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Sell-side analyst heterogeneity and insider trading☆

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ABSTRACT

This study explores insider trading patterns under different earnings surprises. After controlling for stock market liquidity and earnings announcements returns, we show that insiders sell more aggressively depending on the heterogeneity of analysts whose EPS forecasts are met or beaten to camouflage their trades. Specifically, insiders sell more shares of their company sooner after the publication of earnings when top analysts' forecasts are met or beaten. Consistent with the informed trading literature, insiders strategically select these moments because the stock price impact is low and the legal scrutiny of their trades is minimal. To support this result, we employ an exogenous drop in firms' analyst coverage due to the closure or merger of brokerage houses. Furthermore, in line with the camouflage incentives, by selling after top analysts' forecasts are met or beaten, stock prices adjust slowly to insider trades. Finally, we show that the incentives of insiders to hide their trades are concentrated in opportunistic insiders and members of the top management team, who are more likely to bear the costs of selling shares after positive news.

1. Introduction

Corporate insiders, that is, officers, directors or beneficial owners of publicly traded companies are usually considered informed investors since they have access to private information about their firms. Insiders know their companies better than any analyst in the market, so their trades are still very controversial. Consequently, insider trading regulation in the US has tightened over time and insiders are now allowed to trade only in periods when information asymmetry between them and outside investors decreases significantly (Berkman et al., 2009; Brochet, 2010).[1] They are prohibited from trading before certain events when they are likely to possess undisclosed material information (Bettis et al., 2000; Lee et al., 2014). Additionally, many companies have expanded their own insider trading bans so that they allow their managers and directors to trade only during short windows immediately after quarterly

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[1] The Sarbanes-Oxley Act, which took effect in August 2002, further tightens the reporting requirements associated with insider transactions (Brochet, 2010). Insiders are now required to report their trades within two business days after trading.

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earnings announcements (Lee et al., 2014). As a result, insider trading, especially insiders' sales, is concentrated shortly after earnings announcements (Lee et al., 2014; Huddart et al., 2007).[2]

Questions arise regarding whether insiders are still able to use information to their advantage and the consequences of their trading for information dissemination in the stock markets (Lee et al., 2014). Insiders are investors who hold undiversified portfolios; therefore, a large fraction of their trades are undertaken for liquidity or diversification (Lakonishok and Lee, 2001; Jeng et al., 2003; Brochet, 2010; Cohen et al., 2012). However, even if their trades are not driven by material non-public information, by selling after earnings announcements, insiders face costs that could make them to consider more carefully when the time is right to trade.

Insiders are required by law to disclose all their trades in a timely manner, and there is a general perception that the disclosure reveals economically valuable private information of insiders. As the Securities and Exchange Commission admits, "many investors believe that reports of directors' and executive officers' transactions in company equity securities provide useful information as to management's views of the performance or prospects of the company." Consequently, by selling after earnings announcements, insiders could be sending an undesired negative signal to the market (Marin and Olivier, 2008), which results in a negative market reaction to their trades.[3] This reaction could, in turn, significantly affect insiders' decision to trade. Managers care about short-term stock prices, especially after earnings announcements, because new equity issues typically occur in the weeks following earnings news (Richardson et al., 2004).[4] Additionally, executives care about stock price performance since they usually receive grants and awards in the form of stocks and/or stock options (Bennett et al., 2017; Burns and Kedia, 2006); therefore, part of their compensation is linked to the performance of their firm's stocks in the short and long run.

In this study, we propose that insiders use another source of information advantage to trade on public information. We argue that insiders base their trading decision after the earnings announcements on the quality of analysts making forecasts. We hypothesize that insiders, *ex ante* the publication of earnings, identify a subset of analysts (top analysts) who attract more attention from less informed investors and trade against the surprise generated by these analysts' forecasts to hide their profitable sales. In the spirit of the Collin-Dufresne and Fos (2016) model, insiders' optimal strategy is to trade more aggressively at moments when they know that their trades will have little impact on their firms' stock prices, that is, when the abnormal volume is higher and the price impact is lower.[5] We argue that firms beating top analysts' forecasts offer insiders the perfect camouflage to do so.

In order to complement our main finding, we also analyze the effect of this insider trading strategy on information dissemination in the stock market. We argue that insiders choose to sell when top analysts are beaten to reduce the negative impact that their trades can have on their firm's stock prices and, as result of this trading strategy, stock prices adjust slowly to their trades. This is line with Kyle (1985) model and others that follow, when informed traders effectively camouflage their trades behind less informed investors, their private information is incorporated into stock prices gradually.

Our main hypothesis is based on the assumption that insiders are familiar with the analysts following and making forecasts for their firm. Recent empirical evidence shows that this is actually true. Analysts constantly try to develop closer relationships with the management in order to obtain and produce valuable information about the firm for their clients (Soltes, 2014; Green et al., 2014). Private interactions and public meetings, such as conference calls, are opportunities where managers can easily recognize analysts who ask questions and share their views about the firm. In fact, Mayew (2008) shows evidence of management discrimination among analysts during earnings conference calls. Managers use their discretion to discriminate among analysts by giving privileged access to meetings and permission to more favorable analysts to ask questions.[6]

Focusing on US publicly traded firms in the period after earnings announcements from 2003 to 2016, our first main finding is that insiders sell a larger fraction of their company's stocks after the publication of earnings when their firms meet or beat top analysts' forecasts. Additionally, meeting or beating top analysts' forecasts is a stronger determinant of insider selling, beyond moments when their firms meet or beat non-top analysts or the consensus. In particular, when testing a horse-race between meeting or beating top vs. non-top analysts or the consensus, the earnings surprise generated by top analysts is the only significant predictor of net insider sales. Also, beating top analysts remains significant even after controlling for past returns, firm size and abnormal liquidity post publication of earnings. This finding means that insider sales after earnings announcements are not random or mechanically driven by liquidity or the surprise generated by the news (positive or negative) or the magnitude of the earnings returns, but by the analysts on whom the surprise is based.[7] We also show that this trading pattern is concentrated on those insiders who trade faster after earnings news, that is,

[2] More than 50% of insider sales occur within the first month after earnings announcements (Contreras (2020); Lee et al. (2014)).

[3] Past studies show that investors react significantly to their trades, that is, insider sales (purchases) generate negative (positive) abnormal returns for their firms (Seyhun, 1986; Noe, 1999; Ke et al., 2003; Cheng et al., 2007; Brochet, 2010). Although the evidence on returns is stronger for purchases, insider sales also display a significant negative market reaction. For example, Seyhun (1986) documents that over 20 trading days following insider sales, stock prices abnormally drop by 0.9%. Brochet (2010) finds that abnormal trading volume is 1.15% higher and abnormal returns are −0.28% for insider sales filings after SOX. Ravina and Sapienza (2010) shows an average market-adjusted return on sales by officers of −0.52% on the trading day and − 0.18% from day 0 to day +30. Cohen et al. (2012) find that non-routine insider sales, which are most likely based on private information, show monthly abnormal returns of −0.95% and −0.02%, for the routine trades.

[4] In fact, Rossi and Sahlström (2019) show that insider trades around the time of equity issuances provide further information regarding whether the issue is driven by market timing or funding-related activities.

[5] In line with this argument, Brown et al. (2009) find that information asymmetry decreases significantly when firms meet or beat analysts' forecasts and they attribute these findings to an increase in the trading volume of uninformed investors.

[6] In fact, Cen et al. (2020) shows that after a management presentation, analysts who enjoy some privileges with the management have the posibility to ask first and those analysts show better career outcomes in the future.

[7] We use abnormal Amihud as a proxy for liquidity, which has also been used as a proxy for information asymmetry.

within the first 5 days after the publication of earnings.[8]

To provide further support to our main first finding, we use an exogenous change in analyst coverage and test our predictions through a quasi-experimental design. We conjecture that if insiders spot top analysts to trade, then an exogenous drop in top analysts covering their firms should reduce insiders' camouflage opportunities. To perform this test we identify exogenous reductions in analyst coverage due to closures and mergers of brokerage firms (Hong and Kacperczyk, 2010; Kelly and Ljungqvist, 2012). We find that, indeed, when top-analysts' coverage drops, insiders sell fewer shares of their companies after meeting or beating forecasts made by the top analysts that continue to follow the firm. Moreover, this pattern prevails only when top-analysts' coverage decreases but not when non-top analysts' coverage drops.

Our second main finding is related to the camouflage incentives insiders have. Our argument is that insiders trade when top analysts are beaten to minimize the negative effect of their trades on their firm's stock prices. First, in line with the costly signal, we show that post-earnings announcement returns are lower for firms when insiders sell more shares as compared to firms with lower insider selling activity. This finding means that, on average, insiders' sales are informative for the market and stock prices adjust to their trades. This is consistent with the recent evidence in Dargenidou et al. (2018), who show that insiders' contrarian trading after earnings announcements reduces the PEAD for the stock market in the United Kingdom and conclude that, indeed, insider trading provides an additional informative signal. However, in line with our conjectures, we find that stock prices adjust less to insiders sales in firms that meet or beat top analysts' forecasts. This means that when insiders attempt to camouflage their trades with top analysts, the negative impact of their sales is reduced and, as a result, these contrarian trades do not help to attenuate the PEAD.

To confirm the cost-benefit mechanism behind this insider trading strategy, we provide further tests considering different characteristics of insiders. First, we analyze whether these camouflage incentives are concentrated in opportunistic as opposed to routine insiders. Cohen et al. (2012) argue that routine insiders make seasonal trading that is not driven by superior information about their firms. Hence, in our setting, routine insiders do not need to worry about hiding their trades as opposed to opportunistic insiders who try to maximize their profits. Following Cohen et al. (2012), we classify routine insiders as the ones who trade in the same calendar month over three consecutive years and opportunistic as everyone else. In line with our conjectures, we find that only the trades of opportunistic insiders are associated with the earnings surprise generated by top analysts. In contrast, routine trades seem to be mechanically driven by the magnitude of the earnings announcement return.

Second, we analyze the role of the insider in the firm and the sensitivity of executives' compensation to changes in stock prices. We expect that if insiders seek to hide their trades by spotting top analysts, then this trading strategy should be concentrated on those insiders who are more likely to bear the costs of selling shares after very positive news. Consistent with this idea, we first find that only the CEO, the CFO and the top management team consider top analysts to place their trades after a positive surprise as opposed to other insiders (such as directors, non-top executives, other employees, etc.). Finally, we show that this trading strategy is more common in firms in which the compensation of their executives is more sensitive to variations in the stock price (higher delta and higher stock-based compensation).

We define top analysts in the spirit of the classification provided by Kirk et al. (2014) and consider five characteristics to create an index. The characteristics we employ are the following: (1) whether an analyst is classified as an "All-Star" analyst by the *Institutional Investor Magazine*; (2) whether the analyst works for a large brokerage house, such as JP Morgan or Goldman Sachs; (3) the experience at being an analyst; (4) the abnormal trading volume that their forecasts generate when they are announced; and (5) the accuracy of their forecasts. Then, we classify an analyst as top (non-top) if they are at the top (bottom) of the distribution in at least three of the five dimensions (index equal to 3).

Since our main hypothesis and empirical approach relies on different responses of investors when firms beat top and non-top analysts, we perform a test that support this assumption. We look at the market reaction to earnings announcements when top and non-top analyst's benchmarks are met or beaten and find that meeting or beating top analysts leads to an additional marginal return at the earnings announcement beyond the reaction generated by meeting or beating non-top analysts (or the analyst consensus). This result provides further support to the idea of camouflage incentives.

We are not the first to analyze insider trading patterns around earnings announcements. Past studies document the contrarian behavior of insiders when trading after the publication of earnings, showing that insiders are net sellers after positive news and net buyers after negative news (Sivakumar and Waymire, 1994; Garfinkel, 1997; Kolasinski and Li, 2010). Broadly speaking, these papers conclude that this result is consistent with insiders trading on mispricing. Other related studies are Veenman (2012) and Dargenidou et al. (2018). Both test whether insider trading helps investors to disentangle the informational content of earnings. While Veenman (2012) provides evidence that insider purchases reported in Form 4 filings help investors to learn about the valuation implications of past earnings signals, Dargenidou et al. (2018) show that insiders' contrarian trading after earnings announcements reduces the PEAD for the stock market in the United Kingdom and conclude that insider trading does indeed provide an additional informative signal.

