trading referred to earlier.[9] Those studies have a time-series perspective: the tests examine the relative magnitude of insider trading over time and assess whether changes in levels of trading anticipate changes in stock prices. Here we adopt the perspective of financial signaling models: insider trading and forecasts are viewed as signals or indicators that distinguish firms' values one from the other. The perspective is thus a cross-sectional one. The tests are designed to discover whether the relative level of insider trading is a discriminating indicator of firms' stock returns (changes in equity value) and to compare the relative ability of the various measures of insider trading and earnings forecasts to explain the cross-sectional variation in firms' realized returns.

The comparisons are made in terms of the return performance of portfolios formed on basis of the relative magnitudes of the respective signals. At the beginning of each calendar year in the sample period, stocks are assigned to portfolios on the basis of the annual earnings forecast published by management sometime during the ensuing year and on the basis of the relevant insider trading measure based on trading throughout the year.[10] The forecast and insider trading measures are viewed as signals from managements realized during the year and the 12-month return on a given portfolio is a measure of the return an investor informed of their values would earn from investing on the information. The sample consists only of firms whose forecasted fiscal year ends on or after December 31. Thus, the 12-month period over which returns are observed excludes the date of the announcement of actual earnings for the year which the forecast and insider trading are viewed as predicting.

If the expectation in $E_k(\tilde{Y}_{it})$ in (1) is assumed to be unconditional upon the management forecast, the variable f_{it}^k captures the "news" portion of the forecast. In the tests presented here, we use the forecast variable f_{it}^1, the comparison of the management forecast with that of model 1, as a measure of this new information. Similar results were obtained using forecast variable f_{it}^2. Stocks were

[9] In footnote 3.

[10] There is a problem of specifying when details of insider trading arrive at the market. Details of insider trading are published in the *Official Summary* approximately two months, on average, after the date of the trade and evidence [15] indicates that market prices react to the publication of this document. However, some details of insider trading are available prior to its publication in the *Official Summary*. Lorie and Niederhoffer [17] indicate that some stock exchange regulations require insiders to report trades within 10 days of the end of the month in which the trade took place and frequently these reports are made within a few days of the trade. Further, information on trades is available at the SEC as soon as reports are filed. Tests reported here were performed twice, once with insider trading measures based on trades taking place during the fiscal year and once based on trades announced in the *Official Summary* during the year. There was little difference in results. Reported results are for the latter timing assumption. The tests using T_{2t}^6 reported here require insider trading data for the two months before and after the month of the forecast. To ensure this was available in the *Official Summary* during the year, the tests for this measure use only forecasts that were made from February to September of each year.

assigned to portfolios as follows. At the beginning of each (calendar) year in the sample period, firms in the sample for that year were ranked in descending order on their values of f_{it}^1 for that year. This ranked array was then split at the median into two groups and then within each group firms again were ranked on values of the relevant insider trading measure being investigated. Then each of the two groups was split into two further groups at the median based on the ranking on the insider trading measure, to give four groups associated with different levels of the forecast variable and insider trading measure. The top group was comprised of firms with relatively high forecasts and relatively high insider trading measures, and we give this the designation HH; the second group comprised firms with relatively high forecasts but with relatively low insider trading measures within the high forecast group, and we give this the designation HL; the third group consisted of firms with relatively low forecasts but which had relatively high insider trading within the low forecast firms, given the designation LH; and the fourth group consisted of firms with relatively low forecasts and relatively low insider trading measures, and is designated LL. A set of four portfolios was formed for each of the insider trading measures. As the composition of the sample changes from year to year (because firms did not issue a forecast every year), we reformed the portfolios at the beginning of each year of the sample period based on values of the forecast variable and the relevant insider trading measure for firms in the sample for that year.[11]

