Insider Trading and Analyst Forecast Revisions: Global Evidence

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Abstract

We examine how insider trading affects market responses to subsequent analyst forecast revisions in a global setting. We find stronger market responses to analyst forecast revisions subsequent to the insider trading than to other revisions. This stronger response is mainly driven by analyst forecast revisions that are in the same direction as the previous insider trading signal. In further analyses, we find that the market responses are stronger to analyst forecast revisions that follow insider sales for the US data, but stronger to revisions that follow insider purchases for the international data. Overall, our study suggests that investors view analyst forecast revisions as having different information content conditional on the existence and direction of previous insider trading signals and that investors seem to respond to both the analyst signal and the previous insider signal at the time analysts revise their forecasts, although the prior insider trading signal have been publicly known.

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1. Introduction

Corporate managers and financial analysts are two groups of market participants who are often deemed to have superior information about a firm's prospects. Corporate managers are insiders who have superior knowledge about their firm's operating, financing, and investing activities. Financial analysts, on the other hand, are specialists who have knowledge and expertise to analyze a firm's operating environment and performance, especially as compared to the firm's peers. Researchers have documented that activities of both corporate managers and financial analysts are informative and affect the capital market. For example, analysts' information products, including earnings forecasts, stock recommendations, and price target revisions have each been shown to induce significant price reactions (Feldman et al. 2012). Similarly, a long-standing literature examines the market implications of insider trading, an important signal from corporate managers. Empirical analyses show that insider trading often receives significant market responses either at the time of trading or at the time when the trading is reported to SEC and becomes public information. Other studies find that insider trading activities have predictive ability for future returns.[1]

In this study, we examine the interaction between information signals from these two important groups of market participants. Specifically, we investigate how insider trading affects market responses to subsequent analyst forecast revisions. Compared to some other information

[1] Seyhun (1986) finds that following the public dissemination of insider trading information, the abnormal return to outsiders net of the bid-ask spread plus the commission fee is non-positive, suggesting that the market is generally efficient. On the other hand, Lakonishok and Lee (2001) observe little market movement when insiders trade and when they report their trades to the SEC. However, such information predicts cross-sectional market returns, especially for smaller firms, suggesting under-reaction to the insider trading information.

signals from firms, such as financial reports or the introduction of new products, insider trading has a clear buy/sell signal that potentially reveals managers' views about corporate prospects and is easy for the investors to mimic. Investors therefore might not need analysts' assistance in interpreting this signal. Furthermore, insiders are expected to have superior information over analysts about firm specific information. Hutton et al. (2012) find that management's information advantage relative to analysts resides at the firm level and that management forecasts are more accurate than analyst forecasts when firm-specific information drives earnings news. Thus, to the extent that analysts incorporate previous insider trading activities in their forecast revisions, the market implications of these revisions might be muted or diluted if investors view these revisions as redundant information and ignore or discount these revisions. Consequently, there would be a weaker market impact of the revision on stock prices, especially when the two signals agree, as compared to analyst revisions that do not follow prior insider trading.

However, the literature on insider trading has suggested that insider trading signals predict future returns, implying that investors fail to fully incorporate the information content of insider trading at the time of the trading activities (Lakonishok and Lee 2001). While insider purchases may reflect managers' positive view about the firm, they may also be motivated by incentives to own enough shares to control a firm. Similarly, insider sales are often motivated by managers' consumption needs or personal portfolio diversification decisions as opposed to their pessimistic view about the firm (Scott and Xu 2004). Thus, insider trading signals may not be straightforward for investors to process, and investors may need assistance from financial analysts, who have financial expertise and can possibly have access to managers to better understand the motivation for insiders' trading. Recent literature suggests that investors value

analysts' expertise and experience in interpreting previous public information such as earnings announcements or other corporate announcements (Zhang 2008; Livnat and Zhang 2012). In light of these results, investors' responses to analyst forecast revisions subsequent to insider trading could be stronger than responses to other forecast revisions if investors value analysts' interpretation of the previous insider trading signals and treat the new analyst forecasts as more credible and/or more informative signals.

Thus, we consider the effects of insider trading on market responses to subsequent analyst forecast revisions as an empirical question and seek to examine it in a global setting in this study. We first find that market responses to insider trading drift into months after the filing, suggesting the initial responses are incomplete. More importantly, we find stronger market responses to analyst forecast revisions subsequent to insider trading than to other revisions. This stronger response is mainly driven by analyst forecast revisions that are in the same direction as the previous insider trading signal. These results hold for both US and foreign firms, although they are relatively stronger for domestic firms, possibly because of the longer span of data and larger sample sizes. In further analyses, we find that the market responses are stronger to analyst forecast revisions that follow insider sales for the US data, but stronger to revisions that follow insider purchases for the international data. This is also consistent with other differences between the US and foreign insider trading that we document: there are substantially more sell than buy transactions by US insiders, whereas there are fewer sell transaction by foreign insiders than buy transactions; sell transactions are more informative about future returns for foreign firms than they are for US firms.

Overall, our study suggests that investors view analyst forecast revisions as having different information content conditional on the existence and direction of previous insider

trading signals. When analysts confirm the insider trading signal[2], market responses are stronger relative to when there is no previous insider trading, suggesting that market responses to the previous insider trading signals are incomplete and that the responses continue when such signals are confirmed and/or interpreted by subsequent analyst forecast revisions. When analysts' forecast revisions are in the opposite direction to previous insider trading, investors appear to still respond to the revision, but to a lesser extent. These results suggest that investors seem to respond to a weighted average of both the analyst signal and the previous insider signal.

Our study adds to the insider trading literature in two important ways. First, we show a delayed market response to insider trading until at least when financial analysts make subsequent forecast revisions that incorporate their interpretation of the insider trading activity. These results corroborate the evidence in Lakonishok and Lee (2001) and Scott and Xu (2004) about the inefficiency in initial market reactions to insider trading. We also document this phenomenon for European and Asia-Pacific countries.