We add to these papers by showing how insiders' motivation to sell changes depending on the source of the earnings surprise. This means that insiders selling at the earnings announcement is not driven mechanically by positive earnings surprises coming from beating analyst consensus or by the magnitude of the earnings announcement returns, but by the surprise coming from specific analysts making the forecasts. Moreover, we also provide new results on the impact of these transactions on information dissemination in the US stock exchange. We show that when insiders spot top analysts to hide their sales, investors underreact to their trades and, as a result, their transactions do not help to reduce the PEAD.

[8] Our results are robust to the inclusion of alternative measures of liquidity, firm age and institutional ownership.

We also contribute to the literature that studies the determinants of insider trading. This literature traditionally focuses on rational explanations, such as information asymmetry (Aboody and Lev, 2000; Frankel and Li, 2004), agency considerations (Ravina and Sapienza, 2010; Jagolinzer et al., 2011), or past prices (Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005). Only more recently has the literature turned to behavioral explanations of insider trading and person-specific or innate attributes that determine insider trading decisions and profits (Hillier et al., 2015; Davidson et al., 2016; Inci et al., 2017; Ali and Hirshleifer, 2017; Kallunki et al., 2018). However, little is known on whether stricter insider trading regulation has modified their trading patterns, especially during periods in which they are allowed to trade (Lee et al., 2014). We contribute to this literature by showing an alternative channel that insiders use to trade given times of stricter regulation.

Furthermore, we add new evidence to the discussion on whether insider trades are motivated by foreknowledge of future material information (Ke et al., 2003; Cheng et al., 2007; Cohen et al., 2012; Ali and Hirshleifer, 2017) or by past public information such as prices, earnings or other relevant information (Jenter, 2005; Kolasinski and Li, 2010; Alldredge and Cicero, 2015; Contreras et al., 2017). The latter papers suggest in general that insiders are better at interpreting public information or are more attentive to it than outside investors, and they use this advantage to make profitable trades. Our results are in line with this idea, but we add to this literature by showing that insiders use a specific mechanism to trade on public information, analysts' salient characteristics for investors, since they are motivated to camouflage their trades by identifying situations in which they know that their trades will have little impact on future stock price performance.

Finally, we also add to the literature on sell-side analysts and their influence on management decisions (and behavior). It is well established that managers have incentives to be rewarded by the market by consistently meeting or beating analysts' benchmarks. As a result, a number of papers show that analysts can influence firm policies (directly or indirectly), for instance, in investment decisions such as R&D or the propensity to engage in real earnings management (Bhojraj et al., 2009; Gunny, 2010; Hribar et al., 2006). We provide further evidence in line with this literature by showing that managers' trading decisions are also influenced by analysts' benchmarks. These insiders choose to trade at moments when they know that their reward is less likely to be affected, that is, when analysts' forecasts are met or beaten.

The remainder of this paper is organized as follows. Section 2 develops the main hypotheses of the paper. Section 3 describes the data and methodology. Section 4 provides summary statistics. Section 5 validates the categorization of top vs. non-top. Section 6 contains the results for the main hypotheses. Sections 7 and 8 provide further support to the main results and Section 9 concludes. Finally, variable definitions are found in Appendix A.

2. Hypothesis development

Kyle (1985) shows that a large informed trader (an insider) is motivated to camouflage trades so that any private information is gradually incorporated into stock prices. This is because market makers cannot distinguish between trades made by an informed investor from trades made by noisy traders. Consequently, an informed investor maximizes their profits when there are more noisy traders in the market. Collin-Dufresne and Fos (2016) add to Kyle's model by allowing the volatility of noise trading to change over time, and find that the optimal camouflage strategy for an insider is to trade in proportion to the undervaluation of their firm's stock prices and when the price impact is lower. In both models, price impact is measured by how much stock prices move with the order flow. Therefore, the more noisy traders there are in the order flow, the lower the price impact and the better the camouflage for insiders. In line with these theoretical predictions, Collin-Dufresne and Fos (2015) find empirically that activist shareholders (informed traders) trade more aggressively when abnormal volume is higher and price impact is lower.

One public event that usually draws attention from investors, both informed and uninformed, is the earnings announcement. On the one hand, previous studies document the contrarian behavior of insiders after earnings announcements showing that they are net sellers after positive news and net buyers after negative news (Sivakumar and Waymire, 1994; Garfinkel, 1997). On the other hand, earnings news are also attractive for less informed investors. Brown et al. (2009) show that information asymmetry decreases after positive earnings surprises and they attribute this evidence to an increase in uninformed trading volume. The rationale for this evidence is that earnings announcements attract significant attention from the financial media, making some stocks more visible to less informed investors.

The evidence above is especially true for stocks with positive earnings surprises coming from meeting or beating top analysts' forecasts. So (2013) shows that investors tend to overweight analysts' forecasts and, in our view, it is natural to think that investors focus more on those analysts with salient characteristics. Firms meeting or beating top analysts represent attractive opportunities for uniformed investors who are willing to include these stocks in their portfolios after positive earnings surprises. As in Brown et al. (2009), we conjecture that this increase in uninformed trading provides a perfect camouflage for insiders.

These camouflage incentives become even more relevant in the actual context that insiders face. Insider trading regulation in the US has tightened over time so that insiders are prohibited from trading before events when they are likely to possess material nonpublic information (Bettis et al., 2000; Lee et al., 2014). After the introduction of the Sarbanes-Oxley Act in 2002, insiders in the US are now obliged to report their transactions to the SEC no later than two days after the transaction is made. As a result, insider transactions become public information sooner than before. In fact, to avoid legal jeopardy, insiders can publicly disclose their trading plans in advance by using the 10b5-1 Rule enacted by the SEC in the year 2000.[9] Huddart et al. (2001) argue that if insiders must

[9] Jagolinzer (2009) argues that Rule 10b5-1 serves as a legal defense for insiders to claim that their trades are not driven by material nonpublic information.

disclose their trades, then they have more incentives to dissimulate by optimizing their camouflage behind uninformed (or liquidity) traders.

However, insiders have other incentives to hide. We argue that insiders face high costs when selling after earnings announcements. One source of concern for them is future stock returns after the publication of earnings. Managers or other executives have part of their compensation linked to stock price performance, and they often receive grants and awards in the form of stock and/or stock options (Bennett et al., 2017; Burns and Kedia, 2006). On top of that, managers have short- and long-term incentives (according to their compensation contracts), making it difficult for them to dynamically establish when (and how many shares) to trade.

Since insider sales could be perceived as a negative signal, trading after earnings announcements might jeopardize the value of future compensation if the stock performance is poor after the transaction is made. It is well established in the literature that when managers have linked their compensation to stock price performance and/or to accounting goals, they not only care about the short-term but also about the long-term prospects of the firm. For instance, Bennett et al. (2017) show that when managers have linked their compensation to earnings per share or revenues, the ratchet effect occurs. That is, managers are not only worried about meeting the current target goal, but they also do not want to exceed it for too long because, in the next period, they will have to meet a more demanding threshold, which can jeopardize future compensation in the form of grants or awards.

A keystone in our main hypothesis is that managers know the analysts covering the firm and can identify analysts' salient characteristics. Analysts constantly try to develop closer relationships with management in order to obtain and produce valuable information about a firm's value for their clients (Soltes, 2014; Green et al., 2014). Private interactions and public meetings such as conference calls are opportunities where managers can easily identify the analysts who are asking questions and their views about the firm. In fact, Mayew (2008) shows evidence of management discrimination among analysts during earnings conference calls. Managers use their discretion to discriminate among analysts by allowing the more favorable analysts to participate more. Along the same lines, Cen et al. (2020) show that after a management presentation, analysts who enjoy access to management can ask questions first and they have better career outcomes in the future.

Considering all of the above arguments, we conjecture that insiders spot top analysts' forecasts and sell more shares of their company's stocks when their firms beat forecasts made by these top analysts. This is because firms beating top analysts' forecasts are attractive to less informed investors, who buy more of these stocks than stocks of firms beating non-top analysts' forecasts. These moments represent ideal windows of opportunity for insiders to sell some shares of their undiversified portfolios and trade at a minimum cost. Therefore, our first hypothesis is as follows:

H1:. Insiders sell more shares of their company when their firms meet or beat top analysts' forecasts as opposed to non-top analysts in a given quarter.

To properly round out our arguments for the research question, the second hypothesis relates to post-earnings announcement returns. We argue that trading after earnings announcements involves a relevant cost for insiders. Selling after positive news could send an undesired negative signal that might hamper future stock performance. If this were the case, we would expect insider trading returns after earnings news to be lower when insiders sell intensively. However, this prediction changes when we bring top analysts into the picture. Investors assess the signal received from analysts differently depending on analysts' characteristics. For instance, Kirk et al. (2014) show that meeting or beating key analysts' forecasts is an important predictor of earnings announcement returns.

Thus, firms beating of top analysts' forecasts creates a perfect window of opportunity for insiders to hide their contrarian trading strategies. Therefore, we expect to observe two effects of insider trading on stock returns after the publications of earnings. First, in line with the cost mechanism, selling after the publication of earnings adversely affects the firm's performance, so we expect that post-earnings announcement returns are lower after insider sales. However, this cost should be lower for the sales that occur after meeting or beating top analysts' forecasts. In line with insiders camouflaging their trades, post-earnings returns should adjust less to their trading when top analysts are beaten.

H2:. Post-earnings announcement abnormal returns drop for firms with insider sales, but they drop less after these firms meet or beat top analysts' forecasts.

3. Data and methodology

We obtain corporate insider trades from Thomson Financial Insider Filing Data, which contains trades by corporate insiders required to be filed via Form 4 by Section 16 of the Securities Exchange Act of 1934. Insiders required to fill in the form are company officers (executives), directors (non-executive members of the board), and beneficial owners of more than 10% of the company's stock. We start our data set as of January 2003 to include only insider transactions that are reported under new rules of the Sarbanes-Oxley Act of 2002 regarding the timing of insider trades. The last year covered is 2016. We have information on the trading date, reporting (announcement) date, firm id, insider trading and their position within the firm, the number of shares traded, transaction price and direction of trading (purchase or sale). We exclude from our data set owners of more than 10% of the company's stock as their trading is usually less informative. We merge all transactions within one day by the same director in the same direction (purchases/sales), but we keep them if they go in a different direction even on the same day.

Our analysis is built around earnings announcements that are together with accounting information extracted from COMPUSTAT and stock returns, which are from CRSP. We denote the period between two earnings announcements as a quarter and we aggregate all insider transactions, accounting information and stock returns at this quarterly level. Fig. 1 shows our setup and timings. For each quarter, we denote the two earnings announcements at the beginning and end of the quarter as EA_0 and EA_1, respectively. The

numbering of earnings announcements then goes up from EA1 to the future and down from EA_0 to the past. During the period prior to EA_0, we capture analysts' forecasts, which are referred to EA_0, and then we classify them as coming from a top or non-top analyst. Since we also want to study whether insider trades show stock return predictability after earnings announcements, we measure abnormal returns in the period after EA_0. To do so, we define a trading response period that runs from day 0 to day +5 after EA_0.

Our main measure of insider trading activity is *net insider sales*, which is the cumulative number of shares sold minus the cumulative number of shares purchased in a given quarter as a fraction of all shares outstanding.[10] Since our sample is outlined by periods between two earnings announcement dates, we can associate all insider transactions in the Thomson Financial Insider Filing universe with this definition of quarters.[11] Note that our aggregation naturally includes quarters without insider trading as a useful and relatively well-populated data group. This is reflected in our measure of *net insider sales* when taking the value of zero.