These procedures sort firms into portfolios on the basis of the forecast and the insider trading measures. The tests discover the extent to which these rankings correspond to rankings on realized returns. As a summary of realized returns, a mean portfolio return was calculated for each of the four portfolios from the 72 monthly returns on portfolios observed over the six-year period. These mean returns are an estimate of expected returns conditional upon the four alternative joint realizations of the signals above. These expected returns were compared with that unconditional upon the signals, which is assumed to be described by the Capital Asset Pricing Model

$$E(\tilde{R}_{it}) = E(\tilde{R}_{zt}) + [E(\tilde{R}_{mt}) - E(\tilde{R}_{zt})]\beta_{it}$$

where $\tilde{R}_{it}$ is the rate of return on asset i for period t, $\tilde{R}_{mt}$ is the rate of return on the market portfolio for the same period, $\beta_{it} = \text{cov}(\tilde{R}_{it}, \tilde{R}_{mt})/\text{var}(\tilde{R}_{mt})$ is the relative risk of asset i in portfolio m, and $\tilde{R}_{zt}$ is the return on an asset for period t such that $\beta_{zt} = 0$. To control for risk, we weighted securities within portfolios such that the estimated relative risk of the portfolio was unity.[12] We then calculated

[11] Because the number of firms in the sample differs from year to year (see Table 1), the number of firms in each group will differ from year to year. Thus, the variance of returns on portfolios formed from each group is also likely to vary. The test assumes stationary variances and covariances over time. In an attempt to satisfy this condition, the number of eligible securities was reduced (by random selection) to 96, the number in 1971. Tests were repeated including the excluded firms instead of another randomly-selected number of firms with little difference in results. For tests involving T_{2t}^6, the number of firms in each year was 64. See foonote 10.

[12] The relative risk of each security was estimated from 60 monthly returns prior to the date of the formation of portfolios using "market model" regressions. Each group was ranked on estimated relative risk and then divided at the median risk into two groups. The relative risk of these two groups

the differences between the mean returns on each of the four portfolios and that on the market portfolio, as measured by the CRSP equally-weighted monthly returns index. The relative risk of the market portfolio is, by definition, unity. This controls for the market-wide factors, $\tilde{R}_{zt}$ and $\tilde{R}_{mt}$, over the sample period. We thus compare mean returns on portfolios formed on the basis of the forecasts and insider trading measures with that on a control portfolio of equivalent risk chosen without regard to the signals. The mean return differences can be interpreted as estimates of expected abnormal returns to foreknowledge of the forecast and insider trading behavior and as a measure of the relative value changes implicit in different levels of the signals, conditional upon the Capital Asset Pricing Model.

A test that takes into account the contemporaneous covariance of portfolio returns in testing the statistical significance of these mean return differences is Hotelling's T^2 test.[13] Let $\underset{\sim}{\tilde{R}}_t$ be a four-dimensional vector of returns on the four portfolios formed by ranking securities on the forecast variable and the relevant insider trading measure. Let $\underset{\sim}{\tilde{R}}_{mt}$ be a four-dimensional vector of returns on the market portfolio for period t. The null hypothesis is stated as

$$\underset{\sim}{w}^T\left[\mathrm{E}\left(\underset{\sim}{\tilde{R}}_t\right) - \mathrm{E}\left(\underset{\sim}{\tilde{R}}_{mt}\right)\right] = 0$$

for all values of the 4×1 vector, $\underset{\sim}{w}$. The value of the test statistic is

$$(2) \qquad T^2 = \max_{\underset{\sim}{w}} t^2(\underset{\sim}{w}) = M\left(\hat{\underset{\sim}{\mu}}_1 - \hat{\underset{\sim}{\mu}}_m\right)^T \underset{\approx}{S}^{-1}\left(\hat{\underset{\sim}{\mu}}_1 - \hat{\underset{\sim}{\mu}}_m\right)$$

where

$$(2a) \qquad t(\underset{\sim}{w}) = \left[\underset{\sim}{w}^T\left(\hat{\underset{\sim}{\mu}}_1 - \hat{\underset{\sim}{\mu}}_m\right)\sqrt{M}\right] \Big/ \sqrt{\underset{\sim}{w}^T \underset{\approx}{S}\, \underset{\sim}{w}}\,.$$

$\hat{\underset{\sim}{\mu}}_1$ and $\hat{\underset{\sim}{\mu}}_m$ are the sample estimates of $\mathrm{E}(\underset{\sim}{\tilde{R}}_t)$ and $\mathrm{E}(\underset{\sim}{\tilde{R}}_{mt})$, respectively; $\underset{\approx}{S}$ is the sample variance-covariance matrix of $\underset{\sim}{\tilde{R}}_t - \underset{\sim}{\tilde{R}}_{mt}$; and M is the number of observed return vectors in the sample. Conditional upon the null hypothesis, the distribution of $\tilde{T}^2\,[(M-N)\,/\,(N(M-1))]$ is that of $\tilde{F}_{N,\,M-N}$, where N is the dimensionality of $\underset{\sim}{\tilde{R}}_t - \underset{\sim}{\tilde{R}}_{mt}$. Besides incorporating the information on the cross-sectional relationships in security returns in making statistical inferences, this test permits multiple comparisons of differences between mean returns for all possible linear combinations of portfolios.