Second, and more important, our analyses of the international insider trading data add to our understanding of the insider trading activities in different countries with different governance and legal systems. Due to lack of data availability, prior research on international insider trading is limited. Our results show that insider trading activities are different outside the US, with more purchases by insiders than sales, contrary to the US. For example, we find that in the US in an average month, we have a net sell signal for about 1400 firms, and a net buy signal for only 800. In terms of the underlying transactions by insiders there are about 4 sell transactions for every buy transaction. Outside the US, in an average month there are over 1400 firms with a buy signal

[2] In this paper, when we state "confirm" or "agree" we only refer to the fact that analysts' forecast revisions are in the same direction as the previous insider trading signal. We do not intend to suggest that analysts consciously confirm insiders' sell or buy signal.

and only about 900 firms with a sell signal. Similarly, there are roughly 1.2 purchase transactions for every sell transaction outside of the US. Our results also highlight differences in market responses to analyst forecast revisions subsequent to insider trading activities. Specifically, investors seem to place greater value on analysts' interpretation of net insider sales for US firms but on analysts' interpretation of net insider purchases for international firms.

Our study also contributes to the financial analyst literature by suggesting the importance of analysts in interpreting insider trading information. While a number of studies examine analysts' interpretation of various corporate information such as earnings announcements (Zhang 2008), little research focuses on analysts' interpretation of insider trading activities despite these activities' important market implications. A few studies examine analyst forecast revisions subsequent to insider trading activities (e.g. Lustgarten and Mande 1995). However, they only focus on how analysts revise their forecasts in response to insider trading activities without examining how market participants react to the analyst forecast revisions as we do. From investors' perspective, it is important to understand the market implications of analysts' revisions that incorporate insider trading activities.

Our results suggest that despite the buy/sell signals of the insider trading activities, investors look to analysts to better understand the information content of the prior insider trading, implying that there could be noise (as opposed to information) in insider trading such as liquidity or diversification trading. Investors need analysts' expertise in differentiating between such noise and information in the trading activities.

The remainder of this paper proceeds as follows. In Section 2, we describe our sample and insider trading variables. In Section 3, we introduce our research design. Section 4 presents our results based on both domestic and international data. Section 5 concludes.

2. Sample and Insider Trading Variables

We start our analyses with US domestic data for the period from January 1996 to October 2011. We get all trades in Thomson Reuters insider trading database via WRDS that do not have cleanse codes A or S, and where the ACQDISP code is "A" or "D" (buy and sell transactions). We select Form 4 only where the trancode is "P" or "S", i.e., market purchase or sell with amend not being "A" and keep non-duplicated transactions. We exclude sales that immediately follow exercising of stock options.[3] We also require the availability of both a transaction date and a SEC report date for each trade. We keep only Levels 1 and 2 insiders. Levels 3 and 4 insiders include lower level officers, affiliates of investment advisors, beneficial owners, owners and founders who are not board members or high level executives. Transactions by Levels 3 and 4 insiders are less likely to be driven by firm-specific information.

Our analyst forecast information is obtained from IBES. We require the firm to have a minimum market value of $100 million. For each analyst forecast revision, we get (from Compustat) the most recent preliminary quarterly earnings announcement date that is at least 30 days and at most 180 days prior to the revision date. We choose the minimum 30-day period after an earnings announcement because a significant number of analyst revisions occur immediately after earnings announcements (Livnat and Zhang, 2012). Requiring a minimum 30-day period also ensures that insiders have sufficient number of days to trade after an earnings announcement because many firms have a "blackout period" immediately after an earnings announcement when insiders are prohibited from trading their companies' stocks (Bettis et al. 2000). We then merge this data with our insider trading data. Specifically, for each analyst

[3] Option exercises may be caused by imminent expiration of the options, by new awards of options which heighten the need to diversify, and may be more likely to be caused by liquidity needs. The insider trading signal is typically stronger when these transactions are excluded. We perform sensitivity tests by including these sales transactions. Our inferences are unchanged.

revision date, we obtain all insider trading transactions whose SEC report date is after the prior earnings announcement date but one day prior to the revision date. This ensures that the analyst had access to the insider trading information at the time of the revision.

As there could be multiple inside trading transactions preceding an analyst forecast revision, we aggregate these transactions into one signal. Specifically, we first aggregate all transactions by the same insider over the period from the prior earnings announcement date to the revision date, weighting the number of shares by a time factor. The time factor is calculated as 1-(revision date-transaction date)/*dif*, where *dif* is the lag between the earnings announcement date and the revision date. Thus, transactions closer to the analyst revision date get a higher weight in calculating the aggregate signal. We then aggregate this value over all insiders, with which we construct several variables to capture the insider trading signal. The first variable is INSIDER, which takes the value of 1 if there is any insider trading activity in the designated window, and 0 otherwise. Depending on the sign of the aggregate trading, we also construct an indicator variable PURCHASE (SALE) that equals to 1 if the aggregate time-weighted trading is a net purchase (sale), and 0 otherwise. We discuss our international data in Section 4.2.

3. Research Design

Our main focus is to analyze how the market responds to analyst forecast revisions conditional on previous insider trading signals, so as to shed light on whether and how the market relies on analysts' interpretation of previous insider trading signals in assessing such signals. Prior research has largely established that investors' responses to insider trading reports are inefficient and continue to drift for an extended period after the trading activities are reported. Thus, we first seek to replicate this result by examining whether insider trading activities in our

sample generate excess returns in periods after these activities are reported to the SEC and hence become known to the public.

We next examine whether the market responds differently to analyst forecast revisions conditional on the existence of previous insider trading activities since the previous earnings announcements. Specifically, we estimate the following model:

XRET = f (RREV, RREV*INSIDER, INSIDER, RREV x (PROMPT, SIZE, BM, EXP, NUMFIRM, BROKER, HORIZON, INNOVATIVE), PROMPT, SIZE, BM, EXP, NUMFIRM, BROKER, HORIZON, INNOVATIVE)) (1)

Our model largely follows that in Clement and Tse (2003) and Livnat and Zhang (2012). The dependent variable (XRET) is the excess buy-and-hold return over three trading days (day -1, 0, and 1) centered on the forecast revision day (day 0). The excess return is measured relative to matched size, book-to-market, and momentum portfolios (Daniel et al. 1997). For each analyst forecast revision, we calculate its magnitude as the revised forecast minus the same analyst's previous forecast for the same forecast period deflated by stock price as of the end of the month prior to the forecast revision. In our empirical tests, following prior research (e.g., Elgers et al. 2001; Livnat and Zhang 2012), to prevent undue effects by outliers, we rank this scaled revision variable into 10 equal sized deciles by calendar month and then divide the ranks by nine and subtract by 0.5. We use this transformed rank variable, RREV, in our empirical tests. Thus, the coefficient of RREV can be interpreted as a return on a hedge portfolio that is long on the most positive decile of forecast revisions and short on the decile with the most negative revisions. Based on prior research (e.g., Stickel 1991; Clement and Tse 2003), we expect the coefficient on RREV to be greater than zero, indicating a positive association between market reactions and the forecast revisions.