3.1. Top versus non-top analysts

In order to test our main hypotheses, we must identify two groups of analysts: top and non-top analysts. To make this classification, we follow the spirit of Kirk et al. (2014) and use the characteristics of analysts aimed to capture their reputation and quality of earnings forecasts. However, since we want to analyze whether insiders have different trading strategies depending on the types of analysts who are making forecasts, we select attributes that are more likely to attract investors' attention. These attributes are based on 5 dimensions widely used in the literature, which are the following: 1) all-star analysts, 2) analyst tenure, 3) abnormal trading volume, 4) brokerage size and 5) accuracy.[12]

For each of these five attributes, we create binary variables that we use to identify top analysts, so the remaining group is categorized as non-top. We obtain the information from three main sources: IBES, CRSP and the *Institutional Investor Magazine*. The dimensions that we use are defined as follows:

1. All-Star Analysts (*all-star*): From *Institutional Investor* magazine, we collect the names of the top four analysts (first, second, third, and runner-up) for each industry during 1990–2016. We classify an analyst as being influential from the first year if he or she appears in the *Institutional Investor* ranking (*dummy all-star* = 1 and zero otherwise).
2. Brokerage house size (*bhouse*): Larger brokerage houses like JP Morgan or Goldman are important players in financial markets. Thus, analysts working for these brokerage houses receive more attention from investors and the media. Also, these brokerage houses are more likely to have clients who trade based on *in-house* analyst information. Other studies use the size of brokerage houses as a proxy for analysts' access to resources to produce/provide information useful to investors (Drake and Myers, 2011). Each year, we determine the size of brokerage houses according to the number of analysts they have. If the number of analysts working for the brokerage house is in the top decile of the sample distribution, we classify the brokerage house as large (*dummy bhouse* = 1 and zero otherwise).
3. Tenure (*tenure*): Analysts with a longer tenure tend to have a better reputation and more informative signals. We expect that analysts with a longer tenure attract the attention of investors more. Each year, we define analysts as experienced if they are above (below) the sample median in terms of the number of years since they first appear on IBES (*dummy tenure* = 1 if the analyst tenure is above the median and zero otherwise).
4. Abnormal Trading Volume (*tav*): Following Cooper et al. (2001), we identify leader analysts according to the abnormal trading volume (TAV) generated by their earnings forecast revisions. We identify those analysts who produce larger amount of trading in the days surrounding earnings forecast revisions (*dummy tav* = 1 and zero otherwise).
5. Accuracy (*accuracy*): Following Hong and Kubik (2003), we identify the best analysts according to their earnings forecast accuracy ($|EPS^{forecast} - EPS_{actual}|$). We rank analysts by their absolute earnings forecast errors (we do this within firm-year). Analysts with forecasts errors close to zero are the most accurate analysts. Hong and Kubik (2003) propose a score based on the number of analysts following the stock in each year. In addition, since we rank analysts within firms the forecast errors are comparable. Top-ranked analysts are those with a score value above the sample median, which is 50 based on the way in which the score is constructed (*dummy accuracy* = 1 if the analyst has a score above the median and zero otherwise).

After we match every analyst according to these five dimensions, we define a top analyst if he or she is top-ranked in at least three of the five categories. In other words, a top analyst must have at least three dummies with a value of one; otherwise, the analyst is classified as non-top. Please note that, as a result of this classification, we can have cases in which a firm does not have any top analyst for a given quarter. This is because the categorization is made at the analyst level and not at the analyst-firm level.[13]

Once we categorize the analysts, we calculate the average EPS forecast of the two groups for each firm-quarter. We employ the quarterly EPS forecasts obtained from IBES unadjusted file. Then, we create two dummy variables according to the earnings surprise: $Mbe\,top_{i,q} Mbe\,non{-}top_{i,q}$) takes the value of one when firm i in a given quarter q meets or beats top (non-top) analysts' EPS forecasts,

[10] This definition follows a number of papers, for example Seyhun (1986) or Piotroski and Roulstone (2005). Both papers compute net insider purchases and called it the purchase ratio.

[11] Most of the shares are traded by insiders within the first 20 days after the publication of earnings. We display a graph showing the distribution of net insider sales around earnings announcements in figure I.1 in the internet appendix.

[12] For more details on how theses variables impact investor reaction, please see Clarke et al. (2007), Cooper et al. (2001), Branson et al. (1998) and Hong and Kubik (2003).

[13] It is important to emphasize that for the earnings announcement of a current year, the classification of analysts is based on the analyst and brokerage house information from the previous year.

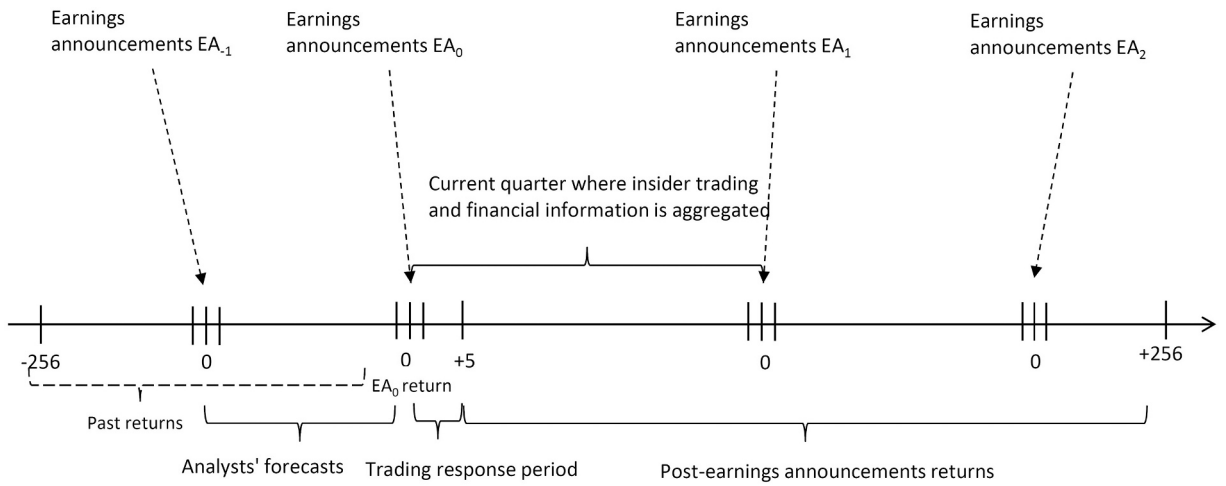

Fig. 1. Insider trading of different executives (*net insider sales*) and post-earnings announcement drift.
The figure shows the exact timings of earnings announcements and related abnormal returns relative to the current quarter with insider transactions. The current quarter is defined as the period between 2 earnings announcements. Earnings announcement abnormal returns are always computed over 3 days around the earnings announcement date. 1, 3, 6 and 12-month returns start (end) 2 days after (before) the earnings announcement.

and zero when there is at least one EPS forecast from a top (non-top) analyst and the average forecast of top (non-top) analysts is not met nor beaten. Additionally, we also identify cases when a firm meets or beats the analyst consensus (or market consensus), which is measured as the mean of all analysts' EPS forecasts for a particular firm-quarter (we require at least one analyst following the firm). Then, *Mbe* takes the value of one when firm *i* in a given quarter *q* meets or beats the analyst consensus, and zero otherwise.

Importantly, our definitions of *Mbe top* and *Mbe non-top* require at least one EPS forecast made by a top (non-top) analyst. Hence, when we include both *Mbe top* and *Mbe non-top* in the main regression, the sample contains only firm-quarter observations where we have at least one top and non-top analyst's EPS forecast. This restriction in the definition of the variables *Mbe top* and *Mbe non-top* ensures that our results are consistent with our main hypothesis.

As noted, our approach is similar to that of Kirk et al. (2014), but we differ in three aspects. First, as we mentioned above, while they focus more on attributes related to forecast precision, ours is based on the characteristics of analysts that are more salient for investors. This is because we argue that the camouflage mechanism of insiders is driven by investors' attention to certain attributes of analysts that are easy to recognize.

Second and more importantly, Kirk et al. (2014)'s measure of key analysts depends on the earnings announcements returns. The methodology they use assigns weights to the different analysts characteristics based on a regression of those characteristics against the earnings announcement returns in the previous eight quarters. Hence, by construction, *key analysts* are more likely to generate large earnings announcement returns when a firm meets or beats the key analysts' EPS benchmark. Since we know insiders are contrarian traders, a result where insiders trade more when key analysts are met or beaten could be a mechanical response by insiders to trade on large returns upon the earnings news rather than the possibility of camouflaging. Instead, we use a simpler categorization that is not driven by earnings announcement returns, which should reduce the concerns of a mechanical trading response by insiders. In our approach, all the five dimensions used have the same weight when we identify top and non-top analysts.

Finally, Kirk et al. (2014)'s methodology identifies just one "key analyst" per firm-quarter, however, this does not fit entirely with our main research question. This is because we want to clearly identify the source of the earnings surprise. In our classification we can completely differentiate two groups of analysts and compare the trading behavior of insiders when the forecasts of these two groups are beaten. In doing so, we can test whether insiders sell more shares when the top analyst benchmark is beaten after controlling for the size of earning surprises (earnings announcement returns) and the fact that non-top analysts are beaten as well.

Despite all these reasons, we test the validity of our classification in Section 5 by testing the effect of meeting or beating earnings forecasts by top and non-top analysts. Moreover, we also show that our results are similar if we follow the methodology provided by Kirk et al. (2014). We display the latter results in the Internet Appendix.

3.2. Baseline regression

To investigate the heterogeneous influence of top and non-top analysts after earnings surprises on insider trading, we estimate the following multivariate regression:

$$Y_{i,q} = \beta_0 + \beta_1 Mbe\,top_{i,q} + \beta_2 Mbe\,non-top_{i,q} + \delta' \cdot X_{i,q} + \alpha_i + \gamma_q + \varepsilon_i \quad (1)$$

where $Y_{i,q}$ is one of the following variables: *Eaar(−1,+1)* is the earnings announcement abnormal returns, which corresponds to the buy-and-hold abnormal stock returns over 3 days around the last earnings announcement date (−1,+1). *Net Insider Sales* corresponds to

the difference between the fraction of shares sold and purchased by insiders in a given quarter divided by the number of shares outstanding. *Post BHAR* is the buy-and-hold abnormal stock returns starting 6 days after the earnings announcement date and ending at different time horizons $(+6,+\tau)$. Both the earnings announcement abnormal returns and the future abnormal returns are adjusted by the corresponding 5×5 size and book-to-market portfolio as downloaded from the Kenneth French website.

Regarding control variables, referred to as X in the equation above, we include book-to-market ratio, firm size, the magnitude of earnings surprises measured as the rescaled quintile rank of unexpected earnings, called *Rue*, and the (il)liquidity measure proposed by Amihud (2002). Following Dargenidou et al. (2018) and Mendenhall (2004), we define $Rue_{i,q}$ as a variable taking the value of −0.5 when an observation belongs to the bottom quintile rank of earnings surprises, and 0.5 when an observation belongs to the top quintile rank of earnings surprises. The earnings surprise corresponds to the difference between the actual earnings per share and the mean (or median) earnings per share forecasted by analysts for a firm in a given quarter, scaled by the stock price of the firm two days before the earnings announcement (Ayers et al., 2011).

In addition, the Amihud (2002) liquidity measure is computed as the daily ratio of the absolute stock return over the dollar trading volume of the stock. In our analysis we employ the *Abnormal Amihud*, which is the average liquidity level over a specific window of time after the earnings announcement, divided by the average liquidity measure over 252 days before the earnings announcement. Importantly, as Hanselaar et al. (2019) argue, this measure closely follows the intuition of the market depth parameter in the Kyle (1985) model.

In all of our tests, we include year-quarter (γ_q) and firm (α_i) fixed effects. This is important in our setting as we want to capture the within-firm variation of the dependent variable when a firm meets or beats top analysts' forecasts as compared to cases when a firm misses these benchmarks. We also report Hubert/White robust standard errors and allow them to cluster within firms. Finally, all the variables are defined in the Appendix A.

4. Summary statistics

Table 1 displays the distribution of firm-quarters that are classified by top and non-top analysts. Panel A shows the unconditional distribution for each dummy variable. We have 106,789 firm-quarters with analysts' forecasts, in which 57,301 (approximately 54% of those quarters) are firms that meet or beat the analyst consensus of EPS forecasts (*Mbe = 1*). Note that in 84,058 firm-quarters there is at least one top analysts issuing a forecast and in 44,849, firms have met or beat their forecasts, which represents approximately 42% of the total.

Firm-quarters in which top and non-top analysts issue forecasts are quite frequent. They coincide in 83,754 quarters (78% of the total). Also, in around 39% of the firm-quarters in our sample (41,289 cases), firms beat both top analysts and non-top analysts. Similarly, in around 34% of the quarters (35,802 quarters), firms miss forecasts by both top and non-top analysts. Quarters in which firms meet or beat top analysts but miss non-top analysts are relatively rare, constituting approximately 3% of the quarters (3404 cases). And the same applies to firm-quarters in which firms beat non-top analysts but miss top analysts' forecasts (3259 cases).

In Table 2 we provide summary statistics for the main variables used throughout the analysis. Panel A displays statistics for the whole sample and Panels B and C split the sample into quarters when top and non-top analysts are met or beaten. The positive mean for *Net Insider Sales* indicates that insiders are net sellers on average. Insiders tend to sell more shares than they purchase, and this pattern is also true for the short window after the publication of earnings (0,+5). Note that the average *Net Insiders Sales* are higher in Panels B and C, which indicates that insiders sell more in quarters when firms meet or beat top and non-top analysts' forecasts. This finding reflects the contrarian nature of insiders at earnings announcements, which has been documented in the literature (Jeng et al., 2003; Sivakumar and Waymire, 1994).