For the sake of space, detailed results are not reported for all the insider trading measures. Tables 3 and 4 give results for three measures, T_t^1, T_t^4, and T_{2t}^6. The latter involves comparisons of the number of insider transactions in the two months before the forecast with those in the two months after. Results for each of the other measures were similar to one or other of those reported here, as will be indicated. Table 3 gives the mean difference between returns on each of

was estimated as the arithmetic average of component securities' estimated relative risks. The two groups were then combined into one portfolio by choosing weights in such a way that estimated relative risk was equal to unity.

[13] See [2], chapter 5. The test has been used to address informational questions in [10], [11], [20], and [22].

the four portfolios and those on the market portfolio, for each set of portfolios formed by ranking securities on the forecast variable and the three alternative insider trading measures. F statistics associated with the mean differences are also given. In the last line of the table, the combined mean return difference for a portfolio formed from the four portfolios using the (normalized) weights, $\underline{w}$, implied by the observed value of $\tilde{T}^2$ is given for each test, with the value of $\tilde{F}_{4,68}$ corresponding to the value of $\tilde{T}^2$. These values indicate the null hypothesis should be rejected.[14] Investment on the basis of knowledge of the signals is abnormally profitable: the "efficient" investment implied by the T^2 weights yields a mean monthly abnormal return of 1.07, 1.35, and 1.14 percent, respectively, for the three sets of signals. The F values associated with the individual portfolios indicate that much of these abnormal returns can be attributed to portfolios 1 and 2, the H ("high") forecast portfolios. Further, differences in mean portfolio returns are positively related to the level of the forecast variable. For relatively high (H) forecasts (portfolios 1 and 2), there appears to be a relationship between mean returns and the (H and L) levels of the insider trading measure, although the difference between mean returns for portfolios 1 and 2 for T_i^1 is not large. There is a consistently reverse relationship between mean returns and levels of insider trading for low (L) forecasts (portfolios 3 and 4).

TABLE 3

Mean Return Differences for Portfolios Formed on the Basis of Management Forecasts and Insider Trading Measures

	Rankings on f_i^1 and T_i^1		Rankings on f_i^1 and T_i^4		Rankings on f_i^1 and T_{2i}^6	
Portfolio	Mean Return Difference	$F_{4,68}$	Mean Return Difference	$F_{4,68}$	Mean Return Difference	$F_{4,68}$
1(HH)	.0113	4.16*	0139	6.12*	.0149	5.52*
2(HL)	.0105	5.23*	.0088	3.58*	0044	.62
3(LH)	.0004	.01	−.0001	.00	.0029	22
4(LL)	.0032	.38	.0038	.73	.0083	1.54
Weighted Portfolio (T^2 weights)	.0107	7.65*	.0135	12.12*	0114	6 72*

Notes: (*) denotes significant at .05 level.

[14] The T^2 test assumes normality of returns and stationarity of variances and covariances over time. Estimated standard deviations, Studentized ranges, and estimated first-order serial correlation coefficients were calculated for each portfolio. The estimated standard deviations were reasonably constant over portfolios (as would be expected of well-diversified portfolios) and Studentized ranges and estimated correlation coefficients consistent with normally distributed, serially uncorrelated returns.

