Why Do Insiders Sell Stocks After Receiving Options?[†]

Fei Fang[a, *] Zhenyang Tang[a] Parianen Veeren[b]

[a] Clark University School of Business. 950 Main St, Worcester, MA 01610, U.S.A.

[b] John Molson School of Business, Concordia University. 1455 Boul. de Maisonneuve Ouest, Montréal, QC H3G 1M8, Canada.

Abstract

We investigate corporate insiders' trading behavior around option grants and find that they substantially increase their net sales after receiving options. The increase in insider net sales is positively associated with risk metrics such as idiosyncratic volatility and stock price crash risk, but not with proxies for insider opportunism. This suggests that the increase in net sales is likely driven by risk-reduction considerations rather than opportunistic trading based on inside information. Consistent with this view, we find that insider sales following option grants do not precede more negative returns.

Keywords: Insider Trading, Option Grants, Hedging, Risk Reduction

JEL classification: D80, G10, G14, G34, G39

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[*] Corresponding author.
Authors' Email addresses: ffang@clarku.edu (Fei Fang), ztang@clarku.edu (Zhenyang Tang), parianen.veeren@concordia.ca (Parianen Veeren).

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1. **Introduction**

Stock option grants have become an increasingly important component of compensation for corporate executives and directors (Frydman and Saks, 2010; Edmans et al., 2017). By increasing pay-performance sensitivity, option grants incentivize insiders to enhance firm performance (Jensen and Murphy, 1990; Hall and Liebman, 1998; Hanlon et al., 2003) and encourage value-enhancing risk-taking (Edmans and Galaix, 2011; Shue and Townsend, 2017). In financial research, it is often assumed that option grants increase insiders' risk exposure and align their interests more closely with shareholders' (Rajgopal and Shevlin, 2002; Oyer and Schaefer, 2005; Roosenboom and van der Goot, 2006; Kuang and Qin, 2009). However, this assumption may not hold if insiders sell a substantial portion of shares they previously own after receiving option grants. In this paper, we investigate the changes in insider net selling following option grants and explore potential reasons for these changes.

Insiders have strong incentives to limit their exposure to firm-specific risk (Kahl et al., 2003; Edmans et al., 2022; Moore, 2023). At the same time, many insiders choose to hold vested shares, anticipating future capital appreciation due to their optimism about the company's growth potential.[1] Johannesson and Kim (2021) show that by retaining vested restricted stock, insiders realize annualized abnormal returns of 5.0-6.3%, with even higher returns in firms with poor information environments. Hence, insider selling decisions represent a trade-off between risk and return.

Option grants represent a sudden increase in insiders' exposure to firm-specific risk, and thus may lead to adjustments in their share positions. Insiders are known to adjust their holdings

[1] Insiders may hold onto their shares for other reasons, such as signaling their confidence and commitment to long-term success, tax avoidance, and personal financial planning considerations.

when they anticipate increased risk (Marin and Olivier, 2008; Chiang et al., 2017; Drobetz et al., 2020). If an insider believes that this increased risk exposure results in sub-optimal portfolio allocation, they may sell shares in the open market to reduce risk back to an optimal level. For example, Lakonishok and Lee (2001) suggest that managers may have an incentive to diversify their portfolios in response to exercising options. Bettis et al. (2015) identify two ways insiders can reduce risk exposure: open market sales and the use of derivatives, focusing on the latter in their study. Ofek and Yermack (2000) analyze annual insider ownership changes and find that insiders sell in years when they receive option grants, though the timing of these sales is not examined. Increased selling after option grants is consistent with utility maximizing models of insider behavior, especially for risky firms, where a negative firm-specific shock could harm both insiders' careers and wealth.

Another potential reason for insiders to trade after receiving option grants is insider opportunism. Option grants tend to precede favorable stock price movements (Yermack, 1997), and insiders may manipulate the timing of news releases (Aboody and Kasznik, 2000; Chauvin and Shenoy, 2001; Narayanan and Seyhun, 2005; Baker et al., 2010) or even backdate option grants (Lie, 2005; Heron and Lie, 2007) for personal gain. The same opportunism may motivate insiders to increase selling after option grants, as they tend to time the market (Cheng and Lo, 2006) and sell more when stock prices are high (Lakonishok and Lee, 2001; Jenter, 2005).