Table 1
Summary statistics: Meet or beat analyst benchmarks.

		# of	Meet or beat				
		quarters	1	0			
All analysts		106,789	57,301	49,488			
Top analysts		85,058	44,849	39,209			
Non-top analyst		106,485	56,487	49,998			
		Mbe top			Mbe non-top		
		0	1	Total	0	1	Total
Mbe	0	36,610	2271	38,881	47,200	2143	49,343
	1	2599	42,578	45,177	2789	54,344	57,142
	Total	39,209	44,849	84,058	49,998	56,487	106,485
Mbe non-top	0	35,802	3404	39,206			
	1	3259	41,289	44,548			
		39,061	44,693	83,754			

This table displays the distribution of firm-quarters between top vs. non-top analysts. We define top (non-top) analysts according to five dimensions: tenure, all-star analyst, accuracy, abnormal trading volume and size of the brokerage house. The variable *Mbe* is a dummy variable that takes the value of one if a firm *i* in a given quarter meets or beats the EPS consensus of all analysts, and zero otherwise. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise.

5. Market reaction to earnings announcements under top and non-top analysts

Our empirical approach relies on the investor reaction when firms beat top and non-top earnings forecasts. Following Kirk et al. (2014), we need to test whether our classification (especially top analysts) has explanatory power over the market reaction to the earnings news. To do this, in Table 3 we test whether meeting or beating top analysts' forecasts helps to explain the earnings announcement abnormal returns beyond meeting or beating the market consensus (where we do not distinguish between top and non-top analysts). Our categorization also allows us to use both top and non-top analysts, instead of analyst consensus, because we can completely identify the two types of analysts that comprise it.

In column (1), we show the basic specification using *Mbe*, which is associated with the analyst consensus. Both the standardized earnings surprise (*Rue*) and the dummy variable indicating whether a firm meets or beats analyst consensus (*Mbe*) are positive and significant. These results confirm an important finding in the literature: investors not only respond to the magnitude of the surprise (*Rue*); they also respond positively to earnings meeting or beating analysts' forecasts. In column (3), we replicate Kirk et al. (2014)'s main result using our classification. We find that *Mbe top* and *Mbe* (market consensus) both explain the earnings announcement returns. Hence, *Mbe top* provides an additional explanatory power after controlling for the market consensus.

In columns (2) and (4) we differentiate between types of analysts, so we include *Mbe top* and *Mbe non-top*. We see that both binary variables are positive and significant individually, and they remain significantly positive even when they are included in conjunction. This means that investors consider both cases when trading on the earnings news and that both variables help to explain the market reaction to earnings announcements. Importantly, in column (4), we find that the coefficient associated with *Mbe top* is similar to the one in column (3); however, *Mbe non-top* takes the same value as the *Mbe* (market consensus) in column (3). These results suggest that, according to our classification, *Mbe top* helps to explain more the stock price reaction at the earnings announcement beyond the reaction generated by meeting or beating non-top analysts. In fact, non-top analysts are more likely to capture the surprise generated by the analyst consensus. This helps us to formulate our main hypothesis in the sense that if insiders spot top analysts to camouflage their trades, this should not be driven entirely by a mechanical response to the magnitude of the earnings announcement returns or the size of the earnings surprise.

6. Main results

6.1. Insider trading under top and non-top analysts

Table 4 contains the results that test hypothesis 1. Here we analyze whether the heterogeneity of analysts matters for insiders' decisions to trade after earnings announcements. The dependent variable in all of the specifications is *Net insider sales (NIS)*, but we differentiate by trading activity during two time windows. From columns (1) to (5), we consider *net insider sales (NIS)* over the whole quarter and from columns (6) to (10), we employ insider trading that takes place shortly after the publication of earnings (from day 0 to +5). Column (1) shows the basic specification with *Mbe* (analyst consensus of EPS forecasts) and the set of control variables explained in Eq. (1). We see that the coefficients for *Eaar*, *Rue* and *Mbe* are all positive and significant in both panels, suggesting that insiders react not only to the magnitude of earnings returns and the surprise but also to whether firms meet or beat analysts' forecasts.

In column (2) we include *Mbe top*. The coefficient of *Mbe top* is positive and significant, which means that insiders also react and sell more when their firms beat top analysts' forecasts. Interestingly, when both the unconditional *Mbe* and *Mbe top* are included, only *Mbe top* remains significantly positive, and the unconditional *Mbe* becomes insignificant. Similarly, column (3) includes *Mbe non-top* along with *Mbe*, and we see that only *Mbe non-top* remains significantly positive. Finally, in column (4) we combine the *Mbe top* and *Mbe non-top* categories together, and once more, only *Mbe top* remains positive and significant, suggesting that only the meeting or beating of top analysts' forecasts is associated with insiders' selling activities. For the sake of completeness, in column (5) we replicate the results in column (4) but we exclude firm fixed-effects and the results are the same.

The results also remain the same in columns (6)–(10) for a shorter window of insider trading. We see that the coefficient for *Mbe top* remains significantly positive in all columns, while the coefficients for *Mbe* and *Mbe non-top* decrease in magnitude and become insignificant when they are included in conjunction with *Mbe top*. *Mbe non-top* is only marginally significant in column (10) where we exclude firm-fixed effects but *Mbe top* is significantly positive and at the same magnitude as in column (9). These results suggest that insiders sell more shares of their company's stocks shortly after the earnings publications when firms meet or beat top analysts' forecasts relative to times when the non-top analyst benchmark or the consensus is beaten. Therefore, in line with our conjecture, analysts' characteristics play an important role in insiders sales. Insiders seem to consider analyst quality when trading after earnings announcements.

In summary, the results in this section are in line with our first hypothesis. Insider trades after earnings announcements are determined by the salient characteristics of the analysts making forecasts. Insiders sell more shares of their company's stock when top analysts are beaten, and this is especially true for those trades occurring closer to the earnings announcement date.

6.2. A quasi-experimental design

One concern is that our findings might be driven by firm characteristics unrelated to firms beating top analysts forecasts, which we could fail to take into account. For example, insiders might be trading on private information about a firm's future profitability that is related to beating top analysts forecasts. Moreover, reverse causality might be a problem in our setup. For instance, firms with more insider trading have a better information environment that attracts top analysts to follow their firms. To alleviate these concerns, we

Table 2
Summary statistics.

Panel A: All Sample	N	Mean	sd	p25	p50	p75
Net Insider sales (%)	106,789	0.027	0.089	0.000	0.002	0.023
Net Insider sales (0,+5) (%)	106,789	0.012	0.044	0.000	0.000	0.001
Rue	106,789	0.001	0.301	0.000	0.000	0.000
Size	106,789	7.314	1.587	6.182	7.205	8.312
B/M ratio	106,789	0.558	0.469	0.266	0.447	0.708
Abnormal Amihud	106,789	1.053	0.876	0.628	0.867	1.198
Eaar	106,789	0.003	0.067	−0.036	0.001	0.040
Post BHAR (3 months)	106,789	0.001	0.171	−0.097	−0.008	0.087
Past returns (1 year)	106,789	0.004	0.302	−0.176	−0.027	0.137
Panel B: Mbe top = 1						
Net Insider sales (%)	44,849	0.032	0.090	0.000	0.005	0.029
Net Insider sales (0,+5) (%)	44,849	0.016	0.048	0.000	0.000	0.006
Rue	44,849	0.160	0.239	0.000	0.000	0.500
Size	44,849	7.757	1.507	6.695	7.648	8.742
Abnormal Amihud	44,849	0.952	0.638	0.629	0.840	1.107
B/M ratio	44,849	0.503	0.387	0.252	0.413	0.648
Eaar (−1,+1)	44,849	0.014	0.062	−0.021	0.011	0.049
Post BHAR (3 months)	44,849	0.013	0.154	−0.076	0.005	0.093
Past returns (1 year)	44,849	0.026	0.281	−0.142	−0.005	0.152
Panel C: Mbe non-top = 1						
Net Insider sales (%)	56,487	0.034	0.096	0.000	0.004	0.031
Net Insider sales (0,+5) (%)	56,487	0.017	0.050	0.000	0.000	0.005
Rue	56,487	0.166	0.240	0.000	0.000	0.500
Size	56,487	7.425	1.566	6.300	7.299	8.415
B/M ratio	56,487	0.508	0.390	0.255	0.419	0.655
Abnormal Amihud	56,487	0.951	0.699	0.604	0.827	1.110
Eaar (−1,+1)	56,487	0.015	0.063	−0.021	0.011	0.050
Post BHAR (3 months)	56,487	0.015	0.161	−0.079	0.005	0.097
Past returns (1 year)	56,487	0.035	0.298	−0.143	−0.001	0.164

This table displays summary statistics for the main variables on a firm-quarter level. Panel A shows summary statistics for all firm-quarters in the sample and Panels B and C for quarters where firms meet or beat top and non-top analysts' forecasts, respectively. All variables are defined the Appendix A.

perform a quasi-experimental design and use a difference-in-difference approach. The identification strategy relies on the exogenous reduction of top-analyst coverage. Specifically, we employ the closure and merger of brokerage houses to test whether an exogenous reduction in top-analyst coverage affects insider trading activity after earnings announcements.[14] Our goal is to test whether an exogenous reduction in top-analyst coverage for a given firm leads to a decrease in insider sales when top analysts' earnings forecasts are met or beaten. Our conjecture is that a sudden decrease in top-analyst coverage hampers insiders' opportunity to camouflage their trades. Therefore, we should observe a lower number of shares sold after top analysts' forecasts are met or beaten.

Following Kelly and Ljungqvist (2012), we identify 32 brokerage shocks and the analysts who stopped covering firms as a consequence of a brokerage house closure or the restructuring of a merged entity.[15] Then, we keep all the analysts in the I/B/E/S details file who were working for the closed brokerage house for up to 12 months before the closure date and who do not appear in the I/B/E/S data set within twelve months after the closure date. After distinguishing the set of analysts who stopped their coverage, we identify those who were classified as top analysts before the brokerage shock. Finally, we identify top and non-top analysts who do not follow the stock for at least twelve months after the brokerage shock.[16]

As in previous studies that employ brokerage shocks, we perform a matching process to have a control group of firms with characteristics similar to the ones affected by the shocks. Using the closest neighborhood methodology (Mahalanobis distance), we match on calendar year and quarter, firm's size, book-to-market, 1-year past returns and analyst coverage (we match on quarter number 3 before the shock). Our final sample contains 619 treated firms (firms that lost either a top or non-top analyst) in which only 49 unique firms lost a top analyst. This small number of treated firms with top analysts might not be surprising since these analysts are less likely to lose their jobs after a brokerage shock, but even if they do lose their job, they are more likely to find a new one faster than non-top analysts.

Then, we use the following regression specification:

[14] See Hong and Kacperczyk (2010), Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) for more details about the brokerage closure shock.

[15] For more details, see the Kelly and Ljungqvist (2012)'s Appendix A.

[16] We say that an analyst covers a firm if she or he issues at least one EPS forecast for the firm. Similarly, we say than an analyst no longer covers the firm within the twelve months after the brokerage house closure date if no forecast is issued.

Table 3
Meet or beat EPS forecasts and stock price reaction.