These relationships and the source of the inconsistency with the null hypothesis are examined more formally in Table 4. Rather than investing in the four portfolios using weights that maximize the value of $\tilde{t}^2(\underline{w})$, particular weights are assigned to portfolios with the aim of discovering the extent to which each signal contributes to the observed abnormal returns observed in Table 3. The weights applied to the four portfolios are given across the top of Table 4, and under these the mean return differences from investing according to those weights are given for each set of tests, along with values of $\tilde{t}(\underline{w})$ and $\tilde{F}_{4,68}$. The first vector of weights invests equally in each portfolio and thus averages out the signals. The difference in mean returns on this portfolio is consistently positive and significantly different from zero for all three tests. This result indicates that forecasting firms are not only those doing abnormally well earnings-wise (as observed in Table 2), but also returns-wise. Thus, they present trading opportunities to insiders. The weight vector number 2 takes a long position on portfolio 1 and a short position on portfolio 2 for zero net investment. Thus it assesses the arbitrage mean return to investing on the basis of the insider trading signals, given that a forecast is relatively high (H). This return is positive for all insider trading measures. However, the signal that appears to be particularly informative is T_{2i}^6. The F value there is significant at the .10 level. However, this is conservative because, while the F value accommodates the multiple comparisons we are making here, it is strictly relevant only under general alternative hypotheses. Given the directional alternative we have in mind here, one may wish to rely on the value of $\tilde{t}(\underline{w})$ in making inferences, keeping in mind that, within a given variance-covariance matrix, we are making seven comparisons in the table.[15] The t value on the mean return difference for weight vector 2 for T_{2i}^6 is significant with a high level of confidence for an (appropriate) one-tail test. This is not so for T_i^1 or T_i^4 (although the t value for the latter is significant at the .10 level), so it appears that with respect to "high" forecasts, the measure based on trading around the forecast is more informative than the others.[16] Weight vector number 3 performs a similar test for portfolios 3 and 4, the "low" forecast portfolios. As suggested in Table 3, the results indicate that none of the insider trading measures separates firms' returns at this level of the forecast.

The linear combinations of portfolios using weights numbered 4 and 5 take long positions on "high" forecasts and short positions on "low" forecast portfolios for "high" and "low" levels of insider trading, respectively. Irrespective of the level of insiders' trading, the mean return differences are positive and t values are significant at the .05 level, with the exception of vector 5 in the last panel. It appears that the forecast does distinguish returns at all levels of insider trading. The relatively superior discriminating power of the forecast is further demonstrated by the sets of weights numbered 6 and 7. The portfolio formed using

[15] Inferences on the basis of F statistics are biased towards nonrejection of null hypothesis. Gabriel [8] has compared a number of hypothesis-testing techniques under general alternatives according to their power functions and has found that, for tests involving alternative linear combinations of parameters, the use of many Student t-tests is a better procedure than any that has been suggested. Note (from (2a)) that the t values take into account the covariance of portfolio returns.

[16] In tests with the alternative sample (see footnote 11), the results were slightly more favorable to T_i^1. The mean monthly return difference was .0048 with a t value of 1.30.

TABLE 4

Mean Return Differences for Selected Combinations of Portfolios

	Weight Vectors						
Portfolio	1	2	3	4	5	6	7
1	¼	1		1		½	½
2	¼	−1			−1	½	−½
3	¼		1	−1		−½	½
4	¼		−1		1	−½	−½
f_t^1 and T_t^1							
Mean Difference	.0063	.0008	−.0028	.0109	0073	.0091	−0010
$t(\underline{w})$	4.26*	.26	−.88	3.03**	2 33**	3.61**	−.46
$F_{4,68}$	4.34*	02	19	2 19†	1 30	3 12*	05
f_t^1 and T_t^4							
Mean Difference	.0066	0051	0040	0140	.0049	0095	0006
$-1t(\underline{w})$	4.22*	1 46††	30	4 25**	1 73**	4 24**	23
$F_{4,68}$	4.27*	.51	.41	4.32*	71	4.31*	01
f_t^1 and T_{2t}^6							
Mean Difference	.0076	.0105	− 0054	.0120	− .0039	.0040	0025
$t(\underline{w})$	4.43*	3.07**	−1.33	2 64**	−1.02	1 25	95
$F_{4,68}$	4.69*	2.26†	.43	1.67	.25	.37	23

Notes:

(*) denotes value is significant at .05 level; (**) denotes value is significant at 05 level for a one-tail test;

(†) denotes value is significant at .10 level, (††) denotes value significant at .10 level for a one-tail test.

weights numbered 6 takes a long position on "high" forecast portfolios and a short position on "low" forecasts (with zero net investment) and averages out the insider trading measures. This yields positive mean abnormal returns which, in the first two panels of the table at least, are associated with significant t and F values. A similar strategy, which uses information in the insider trading measures and averages out the forecast (weight vector number 7), yields mean returns that are not significantly different from zero (and negative for T_t^1). We conclude that the forecast possesses more information. Overall, none of the insider trading measures performs well. However, given that the firm makes a relatively high earnings forecast (which is associated with relatively high abnormal returns), insider trading does tell us something if transactions before and after the forecast are compared.