We then interact the revision variable, RREV, with the insider trading indicator variable, INSIDER. If the coefficient on the interaction term is significantly positive, this suggests that investors consider analysts' interpretation of the previous insider trading activities as adding more information and hence respond more strongly to their revisions. On the other hand, if the coefficient on the interaction term is significantly negative, this suggests that investors might view analysts' interpretation as providing redundant information because the insider signal preempted at least a portion of the revisions' potential impact.

We also include the effects of a number of control variables on the strength of market reactions to analyst revisions following Clement and Tse (2003) and Livnat and Zhang (2012). Specifically, we include firm-specific, analyst-specific (including characteristics of the employing broker), and revision-specific control variables and their interactions with RREV. For firm-specific variables, we control for the effects of firm market value of equity at month-end prior to the revision (SIZE), and book-to-market ratio as of month-end prior to the revision (BM). We next control for the following analyst-specific variables: experience as an analyst in terms of the number of days since the analyst's first EPS forecast on IBES (EXP), number of firms the analyst covers at month-end prior to the revision (NUMFIRM), size (i.e., number of individual analysts) of the employing brokerage house at month-end prior to the revision (BROKER).

We also control for revision-specific variables including the promptness of analyst revision relative to the most recent earnings announcement (PROMPT), and the horizon (HORIZON) and the innovativeness of the forecast revision (INNOVATIVE). PROMPT is an indicator variable that equals to 1 if there is an earnings announcement within three trading days prior to the revision, and 0 otherwise. HORIZON is the number of days from the revision until

the corresponding forecast period end. Innovativeness captures how innovative the analyst's revision is relative to other analysts' revisions. We measure innovativeness following Gleason and Lee (2003). Specifically, if the analyst's revision moves away (relative to his/her previous forecast) from the consensus, we consider it an innovative forecast; otherwise we consider it a non-innovative forecast. To reduce the influence of outliers in our regression models, we take logs of the following variables: SIZE, EXP, HORIZON, NUMFIRM and BROKER. Detailed definitions of all variables are provided in the Appendix. In light of prior literature, we expect that market reactions to analyst revisions are negatively correlated with firm size, book-to-market ratio, number of firms the analyst covers, forecast horizon, and positively correlated with analyst experience, broker size, promptness after earnings announcements, and forecast innovativeness.

We next examine whether the market response is different depending on whether analysts' forecast revisions are in the same direction as the previous insider trading signal. We run the following regression:

XRET = f (RREV, RREV*CONFIRM, RREV*CONFLICT, CONFIRM, CONFLICT, RREV*Controls, Controls) (2)

In Model (2), we are interested to examine whether the information content of analyst forecast revisions differs when analysts agree with the insider trading signal (i.e., CONFIRM=1) or when they disagree (i.e., CONFLICT=1), relative to when there is no insider trading preceding the revision. Prior research suggests that investors generally underreact to insider trading signals. If they are unsure about the proper interpretation of the insider trading activities, analysts' confirmation of such activities is expected to induce investor reaction, which leads to a positive coefficient on RREV*CONFIRM. On the other hand, if investors view analysts' confirming

revision as redundant but consider revisions that are in opposite direction of insiders net trading as being more informative, this would lead to a negative coefficient on RREV*CONFIRM but a positive coefficient on RREV*CONFLICT. Thus, we do not form a prediction on the sign of the coefficient on RREV*CONFIRM or RREV*CONFLICT.

4. Empirical Results

4.1.US Domestic Data

Predictive Ability of Net Insider Trading Activities

As we discuss above, we first examine whether insider trading data in our sample predicts future return by focusing on calendar months. We aggregate all transactions by an insider in the 180 days prior to a calendar month-end, using the same time-weighting scheme as we discuss in Section 2. We aggregate over all insiders from a specific firm during this window and obtain the net insider trading signal for each calendar month.

We separate the firm-month specific insider trading signals into net purchases and net sales and calculate the excess returns over the 30 days after each calendar month-end. We calculate and report in Table 1 the excess returns for long portfolios based on all firms with net purchases for that month-end and short portfolios based on all firms with net sales for that month-end. On average, there are 833 long positions and 1439 short positions each month, suggesting more net selling activities than net buying activities. This is consistent with the popularity of stock-based compensation and the prospect that insider sell transactions are more likely than buy transactions due to managers' diversification and consumption needs (e.g., Ofek and Yermack 2000; Aboody et al. 2005). We find that based on the average of 190 months (i.e., January 1996 to October 2011), one can earn 16.5 basis points of excess returns from the long

portfolio (t=2.49, p=0.01) and 5.5 basis points from the short portfolio (t=0.66, p=0.51). Thus, one can earn an average hedge return of about 22 basis points in the 30-day window after the calendar month end, with most of the hedge return coming from the long portfolio. These results suggest that investors do not fully respond to insider trading signals at the time of the availability of such trading information, particularly for insider purchase transactions. In addition, these results also indicate that insider purchasing is more informative than insider selling, which is consistent with previous research results (Aboody et al. 2005) in the US markets.

Market Responses to Subsequent Analyst Forecast Revisions

Having established that the market underreacts to insider trading activities in our sample, we next focus on market responses to subsequent analyst forecast revisions, conditional on the existence and the direction of previous insider trading signal. This analysis helps us understand whether investors rely on professionals' processing and interpretation of the insider trading activities when responding to insider trading activities.