Variables	(1) Eaar(−1,+1)	(2) Eaar(−1,+1)	(3) Eaar(−1,+1)	(4) Eaar(−1,+1)	(5) Eaar(−1,+1)
Rue	0.0238***	0.0241***	0.0210***	0.0206***	0.0159***
	(0.0010)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Mbe	0.0238***		0.0155***		
	(0.0006)		(0.0010)		
Mbe top		0.0213***	0.0091***	0.0108***	0.0094***
		(0.0006)	(0.0009)	(0.0008)	(0.0008)
Mbe non-top				0.0146***	0.0119***
				(0.0009)	(0.0008)
Abnormal Amihud	−0.0164***	−0.0179***	−0.0178***	−0.0179***	−0.0160***
	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0005)
Size	−0.0151***	−0.0151***	−0.0152***	−0.0151***	−0.0016***
	(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0002)
B/M ratio	0.0065***	0.0077***	0.0077***	0.0080***	0.0056***
	(0.0012)	(0.0013)	(0.0013)	(0.0013)	(0.0007)
Past returns (1 year)	−0.0186***	−0.0198***	−0.0200***	−0.0202***	−0.0189***
	(0.0009)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Constant	0.1196***	0.1278***	0.1258***	0.1256***	0.0316***
	(0.0095)	(0.0112)	(0.0112)	(0.0112)	(0.0088)
Observations	106,789	84,058	84,058	83,754	83,754
R-squared	0.0893	0.0863	0.0891	0.0897	0.0710
Firm FE	Yes	Yes	Yes	Yes	No
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes

This table displays regressions on the abnormal returns around earnings announcements over our main explanatory variables, the dummies of top and non-top analysts. The dependent variable is the earnings announcement abnormal returns, Eaar(−1,+1), which is the buy-and-hold abnormal stock return over 3 days around the last earnings announcement date (−1,+1) estimated as the difference between the observed return and the return corresponding to the 5×5 size and book-to-market portfolio as downloaded from the Kenneth French website or the market portfolio return. The main independent variables are: *Mbe*, which is a dummy variable that takes the value of one when firm *i* in a given quarter meets or beats the EPS consensus of all analysts, and zero otherwise. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in the Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

$$\begin{aligned} NIS(0{+}\tau)_{i,q} = \quad & \beta_0 + \beta_1 Treated_i \times Post_q \times Mbe\,top_{i,q} + \beta_2 Treated_i \times Post_q + \beta_3 Treated_i \times Mbe\,top_{i,q} \\ & + \beta_4 Post_q \times Mbe\,top_{i,q} + \beta_5 Treated_i + \beta_6 Post_q + \beta_7 Mbe\,top_{i,q} + \delta' X_{i,q} + \alpha_i + \gamma_q + \varepsilon_i \end{aligned} \tag{2}$$

The dependent variable, $NIS(0, +\tau)_{i,q}$, is net insider sales for firm *i* in quarter *q* during the two time windows of interest: from day 0 to 5 after earnings announcements and from day 0 to the next earnings announcements. *Treated* is a dummy variable that takes the value of 1 for firms that lost either a top or non-top analyst. *Post* is a dummy variable equal to 1 for the next 3 quarters following coverage reduction. We only consider three quarters before and three quarters after the shock for both the treated and control firms as the sample period. Our coefficient of interest is β_1, which has a triple interaction based on *Treat*, *Post* and *Mbe top*.

We report the results for the difference-in-difference specification in Table 5. In panel A, we display summary statistics to evaluate similarities between the treated and control firms. As we can see, both control and treated firms are similar (mean and median tests) in terms of size, book-to-market, 1-year past returns and coverage. Specifically, we match on coverage to ensure that our results are not driven by the difference in the number of analysts following each firm before the shock. We also match on past returns to avoid that the difference in insider sales after the shock be driven by changes in the stock return performance that affects insiders' decisions to trade. Panel B displays the regression results, columns (1) and (2) show the main test and in columns (3) and (4) we perform a placebo test. As we conjectured, β_1 is negative and significant in columns (1) and (2), which suggests that insiders sell a smaller fraction of their shares in treated firms after a drop in top-analyst coverage when the top-analyst benchmark is met or beaten, as compared to control firms. In other words, when top-analyst coverage decreases, insider chances for camouflage after positive news are reduced (although there are other top analysts making forecasts for that period).

To properly round out these findings, in columns (3) and (4) we use non-top analysts as a placebo test. If our previous results are driven only by top analysts, then we would expect that a drop in non-top analysts would not affect insider sales when top-analyst forecasts are met or beaten. In other words, a reduction in non-top analyst coverage should not affect insiders' decision to sell more after positive news coming from top analysts. In line with this argument, we find that β_1 is not statistically significant in either column. Thus, a decrease in analyst coverage does not affect insider trades after positive earnings news unless the analyst who stopped her coverage is classified as a top analyst before the shock.

These results are consistent with our first hypothesis and, in our view, provide additional support to our analyst classification. Net insider sales do not only depend on the magnitude of the earnings surprise, but also on the type of analysts and their forecasts. Hence, when firms have fewer top analysts making EPS forecasts, insiders' ability to camouflage their trades is reduced and insiders sell a lower amount of shares after beating top-analyst benchmarks. Moreover, this does not happens when there is a drop in non-top analysts coverage. We find that insider sales are not affected by the exogenous reduction in non-top analysts, suggesting that insiders do not

Table 4
Meet or beat EPS forecasts and insider trading.

Dependent variable	Net Insider Sales					Net Insider Sales (0,+5)				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Eaar(−1,+1)	0.1029***	0.0950***	0.1027***	0.0949***	0.1053***	0.0934***	0.0908***	0.0932***	0.0907***	0.0939***
	(0.0047)	(0.0051)	(0.0047)	(0.0051)	(0.0052)	(0.0026)	(0.0029)	(0.0026)	(0.0029)	(0.0029)
Rue	0.0093***	0.0083***	0.0089***	0.0081***	0.0102***	0.0030***	0.0019***	0.0028***	0.0018***	0.0025***
	(0.0014)	(0.0015)	(0.0014)	(0.0015)	(0.0017)	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0008)
Mbe	0.0011	0.0000	−0.0010			0.0014***	0.0003	0.0006		
	(0.0007)	(0.0011)	(0.0011)			(0.0003)	(0.0005)	(0.0005)		
Mbe top		0.0026**		0.0022**	0.0030***		0.0016***		0.0016***	0.0018***
		(0.0011)		(0.0009)	(0.0009)		(0.0005)		(0.0005)	(0.0005)
Mbe non-top			0.0024**	0.0006	0.0005			0.0010*	0.0004	0.0009*
			(0.0010)	(0.0009)	(0.0010)			(0.0005)	(0.0005)	(0.0005)
Abnormal Amihud	−0.0057***	−0.0060***	−0.0057***	−0.0060***	−0.0060***	−0.0029***	−0.0029***	−0.0028***	−0.0029***	−0.0035***
	(0.0005)	(0.0006)	(0.0005)	(0.0006)	(0.0005)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Size	−0.0026*	−0.0033**	−0.0027*	−0.0034**	−0.0048***	0.0028***	0.0020***	0.0029***	0.0021***	−0.0015***
	(0.0014)	(0.0015)	(0.0014)	(0.0015)	(0.0003)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0001)
B/M ratio	−0.0065***	−0.0071***	−0.0065***	−0.0071***	−0.0146***	−0.0009	−0.0014**	−0.0009	−0.0014**	−0.0075***
	(0.0014)	(0.0015)	(0.0014)	(0.0015)	(0.0010)	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0005)
Past returns (1 year)	0.0333***	0.0296***	0.0331***	0.0294***	0.0316***	0.0169***	0.0175***	0.0168***	0.0174***	0.0179***
	(0.0016)	(0.0017)	(0.0016)	(0.0018)	(0.0017)	(0.0007)	(0.0008)	(0.0007)	(0.0008)	(0.0008)
Constant	0.0656***	0.0645***	0.0650***	0.0638***	0.0624***	−0.0022	−0.0014	−0.0031	−0.0026	0.0223***
	(0.0139)	(0.0156)	(0.0139)	(0.0157)	(0.0104)	(0.0067)	(0.0068)	(0.0067)	(0.0068)	(0.0055)
Observations	106,789	84,058	106,485	83,754	83,754	106,789	84,058	106,485	83,754	83,754
R-squared	0.0556	0.0519	0.0554	0.0516	0.0604	0.0646	0.0641	0.0643	0.0637	0.0760
Firm FE	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table displays regressions on insider trading (*net insider sales*) after earnings announcements over our main explanatory variables, the dummies of top and non-top analysts. As dependent variable, we employ two measures of insider trading. First, we use the net insider sales, measured as the difference between the fraction of shares sold and bought by insiders in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter scaled by the number of shares outstanding. Second, we employ net insider sales during a short window following the earnings announcements (from day 0 to day +5), measured as the difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The main independent variables are: *Mbe*, which is a dummy variable that takes the value of one when firm *i* in a given quarter meets or beats the EPS consensus of all analysts, and zero otherwise. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

Table 5
Insider trading and brokerage shock.

Panel A: Matching stats

Variables matched	Treated Mean	Control Mean	Mean test *p*-value	Treated Median	Control Median	Median test p-value
Size	7.914	7.835	0.36	7.939	7.876	0.672
B/M ratio	0.438	0.434	0.749	0.388	0.392	0.915
Past returns (1 year)	−0.023	−0.017	0.649	−0.042	−0.035	0.672
Coverage	13.354	12.67	0.087	12	11	0.203

Panel B: DiD regressions

	Main test Treated: drop in top analyst		Placebo test Treated: drop in non-top analyst	
	(1)	(2)	(3)	(4)
Variables	NIS (0,+5)	NIS (All qrtr)	NIS (0,+5)	NIS (All qrtr)
EAAR(−1,+1)	0.1495***	0.0942	0.1324***	0.0711***
	(0.0392)	(0.0624)	(0.0132)	(0.0187)
Rue	0.0083	0.0076	0.0004	0.0078*
	(0.0132)	(0.0197)	(0.0028)	(0.0044)
Treated × Post× Mbe top	−0.0372***	−0.0420***	0.0003	−0.0024
	(0.0124)	(0.0126)	(0.0045)	(0.0074)
Treated × Post	0.0027	0.0210**	0.0001	0.0029
	(0.0114)	(0.0099)	(0.0029)	(0.0045)
Treated × Mbe top	0.0142	0.0291***	0.0009	0.0077
	(0.0106)	(0.0106)	(0.0033)	(0.0060)
Post × Mbe top	0.0286***	0.0297***	−0.0028	−0.0042
	(0.0079)	(0.0079)	(0.0033)	(0.0050)
Treated	−0.0082	−0.0161	−0.0012	0.0011
	(0.0191)	(0.0300)	(0.0024)	(0.0039)
Post	0.0121	−0.0158	0.0006	−0.0018
	(0.0106)	(0.0142)	(0.0030)	(0.0043)
Mbe top	−0.0174***	−0.0226***	0.0006	0.0005
	(0.0065)	(0.0063)	(0.0024)	(0.0043)
Abnormal Amihud	−0.0108**	0.0105	−0.0020	−0.0110***
	(0.0050)	(0.0139)	(0.0012)	(0.0037)
Size	−0.0106	−0.0068	−0.0002	−0.0207**
	(0.0157)	(0.0175)	(0.0043)	(0.0098)
B/M ratio	−0.0094	−0.0082	−0.0035	0.0007
	(0.0189)	(0.0230)	(0.0038)	(0.0074)
Past returns (1 year)	0.0243**	0.0397***	0.0182***	0.0241***
	(0.0117)	(0.0151)	(0.0035)	(0.0076)
Constant	0.1222	0.0850	0.0186	0.2054**
	(0.1466)	(0.1688)	(0.0365)	(0.0832)
Observations	539	539	5755	5755
R-squared	0.3542	0.4150	0.3234	0.3830
Firm FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes

This table displays difference-in-difference regressions on *net insider sales* after an exogenous drop in analyst coverage of their firms. The drop in analyst coverage occurs due to the closure or the merger of brokerage houses. Specifically, this table analyzes the insider trading activity at the time of earnings announcements after the shock in analyst coverage. As dependent variable, we employ two measures of insider trading. First, we use the net insider sales, measured as the difference between the fraction of shares sold and bought by insiders in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding. Second, we employ net insider sales during a short window following the earnings announcements (from day 0 to day +5), measured as the difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The main independent variables are: *Mbe top* takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. *Treated* takes the value of one when firm *i* lost an analyst due to the closure or merger of the brokerage house. The dummy variable takes the value of one for control firms in which the match was based on size, book-to-market, one-year past returns and calendar year and quarter. *Post* takes the value of one (zero) for the three quarters after (before) the shock. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

camouflage their trades behind them. Finally, the two results together indicates that our classification identifies correctly the analysts who matter for insiders.

6.3. Post-earnings announcement returns and insider trading under analysts' forecasts

Our previous results suggest that insiders strategically choose to trade on the surprise originated by top analysts, but they do not provide much insight into the reasons behind their trades. By selling after earnings announcements, insiders could be sending a negative signal to the market that can be detrimental to stock price performance. We conjecture that insiders trade more when top

analysts are beaten because they can camouflage their trades without affecting stock price performance.

In line with the signaling argument above, Dargenidou et al. (2018) study whether insider trading after earnings announcements sends an additional signal to the market that helps investors to disentangle the information content of earnings. In particular, they show that insiders' contrarian trading after earnings announcements is associated with lower post-earnings returns and they interpret this result as insider transactions helping to reduce the well-known Post-Earnings Announcement Drift anomaly (commonly known as PEAD).