Results similar to those for T_t^1 and T_t^4 were observed for tests using T_t^2. For the insider trading measure commonly used by insider trading analysts, T_t^3, the mean monthly abnormal return for weight vector 2 was .0006 with a t value of .16. For the measure T_{2t}^5 based on a comparison of the number of shares net

purchased in the two months before and after the forecast, the mean abnormal return was .0039 per month using the set of weights numbered 2, with an associated t value of 1.30. Results for T_{1i}^{5} and T_{1i}^{6} (based on trading one month either side of the forecast month) were similar to those for T_{2i}^{5} and T_{2i}^{6}, but those based on a more extensive period (that is for values of t in T_{ti}^{5} and T_{ti}^{6} greater than 2) did not perform as well.

A few other aspects of the tests should be reported. Tests were repeated reversing the order or ranking of securities (that is, first on the insider trading measures and then on the forecast). In general, one would expect less variability in a measure if it were the basis of the second grouping rather than the first. However, results were little different. The tests also were repeated for several subperiods over the sample period. The T^2 test assumes stationarity of variances and covariances over time and this is more likely to hold for shorter periods. The results for the subperiods, covering times of varying economic conditions, were similar to those for the full period. There is evidence to suggest that mean returns are related to firm size (for example, in [5]). Many of the insider trading measures were standardized by shares outstanding and thus the results could be due to the fact that ranking on insider trading measures was effectively ranking on the reciprocal of size, measured by shares outstanding. An analysis of shares outstanding for firms in each portfolio revealed that this was not so.

VI. Summary and Conclusions

The measures of insider trading examined are not particularly strong discriminators among firms' realized returns. Given that management makes a relatively high forecast of earnings for the year, their insider trades are likely to have some explanatory power if the timing of the trades relative to the forecast date is taken into account. This indicates that an important signaling aspect of insider trading is not only the relative intensity of purchases and sales, but also the timing of trades relative to information releases. This is an appealing result because one would expect that, if insiders were trading on the information they possess, then they would time their trades around the date they release their information. Further, one would expect this to be particularly strong with relatively high forecasts of earnings (which are associated with relatively high returns), as we have seen. It has been argued (for example, in [7] and [14]) that the ability of those with privileged information to take market positions and then publish their information to take advantage of their position promotes the dissemination of information. The result here does indicate that insiders' joint trading and information-dissemination activity is informative.

The comparison of insider trading measures and the earnings forecast revealed that insider trading measures do not have the discriminatory power of the forecast in terms of ordering firms' realized returns. This may indicate that the insider trading measures investigated did not capture the informational aspects of insider trading, but also may indicate that not all the information in forecasts is reflected in insiders' trades. Insiders as a group do not appear to take advantage of all the information available to them in making trades. The disincentives associated with legal penalties on trading on inside information perhaps explain this.

However, even if insider trades do capture insiders' information, they are likely to be quite noisy signals due to trading for other than informational reasons.

Note that information content has been assessed on the basis of the contemporaneous correlation between the forecast and insider trading measures and realized returns over a 12-month period during which the signals arrived at the market. Ideally, one would want to identify the precise moment that the signals become available and observe returns around that time. For forecasts, the day of publication can be identified by the *Wall Street Journal* date and indeed the studies referred to earlier have demonstrated price reaction on these days. However, it is very difficult to identify the time of the arrival of the insider trading signal that could be anytime from the date of the trade to the publication of the *Official Summary* approximately six weeks to two months later (see foonote 10). Further, we wished to look at aggregate insider trading for all traders in a given firm and these take place at different times. In addition, forecasts and insider trades occur at different times. For these reasons, we observed returns over a 12-month period that is long enough to capture all annual earnings forecasts and insider trading without identifying the precise time of the arrival of the latter, and long enough to get a consensus among traders of each firm. Further, grouping stocks into portfolios abstracts from timing differences between the insider trades and the forecasts. The trades and forecasts may occur at different times and thus be based on different information. By grouping, differences between the timing of the two signals tend to be averaged out so that, at the portfolio level, both signals (which actually arrive throughout the year) appear about half way into the fiscal year.

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