In Table 2, we first sort the analyst forecast revisions into 10 deciles and report three-day market excess returns around the revisions for each decile. As shown in Panel A, the average excess return on the lowest decile is -4.6% while that on the highest decile is 2.9%, yielding a hedge return of about 7.6% over the three-day window. This is consistent with prior results that analyst forecast revisions contain significant information content.

Our analyses focus more on the excess returns conditional on the existence of previous insider trading activities. Within the lowest decile, analyst forecast revisions preceded by insider trading activities receive an average excess return of -4.7% while those without preceding insider trading activities receive an average excess return of -4.5%. Within the highest decile, the

average excess return is 3.1% when there is previous insider trading and 2.7% when there is not. Accordingly, investors earn an excess hedge return of 7.8% on analyst forecast revisions following insider trading, in contrast to 7.2% on revisions not following insider trading.

Panel B presents regression analyses of the effects of the presence of previous insider trading activities on market responses to analyst forecast revisions. Specifically, we estimate Model (1) where we control for various firm-specific, analyst-specific, and revision-specific factors that are expected to affect market responses to the revisions. Consistent with Panel A and prior studies, the coefficient on RREV, the ranked analyst forecast revisions, is significantly positive at 0.056. Our main interest is on the interaction term between RREV and INSIDER, which, as shown in Panel B, is significantly positive at 0.006. This suggests that *ceteris paribus*, analyst forecast revisions that incorporate analysts' interpretation of the previous insider trading activities receive market responses that are about 10% higher than revisions that do not follow insider trading activities. The coefficients on control variables are generally consistent with prediction and prior research.

These results in Table 2 imply that the information content of analyst forecast revisions is not diluted by market responses to the previous insider trading. Instead, investors value financial analysts' interpretation of insider trading activities and consider these forecast revisions as containing more information than revisions without previous insider trading activities. This is in line with Livnat and Zhang (2012) that on average, investors value analysts' information interpretation role more than their information discovery role.

Market Responses to Subsequent Analyst Forecast Revisions: Confirmation or Confliction

While the previous results show that investors value analysts' interpretation of insider trading signals, it remains unclear whether investors' response to the interpretation depends on the direction of analysts' interpretation (that is, how analysts interpret the insider trading signals). Accordingly, we estimate Model (2) and report the results in Table 3.

We first present in Panel A of Table 3 the univariate analyses. We report the excess stock returns for the 10 deciles with analyst forecast revisions in the same or opposite directions of the previous net insider trading, respectively. It is evident from the panel that confirming analyst forecast revisions receive stronger market responses than conflicting revisions. For example, within the lowest decile, confirming revisions have an average excess return of -5.2%, while conflicting revisions have an average excess return of -4.1%. Similarly, within the highest decile, confirming revisions have an average excess return of 3.4%, while conflicting revisions have an average excess return of 3.0%. It should also be noted that confirming revisions on average receive stronger market responses than revisions not following insider trading activities do. However, conflicting revisions only receive stronger market responses than revisions not following insider trading in the highest decile, but receive less strong market responses in the lowest decile. This suggests that our earlier results in Table 2 about stronger market reactions to analyst revisions following insider trades relative to other revisions are likely driven by confirming revisions, or revisions whose sign agree with the sign of the prior insider trading signal.

Panel B of Table 3 presents regression analyses of Model (2). The coefficient on RREV is 0.056 and significantly positive. This serves as the benchmark case and suggests that analyst forecast revisions without preceding insider trading activities receive significant market responses of about 5.6% on the hedge portfolio of the top minus bottom decile of analyst

revisions. Consistent with Panel A, the coefficient on the interaction between RREV and CONFIRM is 0.012 and significantly positive, suggesting investors react more strongly to forecast revisions when the revisions are in the same direction as previous insider trading. This is an additional 1.2% of market reaction on the hedge portfolio, an increase of more than 20% when compared to the "benchmark" revisions (i.e., revisions without previous insider trading activities).

On the other hand, the interaction term between RREV and CONFLICT is significantly negative at -0.005, suggesting that investors discount analysts' interpretation if the forecast revisions are in the opposite direction of the previous insider trading signal relative to benchmark forecast revisions. Additional tests show that the sum of the coefficients on RREV and RREV*CONFLICT is positive and statistically significant. Thus, even when analysts' signals are in the opposite direction to insiders' signals, investors do not completely ignore these revisions. Overall, it appears that they respond to a weighted average of the analysts' and the insiders' signals. When the two agree, the market reaction to the revision is stronger than benchmark revisions. When they disagree, although the market reactions to the signal are still positive and significant, they are weaker than to the benchmark revisions that do not follow insider trading. These results are consistent with prior studies (Livnat and Zhang 2011) that investors value analysts' interpretation of corporate information.

Market Responses to Subsequent Analyst Forecast Revisions: Purchases vs Sales

While the results in Table 3 focus on conflicting and confirming analyst forecast revisions, they also shed light on possible differential market responses to revisions conditional on whether the previous insider trading is a sell or a buy signal. For example, Panel A of Table 3

shows that when the revision is in the lowest decile and in the same direction as the previous insider selling signal, or in the highest decile and in the opposite direction as the previous insider trading signal, the market responses are stronger than revisions without previous insider trading activities. To the extent that these revisions follow insider sales, this suggests that investors particularly value analysts' interpretation of insider sales. To directly test this conjecture, we include SALE and PURCHASE indicator variables and their interaction terms with RREV in our baseline model and estimate the coefficients.

Table 4 presents these results. Consistent with our conjecture, the interaction term between SALE and RREV has a significantly positive coefficient, while the coefficient on the interaction term between PURCHASE and RREV is statistically insignificant. Thus, when insiders sell, subsequent analyst forecast revisions lead to significantly stronger market responses whether analysts agree or disagree with the insider signal. On the other hand, when insiders buy, subsequent analyst forecast revisions do not have significantly incremental information relative to revisions without preceding insider trading.

Prior studies suggest that insider purchases are more informative than insider sales because insider sales can potentially be triggered by insiders' liquidity or diversification needs as opposed to information advantages. Thus, investors may have difficulties in differentiating between these two types of insider sales. Our results suggest that while investors value analysts' interpretation of previous insider trading activities, they particularly value their interpretation of insider sales, probably due to the ambiguity of the motives for insider sales.