In this section, we follow the setup in Dargenidou et al. (2018) to test hypothesis 2. The dependent variable in all of the specifications is post-earnings announcement abnormal returns in different time horizons. Abnormal returns are computed as the raw buy-and-hold stock return beginning t_1 and ending t_2 days after the earnings announcement date, adjusted for the corresponding 5×5 size and book-to-market portfolio return as downloaded from the Kenneth French website. For these specifications, we only focus on insider trading activity shortly after the news, that is window (0,+5), so we have a clearer timing to assess the profitability of their trades. In this respect, future returns run from day +6 until 1, 2, 3 and 6 months and 1 year after earnings announcements.

As in Dargenidou et al. (2018), our main explanatory variable is *Ctrar_Rue*, which captures the contrarian pattern of insider trading when there is a positive or negative earnings surprise. That is, *Ctrar_Rue* equals *RUE* when insiders trade (in the window (0,+5)) in a contrarian way after an earnings announcements. Specifically, *Ctrar_Rue* is equal to 0.5 when insiders are net sellers after a positive earnings surprise (top quintile rank of earnings surprise); it equals −0.5 when insiders are net buyers after a negative earnings surprise (bottom quintile rank of earnings surprise) and zero otherwise.[17]

Consistent with the main hypothesis provided by Dargenidou et al. (2018), we expect a negative association between *Ctrar_Rue* and post-earnings returns. However, in line with our camouflage mechanism, we expect this negative association to be lower for firms that meet or beat top analysts' forecasts. Regarding other explanatory variables, we include our two main categories (*Mbe top* and *Mbe non-top*) and we interact them with insider trading to evaluate our hypothesis. We also include earnings announcements abnormal returns (*Eaar*), our rescaled quintile rank of standardized earnings surprises *Rue* and past returns (1 year).

The results are in Table 6. In line with our conjectures, we observe that the coefficient for the contrarian trading *Ctrar_Rue* is negative and significant in all of the specifications, indicating that post-earnings announcement returns are lower (higher) after insiders' contrarian sales (purchases). This finding means that the market does indeed react strongly to insiders selling and that their trades exhibit a predictive power for returns (the trades are informative about the future firm value). However, it also reflects that selling is not a costless activity for insiders, especially after the publication of earnings. Secondly, the coefficient for the interaction of *Ctrar_Rue* with *Mbe top* is positive and significant in almost all of the specifications. This indicates that although returns drop after insider sales, they drop less in firms that beat top analysts' forecasts. Moreover, the same does not occur when non-top analysts are met or beaten. The coefficient associated with the interaction $Ctrar\_Rue \times Mbe non-top$ is not statistically significant, indicating that insiders do not camouflage their trades using non-top analysts.

These results show consistency with our second hypothesis. Insiders attempt to reduce the cost of their trading (camouflage) using the earnings surprises associated with top analysts' benchmarks. Also, the fact that stock returns drop after insiders' contrarian trading is in line with Dargenidou et al. (2018) conjecture, which is that these trades are informative for the market and help to reduce the PEAD. However, interestingly, we show that the same does not occur when insiders sell in firms that meet or beat top analysts' forecasts. This means that, when insiders spot top analysts to hide their sales, their transactions do not help reduce the PEAD and, as a result, these trades become less informative for investors.

7. Differentiating insiders by their roles

To provide further support to the cost-benefit mechanism, we look at different types of insiders. According to the information hierarchy hypothesis of Fidrmuc et al. (2006), insiders who are more familiar with the day-to-day operations of the company should be more inclined to camouflage their trades because they are expected to trade on more valuable information. Therefore, we expect that the costs of this insider trading strategy should be more relevant for those who care about the firm's post-earnings performance, as well as for those who are more likely to spot top analysts. These insiders should be the top management team of the firm, such as the CEO, CFO and other top executives. In contrast, we expect that those executives who are not on the front line or who are less exposed to market scrutiny trade only based on the size of the surprise. In other words, the trades made by non-top executives should be more mechanical (simple contrarian trading) and, therefore, only associated with the size of the earnings announcement returns.

To test these conjectures, we use the main regressions again but now differentiating insiders by their main roles in the firm, that is, three groups: CEO&CFO, Top Management Team and Other Executives. The Top Management Team category includes: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Investment Officer (CIO), Chief Operating Officer (COO) and Chief Technology Officer (CTO). In Table 7 we run the same specification as in Table 4, but we identify *net insider sales* made by these three different groups. We consider *net insider sales* in the window (0,+5).

In columns (1) and (2) we look at trades made by top management team and the CEO&CFO, respectively. We find similar results to those previously discussed in Table 4. Meeting or beating top analysts has a positive and statistically significant effect on net insider sales carried out by top executives. However in column (3), when we focus only on other executives (besides the top management team), they only trade based on the magnitude of the earnings announcements returns. The coefficient associated with the earnings

[17] It is important to highlight that even when *Ctrar_Rue* includes both contrarian sales and purchases, contrarian sales are the larger group in this variable, accounting for 75% of trades.

Table 6
Insider trading and post-earnings announcement returns.

Dependent variable:	Buy-and-Hold abnormal returns					
VARIABLES	(1) (+6,+11)	(2) (+6,+26)	(3) (+6,+46)	(4) (+6,+66)	(5) (+6,+136)	(6) (+6,+256)
Eaar(−1,+1)	−0.0011	0.0070	0.0199**	−0.0444***	−0.1436***	−0.1852***
	(0.0033)	(0.0061)	(0.0082)	(0.0105)	(0.0156)	(0.0182)
Rue	0.0052***	0.0030*	0.0029	0.0001	0.0019	0.0049
	(0.0009)	(0.0016)	(0.0023)	(0.0029)	(0.0044)	(0.0052)
Ctrar_Rue	−0.0250***	−0.0313***	−0.0346***	−0.0379***	−0.0449**	−0.0595***
	(0.0038)	(0.0067)	(0.0095)	(0.0122)	(0.0185)	(0.0218)
Mbe top	0.0003	0.0011	0.0009	−0.0019	−0.0020	−0.0033
	(0.0007)	(0.0012)	(0.0017)	(0.0021)	(0.0032)	(0.0038)
Mbe top × Ctrar_Rue	0.0256*	0.0490*	0.0867**	0.1199***	0.0980*	0.1623**
	(0.0138)	(0.0275)	(0.0368)	(0.0454)	(0.0579)	(0.0731)
Mbe non-top	−0.0013**	−0.0016	0.0001	0.0018	0.0033	0.0054
	(0.0007)	(0.0012)	(0.0017)	(0.0021)	(0.0032)	(0.0038)
Mbe non-top × Ctrar_Rue	−0.0065	−0.0215	−0.0533	−0.0820*	−0.0443	−0.0930
	(0.0139)	(0.0278)	(0.0377)	(0.0454)	(0.0586)	(0.0733)
Abnormal Amihud	−0.0014***	−0.0001	0.0003	0.0009	0.0039	0.0012
	(0.0005)	(0.0009)	(0.0012)	(0.0015)	(0.0025)	(0.0029)
Size	−0.0037***	−0.0155***	−0.0361***	−0.0620***	−0.1316***	−0.1726***
	(0.0006)	(0.0012)	(0.0018)	(0.0024)	(0.0047)	(0.0060)
B/M ratio	0.0029**	0.0046**	0.0106***	0.0071	0.0064	0.0068
	(0.0013)	(0.0023)	(0.0038)	(0.0049)	(0.0088)	(0.0112)
Past returns (1 year)	−0.0025***	−0.0036**	0.0075***	0.0012	−0.0082*	−0.0216***
	(0.0008)	(0.0016)	(0.0023)	(0.0028)	(0.0049)	(0.0060)
Constant	0.0166**	0.0979***	0.2190***	0.3982***	0.9455***	1.2323***
	(0.0082)	(0.0163)	(0.0237)	(0.0299)	(0.0472)	(0.0572)
Observations	83,754	83,754	83,754	83,754	83,754	83,754
R-squared	0.0064	0.0138	0.0264	0.0399	0.0761	0.0936
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes

This table displays regressions on the effect of insider trading and meeting or beating top analysts forecasts over post-earnings announcement returns. The dependent variable in all the specifications is post-earnings buy-and-hold abnormal returns (BHAR(6,+τ)) over different time horizons. Specifically, BHAR is the raw stock return over 11, 26, 46, 66, 136 and 256 trading days beginning 6 days after an earnings announcement, adjusted for the corresponding 5 × 5 size and book-to-market portfolio return. *Ctrar_Rue* is equal to *Rue* when insiders trade in a contrarian way after an earnings announcement, and zero otherwise. Insiders are contrarians when they are net sellers (buyers) after positive (negative) earnings surprises. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

announcement returns is positive, statistically significant and much larger in magnitude than those we obtain in columns (1) and (2). Finally, consistent with this finding, the coefficients of *Mbe top* and *Mbe non-top* are not statistically significant and they exhibit similar magnitude and sign.

In sum, the results in Table 7 suggest that insiders who are more exposed to market scrutiny about their trades and care more about future stock return performance are more willing to trade after top analysts are met or beaten. Conversely, non-members of the top management team mechanically trade only based on the size of the earnings surprise.

Finally, Table 8 shows the effect of top executives trades over post-earnings announcement returns. We only consider executives in the top management team as in our previous results we find that the top managers (and no other executives of the firm) trade based on earnings surprises when top analysts' benchmarks are beaten. First, we see that in Table 8*Ctrar_Rue* is again negative and significant in all of the specifications. Post-earnings announcement returns are lower when top executives sell more intensively, which reflects that trading is not a costless activity for insiders, especially for top managers after the publication of earnings. Second, the coefficient for the interaction of *Ctrar_Rue* with *Mbe top* is positive and significant in almost all of the specifications. This indicates that although returns drop after top executives sales, they drop less in firms that beat top analysts' forecasts. Therefore, our results suggest that top managers attempt to reduce the cost of their trading (camouflage) using the earnings surprises associated with top analysts' benchmarks.

8. Routine versus opportunistic insiders

In this section we test whether the camouflage incentives that we document for insider transactions are coming from routine or opportunistic insiders.[18] Cohen et al. (2012) define insider trades that are less likely to be driven by private information as trades that follow a repeated pattern over time, and they call these trades "routine." Routine sales by insiders are very common and well known

[18] We thank the anonymous referee for this valuable suggestion.

Table 7
Insider trading of different insiders and analysts' surprises.

Dependent variable:	NIS (0,+5) Top Management Team	NIS (0,+5) CEO&CFO	NIS (0,+5) Other Executives
Variables	(1)	(2)	(3)
Eaar(−1,+1)	0.0819***	0.0687***	0.3034***
	(0.0042)	(0.0038)	(0.0160)
Rue	0.0023**	0.0023***	0.0106***
	(0.0010)	(0.0009)	(0.0038)
Mbe top	0.0013**	0.0010*	0.0023
	(0.0006)	(0.0005)	(0.0025)
Mbe non-top	0.0004	0.0005	0.0029
	(0.0006)	(0.0005)	(0.0025)
Abnormal Amihud	−0.0024***	−0.0020***	−0.0138***
	(0.0003)	(0.0003)	(0.0014)
Size	0.0028***	0.0026***	−0.0006
	(0.0010)	(0.0009)	(0.0032)
B/M ratio	−0.0012	−0.0010	−0.0085**
	(0.0009)	(0.0008)	(0.0042)
Past returns (1 year)	0.0153***	0.0130***	0.0630***
	(0.0012)	(0.0011)	(0.0049)
Constant	−0.0052	−0.0069	0.0533
	(0.0127)	(0.0114)	(0.0381)
Observations	83,754	83,754	83,754
R-squared	0.0270	0.0246	0.0310
Firm FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes

This table displays regressions on insider trading after earnings announcements differentiating by their main role in the firm. We split insiders in three groups: Top Management Team, CEO&CFO and Other Executives. The Top Management Team category includes: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Investment Officer (CIO), Chief Operating Officer (COO) and Chief Technology Officer (CTO). As dependent variable, we employ net insider sales during the five days after the earnings announcements (NIS(0,+5)), measured as the difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding. Our main independent variables are the dummies *Mbe top* and *Mbe non-top*. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

since executives are often paid with shares of their company, which they then sell to obtain cash or diversify their investments.[19] Routine purchases are also common since executives and other employees often get bonuses in the same calendar month every year and take advantage of the discounts they have to buy shares of their company stocks. According to Cohen et al. (2012), a routine insider is one who trades in the same calendar month for at least three consecutive years. An opportunistic insider is one who is not routine, meaning an insider who does not follow this repeated pattern over time and is, therefore, a residual category.