We analyze open market transactions by corporate insiders who receive option grants and find that such insiders substantially increase their net sales (total sales minus total purchases) following option grants. The increase in net sales over a three-month period is equivalent to 15% of shares underlying the option grants, with about 70% of stock sells occurring within one month after the grants. The abnormally high volume of insider sales is much more common than the use

of hedge instruments to reduce risk exposure (Bettis et al., 2015). The increase in stock sales negates a substantial portion of the incentive alignment effects of option grants and reduces their effectiveness in increasing pay-performance sensitivity.

We next investigate two potential reasons behind the increased insiders selling: risk reduction and insider opportunism. To measure firm-specific risk, we use two common measures of stock risk – idiosyncratic volatility and crash risk. Consistent with the risk reduction hypothesis, we find that insiders are more likely to increase net sales when their firms exhibit higher idiosyncratic volatility or crash risk. In contrast, we find little evidence to support the insider opportunism view. Specifically, we do not observe larger increases in net sales among key insider groups typically considered more informed (Seyhun, 1986; Hillier et al., 2015). We also consider three indirect measures of insider opportunism. First, we follow Cohen et al. (2012) to construct a measure of routine insider trading based on past transactions. Second, we follow Ali and Hirshleifer (2017) to rank insiders on their trading profitability and identify insiders whose trades are more profitable. Third, we follow Akbas et al. (2020) to estimate insider investment horizons. Prior studies suggest that opportunistic insiders are more likely to base their trades on private information, which implies a greater increase in net sales for this group. However, we do not find any significant difference in net sales using any of the three measures of insider opportunism.

Lastly, we investigate the informativeness of insider trades within three months before and after option grants. If the increased insider sales after option grants stem from opportunistic trading, they should precede more negative market movements. Contradicting the insider opportunism narrative, we find that sales after option grants are followed by less negative abnormal returns.

Our paper makes the following contributions. First, we provide direct evidence that insiders significantly increase net sales shortly after receiving option grants. While previous studies (e.g.,

Lakonishok and Lee, 2001; Kahl et al., 2003; Edmans et al., 2022; Moore, 2023) suggest that insiders have incentives to sell immediately after receiving shares or options, they lack empirical support. Bettis et al. (2015) and Jagolinzer et al. (2007) focus on the use of derivatives, but as Bettis et al. (2015) note, using derivatives is fundamentally different from open market sales, reflecting distinct insider motivations. Ofek and Yermack (2000) document insider ownership changes using annual filings but do not address the timing of these sales. In contrast, we focus on insider trades and show that the increase in net sales occurs within a short three-month window following option grants. Additionally, we are able to analyze different insider groups and the profitability of their trades.

Second, we demonstrate that the increased selling is better explained by risk reduction rather than insider opportunism. This finding clearly contrasts with prior literature on opportunistic insider behavior around option grants (e.g., Aboody and Kasznik, 2000; Chauvin and Shenoy, 2001; Narayanan and Seyhun, 2005; Baker et al., 2010; Ali et al., 2011; Bonaime and Ryngaert, 2013; Devos et al., 2015; Cheng et al., 2023) and studies of insider trade informativeness (e.g., Frankel and Li, 2004; Fidrmuc et al., 2006; Huddart and Ke, 2007; Cohen et al., 2012; Hillier et al., 2015; Cline et al., 2017; Dang et al., 2021). Our results suggest that insider sales are not driven by opportunism or private information, aligning with Bettis et al. (2015) who argue that opportunism is more common in derivative trading than in open markets sales.

Third, our findings enhance the understanding of insider ownership, a key factor in aligning managerial and shareholder interests. Greater insider ownership can be a driver of value creation (Morck et al., 1988); however, our study shows that despite the widespread use of incentive plans such as option grants, insiders offload a substantial portion of shares shortly after receiving option grants to adjust their exposure to firm-specific risk. These insights can help researchers and policy

makers assess the effectiveness of option grants and assist industry practitioners in designing better executive compensation plans.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature and develops testable hypotheses. Section 3 summarizes our data and variables. Section 4 presents our empirical findings. Section 5 concludes.

2. Hypothesis Development

Stock option grants remained a small proportion of executive compensation until the late 1970s and surged to become the largest component of executive pay during the 1980s and 1990s (Heron et al., 2007; Edmans et al., 2017). The use of stock option grants in compensation plans for other insiders, including middle- and lower-level employees, has grown over time. The widely use of option grants is often justified by an incentives-based explanation (Core and Guay, 2001; Kedia and Mozumdar, 2003). In addition, other explanations of option grants have been discussed (Oyer and Schaefer, 2005), such as attracting and retaining certain types of employees (Lazear, 2001).