4.2.International Data

Data

In this subsection, we examine the same research questions with international data. Our international insider trading data is obtained from 2iQ Research, which collects insider trading data from various sources for European and Asia-Pacific countries (see Dardas and Güttler 2011 and Dardas 2012 for further details). Our tests are based on data from January 2006 to February 2012. We define a buy transaction to include buy, subscribe, award and acquire activities. A sell transaction includes sell and dispose transactions. Similar to the domestic data, we exclude sale transactions that are associated with option exercises.[4] We focus only on equity transactions from insiders at Levels A, B or C, which will be similar to the domestic Levels 1 and 2. This includes top insiders, upper level management, non-executives board members, and excludes lower level executives, legal entities, funds and trusts, family and other relatives, partners, large shareholders, founders, investors, and family holdings. Further, we only use transactions with trade significance greater than 2. This excludes non-intentional or mechanical transactions, awards shares, tax-related transactions, remuneration, share plan purchases, or cases where there is no change in beneficial holdings such as a share transfer to a spouse.

Our international analyst forecast data is obtained from IBES International. We use exactly the same procedure as in our domestic analyses to measure RREV and other analyst-related variables.[5] For each analyst revision date, we first aggregate all transacted shares by a specific insider over the prior 180 days, time-weighting the number of shares bought/sold. Specifically, the number of shares for a particular date t-k (i.e., k days prior to the revision date t) relative to revision date t is multiplied by [1-(t-(t-k))/180] or (1-k/180). Thus, recent transactions are weighted more heavily than older transactions. We then aggregate the time-weighted number

[4] The inferences are unchanged if we include these transactions.
[5] The only exception is that we use the actual preliminary announcement date of earnings from IBES, as opposed to those from Compustat domestically.

of shares bought/sold over all insiders. We set INSIDER, CONFIRM, CONFLICT, SALE, and PURCHASE indicator variables as before. To determine excess returns for international firms, we follow these steps:

1. We obtain daily returns in USD from Capital IQ on all global firms in the Capital IQ database with a price>0. These include both US and foreign firms.

2. We obtain from Charter Oak's Worldscope Point-In-Time database each month-end the firm's market value in USD (Item 7211), the most recent book value in USD (Item 7211), the most recent annual cash from operations per share (Item 5510), price per share (Item 5006), the four-week price trend (return without dividends, Item 9005), and the 52-week price trend (Item 9026).

3. For each month end, we calculated book/market (BM) as the book value to market value if book value was positive and market value was greater than $10 million, the cash flow yield as CFO/price if price was greater than 0.001, and momentum as

[(1+52week price trend/100)/(1+4week price trend/100)-1]

4. For each daily return, we match the firm Sedol with the Sedol of the characteristics from Charter Oak's PIT Worldscope database of the immediately preceding month. We require that data would be available on all of the characteristics -- B/M, Size (market value in USD), Momentum and cash flow yield.

5. Each day, we rank firms into 3 groups for each of the four characteristics. We use two specifications of the excess returns, one based on size, B/M and momentum, and the other on size, cash flow yield and momentum. The latter is because of Hou et al (2011). We calculate a value-weighted average return for each 3-charcteristic portfolio.

6. Buy and hold excess returns on a stock are the buy and hold return on the stock minus the value-weighted average return of the portfolio with the same three characteristics (size, momentum and B/M or cash flow yield).[6]

Empirical Results

Similar to our domestic analyses, we first examine the excess returns subsequent to insider sale and purchase transactions over the 30-day window. As reported in Table 5, on average, there are 1478 net purchase position and 904 net sale position. This is in contrast to our domestic result in that there are more net purchases than net sales in our international data. This likely reflects the weaker emphasis on stock-based compensation outside of the US, as well as the closer concentration of owner-managers outside of the US. The excess return is on average (based on 74-month observations) 2.2 basis points (t=0.04, p=0.97) on the long portfolios and 75 (t=1.40, p=0.17) on the short portfolios. On average, a hedge strategy based on our international insider trading data earns a statistically significant 77-basis point return on a calendar month basis (t=1.98, p=0.05). Thus, more of the hedge return comes from the short positions, again in contrast to our domestic result, possibly because sale transactions outside of the US are less common and may be more likely driven by new information rather than diversification or liquidity needs. Nevertheless, we find the insider trading signal to be effective in predicting future returns, indicating that investors do not fully react to the insider trading of foreign firms.

Table 6 Panel A presents market responses to decile portfolios based on analyst forecast revisions. The average excess returns on the lowest decile is -1.4% and on the highest decile is

[6] When we use cash flow/price instead of B/M as benchmark returns, our inferences are unchanged.

1.1%. These numbers are substantially smaller than their domestic counterparts (-4.6% and 2.9% respectively) in Table 2 Panel A. We also present average excess returns for these decile portfolios conditional on the presence of previous insider trading activities. In contrast to domestic results, there are little differences in excess returns between revisions with and without previous insider trading. In the highest decile, the average excess returns are 1.0% and 1.1% respectively. In the lowest decile, the average excess returns are both -1.4%.

In Panel B of Table 6, we estimate Model (1) using the international data. It is again evident from this panel that analyst forecast revisions in our European and Asian sample receive significantly lower market responses than our US sample. The coefficient on RREV is positive and statistically significant of 0.023, which is smaller in magnitude than the 0.056 documented for the domestic data in Table 2 Panel B. The coefficient on the interaction term between RREV and INSIDER is 0.002, and only marginally significant (p=0.10).

The effects of the control variables are generally similar to our earlier domestic results. In particular, we find significantly positive coefficient on PROMPT, suggesting that the US results documented in Livnat and Zhang (2002) also hold for international data. That is, investors respond more strongly to analyst forecast revisions made immediately after earnings announcements than other revisions. As discussed in Livnat and Zhang (2012), to the extent that prompt revisions are more likely to reflect analysts' information interpretation role, our results suggest that in the international setting, investors also place greater value on analysts' interpretation role than discovery role. Also consistent with Livnat and Zhang (2012) for the domestic analyst revisions, size and B/M are negatively associated with the market responses to analyst revisions as is the number of companies covered by the analyst. Also consistent with the domestic evidence, we find that the analyst experience, the size of the brokerage house and

whether the revision is innovative are all positively associated with the market reactions to the analyst revisions.