It is important to mention that Cohen et al. (2012) consider an opportunistic insider to be the one who is more likely to trade on private information, and they attribute this private information to the firm's future prospects which could be associated with illegal trading. Nevertheless, since their opportunistic classification is a residual category, these trades are not necessarily illegal, but driven by private information coming from their interpretation of public information (Alldredge and Cicero, 2015; Ben-David et al., 2019).[20] In our context, since we are analyzing insider trading after the release of public information, opportunistic trades are more consistent with the latter definition. In line with these arguments, we conjecture that the camouflage incentives of insiders are more concentrated in the opportunistic category. We expect that routine traders do not consider analysts' heterogeneity to trade since their transactions are driven by liquidity or diversification.

We classify routine and opportunistic insiders following Cohen et al. (2012) and then we aggregate these trades to our setup around the time of earnings announcements. Cohen et al. (2012) require an insider to make at least one trade per year in three consecutive years to classify her as either routine or opportunistic. This means that, with their classification, some of the trades in our sample could not be classified, resulting in missing observations. We perform the classification considering the whole insider trading universe in Thomson and then we take all these trades into our setting to compute net insider sales in the trading response windows indicated in Fig. 1. Consequently, for the routine sample we only consider routine trades that take place after the publication of earnings, but for the opportunistic sample, we take a different approach. Opportunistic insiders would be everyone else in our sample that is not routine and satisfies the requirement of having at least 3 trades per consecutive year with transactions. Then, with this classification, we estimate the same model as Eq. (1).

[19] Some well-known executives or directors, such as Bill Gates, trade on a pre-announced date to reduce the investor speculation.

[20] In addition to trading on private information, insiders trade against mispricing based on known pricing anomalies (Rozeff and Zaman (1998); Jenter (2005)) and are better than other investors at trading on public information (Alldredge and Cicero (2015); Ben-David et al. (2019)).

Table 8
Top management trading and post-earnings announcement drift.

Dependent variable	Buy-and-Hold abnormal returns					
Variables	(1) (+6,+11)	(2) (+6,+26)	(3) (+6,+46)	(4) (+6,+66)	(5) (+6,+136)	(6) (+6,+256)
Eaar(−1,+1)	−0.0021	0.0061	0.0189**	−0.0453***	−0.1433***	−0.1851***
	(0.0033)	(0.0061)	(0.0082)	(0.0105)	(0.0157)	(0.0182)
Rue	0.0038***	0.0018	0.0017	−0.0009	0.0022	0.0050
	(0.0008)	(0.0015)	(0.0022)	(0.0028)	(0.0042)	(0.0050)
Mbe top	0.0004	0.0012	0.0010	−0.0017	−0.0019	−0.0031
	(0.0007)	(0.0012)	(0.0017)	(0.0021)	(0.0032)	(0.0038)
Ctrar_Rue (Top Management Team)	−0.0290***	−0.0409***	−0.0378***	−0.0455**	−0.0815***	−0.1186***
	(0.0058)	(0.0101)	(0.0143)	(0.0186)	(0.0276)	(0.0329)
Mbe top × Ctrar_Rue (Top Management Team)	0.0271***	0.0407***	0.0398***	0.0468**	0.0855***	0.1302***
	(0.0062)	(0.0107)	(0.0153)	(0.0201)	(0.0292)	(0.0354)
Mbe non-top	−0.0013*	−0.0016	0.0001	0.0017	0.0032	0.0052
	(0.0007)	(0.0012)	(0.0017)	(0.0021)	(0.0032)	(0.0038)
Abnormal amihud	−0.0014***	−0.0001	0.0003	0.0009	0.0038	0.0011
	(0.0005)	(0.0009)	(0.0012)	(0.0015)	(0.0025)	(0.0029)
Size	−0.0037***	−0.0156***	−0.0362***	−0.0621***	−0.1316***	−0.1727***
	(0.0006)	(0.0011)	(0.0018)	(0.0024)	(0.0047)	(0.0060)
B/M ratio	0.0030**	0.0048**	0.0109***	0.0074	0.0066	0.0070
	(0.0013)	(0.0023)	(0.0038)	(0.0049)	(0.0088)	(0.0111)
Past returns (1 year)	−0.0027***	−0.0037**	0.0074***	0.0010	−0.0081*	−0.0216***
	(0.0008)	(0.0016)	(0.0023)	(0.0028)	(0.0049)	(0.0060)
Constant	0.0172**	0.0988***	0.2202***	0.3996***	0.9471***	1.2340***
	(0.0081)	(0.0162)	(0.0236)	(0.0297)	(0.0471)	(0.0572)
Observations	83,754	83,754	83,754	83,754	83,754	83,754
R-squared	0.0058	0.0136	0.0262	0.0397	0.0762	0.0936
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes

This table displays regressions on the effect of net sales made by top executives and meeting or beating top analysts forecasts over post-earnings announcement returns. We restrict our sample to trades made only by members of the Top Management Team: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Investment Officer (CIO), Chief Operating Officer (COO) and Chief Technology Officer (CTO). The dependent variable in all the specifications is post-earnings buy-and-hold abnormal returns (BHAR(6,+τ)) over different time horizons. Specifically, BHAR is the raw stock return over 11, 26, 46, 66, 136 and 256 trading days beginning 6 days after an earnings announcement, adjusted for the corresponding 5 × 5 size and book-to-market portfolio return. *Ctrar_Rue* is equal to *Rue* when insiders trade in a contrarian way after an earnings announcement, and zero otherwise. Insiders are contrarians when they are net sellers (buyers) after positive (negative) earnings surprises. $Mbe\,top\,(Mbe\,non-top)$ takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

The results are in Table 9. Since our sample period is different from Cohen et al. (2012) and we also aggregate all trades into a quarterly level, in Panel A we report summary statistics for the classification at the trade level. For consistency with Cohen et al. (2012), we display figures in line with their Table 1 and find very similar numbers. The percentage of routine and opportunistic purchases and sales remains fairly similar in our sample period. In Panel B we report the regression results for net insider sales. We see that in line with our conjectures, only opportunistic insiders sell more when top-analysts' forecasts are met or beaten. This means, as we expected, that the camouflage incentives we document are concentrated in opportunistic trades.

9. Managers' compensation

To provide further supporting evidence for our first hypothesis, we analyze the sensitivity of managers' compensation to stock prices. As in the previous section, we conjecture that if the costs that insiders face when selling after positive surprises exist, we should observe that the camouflage incentives prevail for those insiders whose compensation is more sensitive to changes in stock prices (especially managers, who by construction have undiversified portfolios).

We collect data from Executive Compustat regarding the compensation components of top executives (top management team) and we construct two measures associated with compensation sensitivity to stock price variations. First, following Humphery-Jenner et al. (2016), we define *Equity Intensity* as the proportion of total annual executive compensation that comes from option and stock grants. This is the value of annual option awards plus the value of annual stock grants scaled by the amount of total annual compensation. Second, following Core and Guay (2002) and Brockman et al. (2010), we construct the *Delta* measure, which captures the sensitivity of compensation to stock prices calculated as the change in the value of an executive's stock and option portfolio in response to a 1% increase in the price of the firm's stocks. Since the frequency of both measures is annual, we match both variables in year *t-1* with each quarter in year *t*.

To test this conjecture we split the sample using the median of the *Delta* and *Equity Intensity* distribution. We classify executives with high (low) compensation sensitivity to firm's stock price changes if *Delta* and *Equity Intensity* are above (below) the sample median. Then, we run the same specifications as in Table 4 in which we test the effect of meeting or beating top and non-top analysts' forecasts

Table 9
Routine versus opportunistic insiders.

Panel A: Statistics at insider level				
Classified transactions	Cohen et al. (2012) sample		This paper's sample	
	Opportunistic	Routine	Opportunistic	Routine
% of buys that are	35.87	64.13	32.00	68.00
% of sales that are	44.87	55.13	41.20	58.80
Panel B: Regression results	(1)	(2)	(3)	(4)
	Net Insider Sales (0,+5)		Net Insider Sales	
Variables	Routine	Opportunistic	Routine	Opportunistic
Eaar(−1,+1)	0.0188***	0.0892***	0.0131***	0.0850***
	(0.0020)	(0.0030)	(0.0028)	(0.0047)
Rue	0.0002	0.0021***	0.0032***	0.0065***
	(0.0005)	(0.0008)	(0.0010)	(0.0013)
Mbe top	0.0001	0.0016***	0.0006	0.0021**
	(0.0003)	(0.0005)	(0.0006)	(0.0009)
Mbe non-top	0.0003	0.0003	−0.0001	0.0005
	(0.0003)	(0.0005)	(0.0006)	(0.0009)
Abnormal Amihud	−0.0010***	−0.0028***	−0.0009**	−0.0058***
	(0.0002)	(0.0003)	(0.0004)	(0.0005)
Size	−0.0008	0.0024***	−0.0045***	−0.0031**
	(0.0006)	(0.0006)	(0.0013)	(0.0014)
B/M ratio	−0.0020**	−0.0014**	−0.0054***	−0.0067***
	(0.0009)	(0.0007)	(0.0017)	(0.0014)
Past returns (1 year)	0.0025***	0.0178***	0.0049***	0.0259***
	(0.0006)	(0.0009)	(0.0010)	(0.0016)
Constant	0.0162**	−0.0106*	0.0455***	0.0475***
	(0.0065)	(0.0057)	(0.0106)	(0.0126)
Observations	32,013	70,734	32,013	83,581
R-squared	0.0148	0.0668	0.0196	0.0459
Firm FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes

This table displays results on insider trading patterns after earnings announcements differentiating insiders as routine or opportunistic. We classify routine insiders following the procedure in Cohen et al. (2012) as the one who placed a trade in the same calendar month for at least three consecutive years. Opportunistic traders are everyone else. Then we aggregate routine and opportunistic trades to our setting. In Panel A, we display summary stats regarding this classification and in Panel B we show regression results. As dependent variable in Panel B, we employ net insider sales coming from routine and opportunistic during the five days after the earnings announcements (NIS(0,+5)). Our main explanatory variables are the dummies of *Mbe top* (*Mbe non-top*) which takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

on insider trading activity. The results are reported in Table 10, where in columns (2) and (4) correspond to the sample of executives whose compensation is highly sensitive to the firm's stock price changes (higher *Delta* and *Equity Intensity*) and columns (1) and (3) to the low sensitivity sample.

The results in columns (2) and (4) show that insiders' (executives) trades when top analysts are beaten are concentrated in firms with higher *Delta* and *Equity Intensity*. Since those executives care more about the current and future stock price of the firm, they use top analysts as a camouflage device. In contrast, columns (1) and (3) indicate that executives with less sensitivity to the firm's stock prices changes do not care about meeting or beating top analysts' forecasts to trade after earnings announcements (both *Mbe top* and *Mbe non-top* remain insignificant). In fact, they are trading in a more mechanical manner (simple contrarian trading) focusing only on the returns generated by the earnings surprise.

10. Robustness tests

In this section we provide other tests to support our main finding. First, we revisit our results with an alternative measure of liquidity, which is the abnormal *Bid-Ask* spread. Second, we explore whether our results survive after controlling for firm age. This is because as firms grow older, their characteristics and internal governance might change over time, especially after they go public (Kieschnick and Moussawi, 2018). Hence, insider trading in our setting may be explained by cross-sectional differences in firm age.[21]

As a last test, we analyze whether institutional ownership influence insider trading behavior. In particular, we identify two

[21] We thank the two anonymous referees and the editor for valuable suggestions to improve this section.

Table 10
Top management compensation and insider trading.