Some studies suggest that insiders have incentives to negate the ownership increase following option grants. This can be achieved in two ways: through the use of derivatives or by open market sales. Jagolinzer et al. (2007) and Bettis et al. (2015) show that insiders actively hedge or diversify their increased ownership using derivatives such as prepaid variable forwards. Regarding open market sales, Ofek and Yermack (2000) analyze annual insider holdings and suggest that the executives sell during years of option grants, but they do not investigate when the selling occurs or what drives the increase in sales.

A different, but larger strand of literature studies possible insider opportunism from the perspective of insiders who receive options. It starts with studies examining stock returns around

insider option grants, including Yermack (1997), Aboody and Kasznik (2000), and Chauvin and Shenoy (2001). Specifically, option grants coincide with favorable stock price movements: stock returns are abnormally low prior to option grants, and abnormally high immediately after option grants. Because stock options are generally granted at the money, the perfect timing of option grants is often attributed to opportunistic timing of either the option grants or information releases around option grants. Studies like Lie (2005) and Heron and Lie (2007) suggest that insiders may backdate option grants for personal gain. Baker et al. (2003) find that insiders may engage in earnings management to increase the value of their option grants. Narayanan and Seyhun (2008) document that insiders designate option grant dates to increase their compensation. The widespread insider opportunism behavior around option grants suggests that insiders may sell more after option grants when prices are favorable, as they tend to time the market (Gosnell et al., 1992; Seyhun and Bradley, 1997; Ali et al., 2011; Chan et al., 2012; Bonaime and Ryngaert, 2013; Devos et al., 2015; Cheng et al., 2023) and their trades tend to precede favorable stock price movements (Frankel and Li, 2004; Fidrmuc et al., 2006; Huddart and Ke, 2007; Cohen et al., 2012; Hillier et al., 2015; Cline et al., 2017; Dang et al., 2021).

Both the risk reduction/hedging consideration and insider opportunism suggest that insiders may actively engage in open market selling of their own firms' shares after receiving option grants:

Hypothesis 1: Insiders increase their net sales after receiving option grants.

To identify the reason behind insider sales after receiving grants, we investigate firm-level determinants of post-grant insider sales. If insiders sell due to risk reduction considerations, we should expect more sales in firms with greater stock risk (i.e., volatility and crash risk). In contrast,

if insiders sell shares due to opportunism, the increased selling should be associated with the extent of insider opportunism. Hence, we propose the following hypotheses:

Hypothesis 2a: The increase in insider sales after receiving option grants is positively associated with idiosyncratic volatility and crash risk.

Hypothesis 2b: The increase in insider sales after receiving option grants is more pronounced for opportunistic insiders.

We are equally interested in the informativeness of insider trades. The risk reduction view and the insider opportunism view lead to opposite predictions of insider trading informativeness: if insiders increase net sales to opportunistically time the market and achieve greater returns, then their sales following insider grants will precede significantly more negative cumulative abnormal returns. Alternatively, if insiders sell to reduce their exposure to firm-specific risk, their sales following option grants will not precede more negative cumulative abnormal returns.

Hypothesis 3: Insider sales following option grants precede less negative cumulative abnormal returns.

3. Data and Variables

The insider open market stock transaction data and the insider option grants data are from the Insider Filing Data of Thomson Reuters. We construct our initial sample using all option grants recorded in Thomson Reuters data from April 1996 to March 2019. The sample includes all insiders identified by the Securities Exchange Act of 1934, and a substantial portion of the option grants go to officers and directors who are not CEOs, CFOs, presidents or chairs. We then merge the option grants data with open market stock transactions (transactions coded as either open

market purchases or open market sales), by the same insider in the same firm, which occur in a window starting three months prior to the option grant date and ending three months after the option grant date. The three-month window prior and post the grants is chosen to minimize the impact from insider trading routines and blackout periods – for instance, Cohen et al. (2012) find that some insiders tend to trade in the same month of a year, and Roulstone (2003) reports that many firms have insider trading black-out periods prior to earnings announcements.[2] For insiders who make multiple transactions in the same day, we combine their transactions into one. The stock price data are from CRSP. The accounting data are from COMPUSTAT and the analysts' data are from IBES. To avoid outliers from small and illiquid firms, we drop firms with total book asset less than $10,000,000 from our analysis. The total number of option grants in our sample is 53,293. There are 5,746 unique firms and 27,798 insiders in our sample.