Overall, our results in Table 6 show that while there is some incrementally stronger market responses to analyst forecast revisions following insider trading activities relative to other analyst forecast revisions, the differences are small in both magnitude and statistical significance compared to our US results. This relatively weaker result may be attributable to shorter span of the international data and smaller sample sizes.

We next examine the differential market responses to confirming and conflicting analyst forecast revisions. The results are presented in Table 7. In univariate analyses, we find that within the lowest decile, conflicting revisions have lower excess returns than other revisions, while within the highest decile, confirming revisions have higher excess returns than other revisions. This result does not suggest that confirming revisions are necessarily considered more informative by investors than non-confirming revisions, unlike our domestic results.

We examine this issue more comprehensively by estimating the regression model where we control for other factors that affect market responses to analyst forecast revisions. In Panel B of Table 7, we find that the coefficient on RREV is 0.023 and significantly positive. The coefficient on the interaction term between RREV and CONFIRM is significantly positive at 0.006 (about 25% higher than analyst revisions that do not follow insider transactions), while that on the interaction term between RREV and CONFLICT is statistically insignificant. This result is consistent with our domestic findings, suggesting that when analysts agree with insiders, the market responds more strongly to their forecast revisions. When analysts disagree with insiders, the market treats these revisions as containing similar amount of information content to those revisions without previous insider trading activities.

Finally, we examine whether there are differences in market responses to analyst forecast revisions subsequent to insider net sales versus insider net purchases. The results are presented in Table 8. The coefficients on the interaction terms of RREV with PURCHASE and SALE are both 0.002. However, it is marginally significant for the interaction term with PURCHASE and insignificant for the interaction term with SALE. This result is in contrast to our domestic findings where analysts' interpretation of insider trading is more important for sale transactions than for purchase transactions. It seems that in the US, insider purchase is on average a more informative signal (than insider sale) and therefore investors do not need analysts' assistance in interpreting this signal. Outside the US, however, insider sale is on average more informative than insider purchase. This is an interesting phenomenon that we leave for future research to examine.

5. Conclusion

In this study we provide global evidence on the implications of insider trading activity for market responses to subsequent analyst forecast revisions. We find that for both US data and international data, analyst forecast revisions following insider trading activities are more informative than other analyst forecast revisions, as illustrated by stronger market responses. Further analyses show that this stronger market response is primarily driven by analyst forecast revisions that are in the same direction as in the previous insider trading signal. We also find that the US results are stronger for analyst forecast revisions following insider sales while the international results are stronger for revisions following insider purchases.

Our results suggest the importance of analysts in interpreting insider trading information.

Our study also provides new evidence on the characteristics of international insider trading activities. Prior evidence on this is scarce probably due to the limited data availability. Our analyses highlight a few differences between US and international results that may be fruitful for future research.

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Appendix

Variable Name	Definition
RREV	The revised forecast minus the same analyst's previous forecast for the same forecast period deflated by stock price as of the end of the month prior to the forecast revision. RREV is the decile rank of this variable by calendar month deflated by 9 minus 0.5.
INSIDER	1 if there is at least one insider transaction from the previous earnings announcement date (that is at least 30 days and at most 180 days prior to the revision date) to one day before the revision date, and 0 otherwise. For international data, it is 1 if there is at least one insider transaction in the previous 180 days.
SALE	1 if there is net insider sale in the window described in INSIDER, and 0 otherwise. Net insider trading is based on time-weighted insider trading transactions aggregated over all insiders.
PURCHASE	1 if there is net insider purchase in the window described in INSIDER, and 0 otherwise. Net insider trading is based on time-weighted insider trading transactions aggregated over all insiders.
CONFLICT	1 if the sign of RREV is opposite of the sign of the net insider trading in the window described in INSIDER, and 0 otherwise.
CONFIRM	1 if the sign of RREV is the same as the sign of the net insider trading in the window described in INSIDER, and 0 otherwise.
XRET	Buy-and-hold excess return over the three trading days (-1, 0, 1) centered on the analyst forecast revision (day 0). Excess returns are measured over matched size, book-to-market, and momentum portfolios. See the text for details of the construction of benchmark portfolios.
PROMPT	1 if there is an earnings announcement within three trading days prior to the revision, and 0 otherwise.
BM	Book-to-market ratio as of the end of the month prior to the revision. Book value is from the Point-In-Time Quarterly Compustat database.
EXP	Analyst experience in terms of number of days since the analyst's first EPS forecast on IBES.
NUMFIRM	Number of firms the analyst covers as of the end of the month prior to the revision.

BROKER	Size of the employing brokerage house measured as the number of individual analysts as of the end of the month prior to the revision.
HORIZON	Number of days from the revision until the corresponding forecast period end.
INNOVATIVE	1 if the analyst's revision moves away (relative to his/her previous forecast) from the consensus, and 0 otherwise. Consensus is the mean analyst forecast over the prior 365 days, where only the most recent forecast is retained for each analyst.

Table 1 Insider Trading and Future Excess Returns: US Data

	Months	Ave. # of Firms	30-day Ave. Excess Returns	t-stat	p-value
Long	190	833	0.165	2.49	0.01
Short	190	1439	0.055	0.66	0.51
Hedge	190		0.220	2.53	0.01

This table presents average excess returns over the 30-day window after calendar month end for short, long, and hedge portfolios from January 1996 to October 2011. Short (long) portfolio includes all firm-months that have net insider sale (purchase) activities.