	NIS Top Management Team (0, + 5)			
	Delta		Equity Intensity	
	(1)	(2)	(3)	(4)
Variables	Low	High	Low	High
Eaar(−1,+1)	0.0413***	0.0696***	0.0616***	0.0555***
	(0.0036)	(0.0041)	(0.0042)	(0.0033)
Rue	0.0006	0.0014	0.0004	0.0010
	(0.0009)	(0.0009)	(0.0010)	(0.0008)
Mbe top	0.0004	0.0016**	0.0006	0.0012*
	(0.0005)	(0.0008)	(0.0006)	(0.0006)
Mbe non-top	0.0007	−0.0009	−0.0000	0.0001
	(0.0005)	(0.0008)	(0.0006)	(0.0006)
Abnormal Amihud	−0.0014***	−0.0026***	−0.0018***	−0.0019***
	(0.0003)	(0.0004)	(0.0003)	(0.0003)
Size	0.0038***	0.0005	0.0050***	0.0013*
	(0.0010)	(0.0011)	(0.0010)	(0.0008)
B/M ratio	0.0012	−0.0017	0.0015	−0.0006
	(0.0007)	(0.0014)	(0.0010)	(0.0007)
Past returns (1 year)	0.0067***	0.0153***	0.0090***	0.0121***
	(0.0009)	(0.0013)	(0.0011)	(0.0010)
Constant	−0.0239***	0.0006	−0.0370***	−0.0037
	(0.0080)	(0.0102)	(0.0077)	(0.0078)
Observations	20,749	30,202	24,861	34,849
R-squared	0.0337	0.0385	0.0373	0.0373
Firm FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes

This table displays regressions on insider trading (*net insider sales*) after earnings announcements differentiating insiders by their role in the firm. We restrict our sample to trades made only by members of the Top Management Team: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Investment Officer (CIO), Chief Operating Officer (COO) and Chief Technology Officer (CTO). Additionally, we split the sample into high and low compensation sensitivity to stock price changes. We classify executives with high (low) compensation sensitivity to the firm's stock price changes if *Delta* or *Equity Intensity* is above (below) the sample median. As dependent variable, we employ net insider sales during the five days after the earnings announcements (NIS(0,+5)), measured as the difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding. Our main independent variables are the dummies *Mbe top* and *Mbe non-top*. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

channels in which institutional investors could affect our results. First, institutional ownership could be associated with the quality of corporate governance.[22] If this is the case, then insider trading would be concentrated after earnings announcements as firms with a better governance are likely to have internal mechanisms to avoid illegal insider trades (Dai et al., 2016). In other words, firms with better governance might encourage their insiders to place trades when the level of scrutiny and asymmetric information are minimal in order to reduce legal jeopardy. Hence, our results may not be explained by camouflage incentives of insiders, but rather by better governance mechanisms of their firms.

Second, recent literature on analyst performance documents catering behavior of analysts who adjust their forecasts depending on the type of institutional investor. For instance, Pacelli (2019) show how brokerage houses and their analysts tend to spend more time and effort providing research products catered to institutional clients at the expense of individual investors. Moreover, Bilinski et al. (2019) show evidence that analysts cater to short-term investors (such as hedge funds) by issuing optimistic target prices. Taking this together, higher institutional ownership could lead to a bias in the EPS forecasts, which in turn, might affect the stock price reaction at the earnings announcement and the subsequent insider trades. In other words, our results could be driven by insiders reacting to large earnings returns coming from optimistic forecasts made by top analyst trying to cater to institutional investors.

We tackle these two problems by controlling for institutional investors ownership in our regressions. We obtain institutional holdings from Thompson Reuters (file 34) and calculate institutional ownership as the number of a firm's shares held by institutional investors in each quarter (according to the report date), divided by the number of shares outstanding. For firm age, we follow Kieschnick and Moussawi (2018) and measure it as the number of years after the firm goes public (we use the first trading day provided

[22] It is well established in the literature that institutional investors improve corporate governance by playing an important role in monitoring firms (Brav et al., 2008; Appel et al., 2016)

Table 11
Meet or beat EPS forecasts and insider trading: Robustness test.

Dependent variable:	Net Insider Sales				Net Insider Sales (0,+5)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Eaar(−1,+1)	0.0999***	0.0998***	0.0994***	0.0993***	0.0931***	0.0931***	0.0927***	0.0927***
	(0.0051)	(0.0051)	(0.0051)	(0.0051)	(0.0029)	(0.0029)	(0.0029)	(0.0029)
Rue	0.0083***	0.0084***	0.0082***	0.0082***	0.0019***	0.0019***	0.0018***	0.0019***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Mbe top	0.0026***	0.0026***	0.0026***	0.0026***	0.0016***	0.0016***	0.0016***	0.0016***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Mbe non-top	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0004
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Firm Age		−0.0028***		−0.0028***		−0.0008***		−0.0008***
		(0.0003)		(0.0003)		(0.0002)		(0.0002)
Inst. Ownership			0.0166***	0.0168***			0.0122***	0.0122***
			(0.0046)	(0.0046)			(0.0020)	(0.0020)
Abnormal Bid-Ask	−0.0061***	−0.0062***	−0.0060***	−0.0062***	−0.0004	−0.0004	−0.0004	−0.0004
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Size	−0.0030*	−0.0029*	−0.0038**	−0.0037**	0.0023***	0.0024***	0.0018***	0.0018***
	(0.0015)	(0.0015)	(0.0016)	(0.0016)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
B/M ratio	−0.0095***	−0.0093***	−0.0093***	−0.0092***	−0.0026***	−0.0026***	−0.0025***	−0.0025***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Past returns (1 year)	0.0316***	0.0316***	0.0317***	0.0317***	0.0189***	0.0189***	0.0190***	0.0190***
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Constant	0.0579***	0.0953***	0.0528***	0.0908***	−0.0065	0.0036	−0.0102	0.0003
	(0.0158)	(0.0165)	(0.0156)	(0.0163)	(0.0068)	(0.0074)	(0.0068)	(0.0074)
Observations	82,547	82,547	82,547	82,547	82,547	82,547	82,547	82,547
R-squared	0.0510	0.0513	0.0514	0.0517	0.0630	0.0631	0.0639	0.0639
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table displays regressions on insider trading after earnings announcements over our main explanatory variables, controlling for other factors that may affect our main results. As dependent variable, we employ two measures of insider trading. First, we use the net insider sales, measured as the difference between the fraction of shares sold and bought by insiders in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding. Second, we employ net insider sales during a short window following the earnings announcements (from day 0 to day +5), measured as the difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The main independent variables are: *Mbe*, which is a dummy variable that takes the value of one when firm *i* in a given quarter meets or beats the EPS consensus of all analysts, and zero otherwise. *Mbe top* (*Mbe non-top*) takes the value of one when firm *i* in a given quarter meets or beats top (non-top) analysts' EPS forecasts, and zero otherwise. Additional to the control variables used in Table 4, we include two variables: 1) *Firm Age* and 2) *Institutional Investor Ownership*. Moreover, we employ the *Abnormal Bid-Ask Spread* instead of the *Abnormal Amihud*. All variables are defined in Appendix A and are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

by CRSP).[23] We present the results in Table 11.

In line with our expectations, the results are robust to the inclusion of an alternative measure of liquidity, firm age and institutional ownership. We see in Table 11 that the coefficient for *Mbe top* remains positive and statically significant in all the columns when including each variable separately, and also when we include them altogether. Moreover, as expected, institutional ownership is positively associated with net insider sales after earnings announcements.

11. Conclusion

Focusing on publicly traded US firms in the period after earnings announcements from 2003 to 2016, we show that insiders sell more aggressively and quickly shortly after the publications of earnings when their firms meet or beat top analysts' forecasts. We argue that insiders do so to camouflage their trades, since trading after positive earnings surprises is costly for them. In particular, by selling after earnings announcements, insiders could be sending an undesired negative signal to the market that causes a negative market reaction to their trades, which in turn significantly affects insiders' decisions to trade. For this reason that insiders identify a subset of analysts (top analysts), who attract more the attention of investors and trade against the surprise generated by their forecasts.

To support our main finding we employ a quasi-experimental design in which we identify exogenous reductions in analyst coverage due to closures and mergers of brokerage firms (Hong and Kacperczyk, 2010; Kelly and Ljungqvist, 2012). We find that, indeed, when

[23] We focus on this measure instead of using founding dates because previous research emphasizes that the length of time that a firm has been a public firm has an influence on corporate governance features. However, in unreported tests we also measure firm age using founding dates obtained from Ray Ritter's website and find similar results. By using CRSP to obtain firm age, we also ensure a similar sample size employed in the baseline regressions.

top-analyst coverage drops, insiders sell fewer shares of their companies after meeting or beating forecasts made by the top analysts that continue to follow the firm. Moreover, as a placebo test, this pattern only holds up when top-analyst coverage decreases but not when non-top analyst coverage decreases.

In line with the costly signal that insiders send by selling shares of their company, we show that post-earnings announcement returns are lower for firms when insiders sell shares as compared to firms with no insider trading. However, consistent with the camouflage mechanism, returns drop less after insiders sell shares in firms that meet or beat top analysts' forecasts.

Moreover, we provide further support to the cost-benefit mechanism underlying this insider trading strategy by considering the role of the insider in the firm, their compensation sensitivity to stock price changes and whether insiders are routine or opportunistic traders. We find that only the CEO, the CFO and the top management team consider top analysts in placing their trades after a positive surprise as opposed to other insiders (such as directors, non-top executives, other employees, etc.). In addition, when we consider executive compensation sensitivity to stock price changes, we find that the selling pattern of managers with high compensation sensitivity to changes in stock prices is more pronounced when top analysts are met or beaten. Finally, we show that the incentives of insiders to hide their trades are concentrated in opportunistic rather than routine insiders.

This research contributes to the literature on the informational content of insider trades and their impact on stock market efficiency. We contribute to this literature by studying how insiders' motivation to trade can change depending on certain types of analysts' forecasts and the impact of these transactions on information dissemination in the US stock exchange. Secondly, this paper is related to the analyst forecast literature by studying how the heterogeneity of analysts matters not only for outside investors but also for insiders. Finally, this study is also related to the literature on sell-side analysts as information intermediaries and their effect on management decisions (and behavior).

Appendix A. Variable definitions

Variable	Definition	Source
Abnormal Amihud	Average Amihud liquidity level over a specific window of time after the earnings announcement, divided by the average liquidity measure over 252 days before the earnings announcement. The Amihud (2002) liquidity measure is computed as the daily ratio of the absolute stock return over the dollar trading volume of the stock.	CRSP
B/M ratio	Book value of equity in the previous quarter over the market capitalization 2 days before an earnings announcement	COMPUSTAT
Ctrar_Rue	Equal to *RUE* when insiders trade in a contrarian way after an earnings announcement; and zero otherwise. Insiders are contrarians when they sell (buy) after a positive (negative) earnings surprise. Ctrar_Rue (top executives) is equal to *RUE* when a top executive trades as a contrarian after the publications of earnings.	Thomson Financial and IBES
Eaar(−1,+1)	Buy-and-hold abnormal stock returns over 3 days around the last earnings announcement date (−1, +1), estimated as the difference between the observed return and the return corresponding to the 5×5 size and book-to-market portfolio downloaded from the Kenneth French website or the market portfolio return.	CRSP, French's website
Mbe	Dummy variable equal to 1 for a firm-quarter that meets or beats the analyst consensus. The analyst consensus is measured as the mean forecasts made for a particular firm's earnings per share (EPS).	IBES
Mbe top (non-top)	Dummy variable equal to 1 for a firm-quarter in which a top (non-top) analyst is beaten at the earnings announcement.	IBES
Net insider sales (NIS)	The difference between the fraction of shares sold and bought by insiders in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding.	Thomson Financial
Net insider sales (NIS) (0,+5)	The difference between the fraction of shares sold and bought by insiders from day 0 to day +5 after an earnings announcement in a given quarter. The fraction of shares sold (bought) by insiders is the total number of shares sold (bought) by all officers and directors in the quarter, scaled by the number of shares outstanding.	Thomson Financial
Past returns (1 year)	The raw stock return over 12 months (265 trading days) ending 2 days before EA_0 adjusted for the corresponding 5×5 size and book-to-market portfolio return downloaded from the Kenneth French website and computed as the buy-and-hold abnormal return.	CRSP, French's website
Post BHAR (+ 6, +τ)	The raw stock return over 11, 26, 46, 66, 136 and 256 trading days beginning 6 days after an earnings announcement, adjusted for the corresponding 5×5 size and book-to-market portfolio return as downloaded from the Kenneth French website and computed as the buy-and-hold abnormal return.	CRSP, French's website
Rue	Rescaled quintile rank of standardized earnings surprises. It takes the value of −0.5 when an observation belongs to the bottom quintile rank of earnings surprises, and 0.5 when an observation belongs to the top quintile rank of earnings surprises. The standardized earnings surprise corresponds to the difference between the actual earnings per share and the mean earnings per share forecasted by analysts for a firm in a given quarter. This difference is scaled by the stock price two days before the earnings announcements.	Thomson
Size	Stock price times the number of shares outstanding 2 days before the earnings announcement date, in regressions used in a logarithmic transformation.	COMPUSTAT

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2020.101778.

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