Table 2 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: US Data

Panel A Univariate Analyses

	N			Average Excess Returns		
Decile	All	Insider=0	INSIDER =1	All	INSIDER=0	INSIDER =1
0	129215	87137	42078	-0.046	-0.045	-0.047
1	129316	79101	50215	-0.031	-0.03	-0.034
2	129311	76158	53153	-0.022	-0.02	-0.024
3	129297	72733	56564	-0.015	-0.014	-0.016
4	129263	68735	60528	-0.007	-0.007	-0.007
5	129300	66620	62680	0.003	0.003	0.004
6	129396	67575	61821	0.011	0.011	0.011
7	129342	69830	59512	0.018	0.017	0.02
8	129318	73021	56297	0.024	0.023	0.025
9	129238	80286	48952	0.029	0.027	0.031
Hedge				0.075	0.072	0.078
All		741196	551800	-0.004	-0.004	-0.002

Panel B Regression Analyses

	Est.	t-stat	p-value
Intercept	-0.008	-4.1	<.0001
RREV	0.056	8.32	<.0001
RREV*INSIDER	0.006	4.67	<.0001
RREV*PROMPT	0.047	23.58	<.0001
RREV*SIZE	-0.007	-15.88	<.0001
RREV*BM	-0.009	-7.24	<.0001
RREV*EXPERIENCE	0.002	5.55	<.0001
RREV*COVER	-0.011	-15.57	<.0001
RREV*BROKERSIZE	0.007	18.05	<.0001
RREV*HORIZON	0.001	0.72	0.4744
RREV*INNOVATE	0.018	18.77	<.0001
INSIDER	-0.001	-3.13	0.002
PROMPT	-0.002	-5.01	<.0001
SIZE	0.001	8.62	<.0001
BM	-0.008	-16.1	<.0001
EXPERIENCE	0.000	1.25	0.2124
COVER	0.001	4	<.0001
BROKERSIZEL	-0.001	-9.98	<.0001
HORIZONL	0.000	1.99	0.0483
INNOVATIVE	0.000	0.78	0.4345
R_Squared	0.113	31.67	<.0001

Panel A reports average 3-day excess returns on deciles of analyst forecast revisions. Panel B reports Fama-Macbeth regression estimates based on 190 OLS monthly regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.

Table 3 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: Conflicting vs. Confirming Revisions in US Data

Panel A Univariate Analyses

	N			Average Excess Return		
	INSIDER=0	CONFIRM=0	CONFIRM=1	INSIDER=0	CONFIRM=0	CONFIRM=1
0	87137	19442	22636	-0.045	-0.041	-0.052
1	79101	18453	31762	-0.03	-0.025	-0.039
2	76158	17415	35738	-0.02	-0.018	-0.027
3	72733	17971	38593	-0.014	-0.011	-0.019
4	68735	28344	32184	-0.007	-0.002	-0.012
5	66620	42250	20430	0.003	0.006	-0.001
6	67575	46555	15266	0.011	0.012	0.009
7	69830	45473	14039	0.017	0.02	0.018
8	73021	41619	14678	0.023	0.025	0.026
9	80286	32932	16020	0.027	0.03	0.034
Hedge				0.072	0.071	0.086
All	741196	310454	241346	-0.004	0.006	-0.013

Panel B Regression Analyses

	Est.	t-stat	p-value
Intercept	-0.008	-4.08	<.0001
RREV	0.056	8.24	<.0001
RREV*CONFIRM	0.012	4.69	<.0001
RREV*CONFLICT	-0.005	-3.5	0.0006
RREV*PROMPT	0.046	23.63	<.0001
RREV*SIZE	-0.007	-16.15	<.0001
RREV*BM	-0.008	-6.98	<.0001
RREV*EXPERIENCE	0.002	5.78	<.0001
RREV*COVER	-0.011	-15.36	<.0001
RREV*BROKERSIZE	0.007	18.02	<.0001
RREV*HORIZON	0.001	0.9	0.3718
RREV*INNOVATE	0.018	19.11	<.0001
CONFIRM	-0.004	-7.8	<.0001
CONFLICT	0.003	5.72	<.0001
PROMPT	-0.003	-5.06	<.0001
SIZE	0.001	8.7	<.0001
BM	-0.008	-16.27	<.0001
EXPERIENCE	0.000	1.1	0.2713
COVER	0.001	4	<.0001
BROKERSIZEL	-0.001	-10.06	<.0001
HORIZONL	0.000	2.12	0.0354
INNOVATIVE	0.000	0.19	0.8511
R_Squared	0.116	32.21	<.0001

Panel A reports average 3-day excess returns on deciles of analyst forecast revisions. Panel B reports Fama-Macbeth regression estimates based on 190 OLS monthly regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.

Table 4 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: Net Sales vs. Net Purchases in US Data

Intercept	-0.008	-4.17	<.0001
RREV	0.056	8.24	<.0001
RREV*PURCHASE	-0.003	-2.23	0.0268
RREV*SALE	0.012	7.27	<.0001
RREV*PROMPT	0.046	23.59	<.0001
RREV*SIZE	-0.007	-16.04	<.0001
RREV*BM	-0.008	-7.09	<.0001
RREV*EXPERIENCE	0.002	5.78	<.0001
RREV*COVER	-0.011	-15.43	<.0001
RREV*BROKERSIZE	0.007	18.02	<.0001
RREV*HORIZON	0.001	0.83	0.4084
RREV*INNOVATE	0.018	19.32	<.0001
PURCHASE	0.003	5.85	<.0001
SALE	-0.003	-7.12	<.0001
PROMPT	-0.002	-5.04	<.0001
SIZE	0.001	9.05	<.0001
BM	-0.008	-16.54	<.0001
EXPERIENCE	0.000	1.12	0.2648
COVER	0.001	3.84	0.0002
BROKERSIZEL	-0.001	-10	<.0001
HORIZONL	0.000	1.94	0.0534
INNOVATIVE	0.000	0.68	0.4978
R_Squared	0.116	32.3	<.0001

This table reports Fama-Macbeth regression estimates based on 190 monthly OLS regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.

Table 5 Insider Trading and Future Excess Returns: International Data

	Months	Ave. # of Firms	30-day Ave. Excess Returns	t-stat	p-value
Long	74	1478	0.022	0.04	0.97
Short	74	904	0.750	1.40	0.16
Hedge	74		0.772	1.98	0.05

This table presents average excess returns over the 30-day window after calendar month end for short, long, and hedge portfolios from January 2006 to February 2012. Short (long) portfolio includes all firm-months that have net insider sale (purchase) activities.

Table 6 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: International Data

Panel A Univariate Analyses

	N			Average Excess Returns		
Decile	All	Insider=0	INSIDER =1	All	Insider=0	INSIDER =1
0	79427	55646	23781	-0.014	-0.014	-0.014
1	79468	59776	19692	-0.01	-0.01	-0.012
2	79472	58280	21192	-0.008	-0.007	-0.009
3	79465	56382	23083	-0.005	-0.004	-0.007
4	79183	55990	23193	-0.002	-0.002	-0.003
5	79784	55882	23902	0.001	0.001	0.001
6	79431	55839	23592	0.005	0.005	0.004
7	79465	57184	22281	0.008	0.008	0.008
8	79475	59068	20407	0.01	0.01	0.010
9	79428	54671	24757	0.011	0.011	0.010
Hedge				0.025	0.025	0.024
All	794598	568718	225880	0	0	-0.001

Panel B Regression Analyses

	Est.	t-stat	p-value
Intercept	0.002	0.86	0.3908
RREV	0.023	5.77	<.0001
RREV*INSIDER	0.002	1.67	0.099
RREV*PROMPT	0.025	13.39	<.0001
RREV*SIZE	-0.005	-17.16	<.0001
RREV*BM	-0.004	-4.89	<.0001
RREV*EXPERIENCE	0.002	6.98	<.0001
RREV*COVER	-0.002	-2.42	0.0181
RREV*BROKERSIZE	0.003	10.12	<.0001
RREV*HORIZON	0.002	5.07	<.0001
RREV*INNOVATE	0.011	12.92	<.0001
INSIDER	-0.001	-1.92	0.0588
PROMPT	-0.001	-0.78	0.4374
SIZE	0.000	-1.68	0.0983
BM	0.000	-0.99	0.3253
EXPERIENCE	0.000	0.67	0.5065
COVER	0.000	0.37	0.7115
BROKERSIZEL	0.000	-1.6	0.1131
HORIZONL	0.000	0.97	0.3335
INNOVATIVE	-0.001	-2.96	0.0042
R_Squared	0.028	17.73	<.0001

Panel A reports average 3-day excess returns on deciles of analyst forecast revisions. Panel B reports Fama-Macbeth regression estimates based on 74 monthly OLS regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.

Table 7 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: Conflicting vs. Confirming Revisions in International Data

Panel A: Univariate Analyses

	N			Average Excess Return		
	INSIDER=0	CONFIRM=0	CONFIRM=1	INSIDER=0	CONFIRM=0	CONFIRM=1
0	55646	16527	7254	-0.014	-0.015	-0.012
1	59776	12923	6769	-0.01	-0.011	-0.012
2	58280	13335	7857	-0.007	-0.008	-0.011
3	56382	14011	9072	-0.004	-0.007	-0.007
4	55990	13660	9533	-0.002	-0.003	-0.003
5	55882	13759	10143	0.001	0.001	0.001
6	55839	11896	11696	0.005	0.003	0.005
7	57184	9721	12560	0.008	0.007	0.009
8	59068	7895	12512	0.01	0.009	0.01
9	54671	8945	15812	0.011	0.007	0.013
Hedge				0.025	0.022	0.025
All	568718	122672	103208	0	-0.003	0.002

Panel B: Regression Analyses

	Est.	t-stat	p-value
Intercept	0.002	0.82	0.4131
RREV	0.023	5.8	<.0001
RREV*CONFIRM	0.006	3	0.0037
RREV*CONFLICT	-0.001	-0.6	0.5536
RREV*PROMPT	0.025	13.34	<.0001
RREV*SIZE	-0.005	-17.33	<.0001
RREV*BM	-0.004	-4.89	<.0001
RREV*EXPERIENCE	0.002	7.03	<.0001
RREV*COVER	-0.002	-2.47	0.016
RREV*BROKERSIZE	0.003	10.13	<.0001
RREV*HORIZON	0.002	5.09	<.0001
RREV*INNOVATE	0.011	13.04	<.0001
CONFIRM	-0.001	-2.43	0.0178
CONFLICT	-0.001	-2.02	0.0472
PROMPT	-0.001	-0.78	0.4373
SIZE	0.000	-1.56	0.1222
BM	0.000	-1.09	0.2793
EXPERIENCE	0.000	0.65	0.5163
COVER	0.000	0.39	0.6943
BROKERSIZEL	0.000	-1.65	0.1042
HORIZONL	0.000	0.96	0.3402
INNOVATIVE	-0.001	-2.91	0.0048
R_Squared	0.029	18.14	<.0001

Panel A reports average 3-day excess returns on deciles of analyst forecast revisions. Panel B reports Fama-Macbeth regression estimates based on 74 monthly OLS regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.

Table 8 Insider Trading and Market Responses to Subsequent Analyst Forecast Revisions: Net Sales vs. Net Purchases in International Data

	Est.	t-stat	p-value
Intercept	0.002	0.84	0.4015
RREV	0.023	5.77	<.0001
RREV*PURCHASE	0.002	1.64	0.1045
RREV*SALE	0.002	1.08	0.2828
RREV*PROMPT	0.025	13.37	<.0001
RREV*SIZE	-0.005	-17.37	<.0001
RREV*BM	-0.004	-4.95	<.0001
RREV*EXPERIENCE	0.002	6.99	<.0001
RREV*COVER	-0.002	-2.45	0.0166
RREV*BROKERSIZE	0.003	10.13	<.0001
RREV*HORIZON	0.002	5.07	<.0001
RREV*INNOVATE	0.011	13.03	<.0001
PURCHASE	0.000	-0.07	0.9442
SALE	-0.002	-4.03	0.0001
PROMPT	0.000	-0.76	0.4517
SIZE	0.000	-1.6	0.1131
BM	0.000	-1.11	0.27
EXPERIENCE	0.000	0.66	0.5129
COVER	0.000	0.43	0.6678
BROKERSIZEL	0.000	-1.65	0.1026
HORIZONL	0.000	0.93	0.3546
INNOVATIVE	-0.001	-2.96	0.0042
R_Squared	0.029	18.13	<.0001

This table reports Fama-Macbeth regression estimates based on 74 monthly OLS regressions, where the dependent variable is XRET. See the Appendix for detailed variable definitions.