In Table 1 we report the descriptive statistics of employee options grant and insider stock trading three months before and three months after the option grants. The option grants studied in this paper are economically significant: on average, each option grant gives an insider about 44,487 shares, carrying an average value of about $1.07 million and a median value of $263,400. Insider open market trading is active around option grant dates: we see an average of 2,577 shares bought and 13,678 shares sold by an insider in the three-month period before she receives an option grant, and an average of 2,751 shares bought and 16,537 shares sold in the three-month period after the option grant. The increase in net sales is mainly driven by the increase in sales rather than purchases. Note that the four derivatives described by Bettis et al. (2015) are also included in the Thomson Reuters data, and we find that the usage of these are extremely limited (less than 100 per

[2] Our untabulated results show that the findings remain robust when using six-month windows before and after option grants; however, the majority of the increase in insider net selling occurs within the three months following the grants.

year). We also note that for some insiders, option grant dates could coincide with the vesting dates of option grants issued in previous years; while this does not change our story, we show in untabulated robustness result that excluding insiders who receive option grants multiple times from our analysis does not affect our result.

[Insert Table 1]

To capture the overall trading activity by insider around option grants, we look at the net sales difference. For each option grant, the stock net sales are defined as the total number of shares sold minus the total number of shares purchased. Specifically, for each option grants to insider i, we analyze stock transactions by insider i in a 180-day window around option grants (from days -90 to +90). Our dependent variable, net sales difference of option grant j to insider i from firm k, is calculated as insider i's total number of stock net sales over the three months after option grant j minus insider i 's total number of stock net sales over the three months before option grant j, scaled by the total number of shares outstanding of firm k.[3]

$$NetSaleDiff_{i,j,k} = \frac{Net\ Sales_{i,k}^{3\ month\ after\ j} - Net\ Sales_{i,k}^{3\ month\ before\ j}}{Number\ of\ Shares\ Outstanding_k} \qquad (1)$$

Following Ang et al. (2006), we measure idiosyncratic volatility for firm k as the standard deviation of the error terms from the Fama-French three-factor model using daily stock returns in the past year.

$$r_{k,t} = \alpha_k + \beta_{1k}(r_{m,t} - r_{f,t}) + \beta_{2k}SMB_t + \beta_{3k}HML_t + \varepsilon_{k,t} \qquad (2)$$

where *m* denotes the market portfolio, *f* denotes the risk-free asset, and *t* denotes time (day).

[3] Our results hold when scaling insider net sales by the size of option grants.

The crash risk is defined following Hutton et al. (2009) and Kim et al. (2011), based on firm-specific returns using the following Equation (3). We define the crash risk of firm *k* as the number of days when the daily returns of the firm are below the mean of the firm-specific daily return by 3.2 times the standard deviation of the daily return over the entire year. The 3.2 is chosen to generate a frequency of 0.1% in the normal distribution.

$$r_{k,t} = \alpha_k + \beta_{1k} r_{m,t-2} + \beta_{2k} r_{m,t-1} + \beta_{3k} r_{m,t} + \beta_{4k} r_{m,t+1} + \beta_{5k} r_{m,t+2} + \varepsilon_{k,t} \qquad (3)$$

where *m* denotes the market portfolio, and *t* denotes time (day).

We use the following variables to proxy for insider opportunism. First, we include insider role dummy variables because these dummies are associated with inside information and trading patterns (Hillier et al., 2015; Rahman et al., 2021). In addition, we consider three measures of insider opportunism: routine trading, profitability, and investment horizon. Following Cohen et al. (2012), we examine each insider's trading pattern over the entire sample period and, if an insider makes at least one trade in the same month of a year for three consecutive years, we code this insider a routine insider (i.e. *Routine* =1). Following Ali and Hirshleifer (2017), we rank insiders on their trading profitability prior to the last quarterly earnings announcement, and classify the top quintile as opportunistic insiders (i.e. *Profitable Insider* =1). Following Akbas et al. (2020), we estimate insider investment horizon as the absolute average annual net order flow of stock by the insider over the last ten years multiplied by -1. When this measure is -1, the insider is considered to have a long horizon (i.e. *Long Horizon Insider* =1), and when this measure is greater or equal to -0.53 the insider is considered to have a short horizon (i.e. *Short Horizon Insider* =1).

We control for a battery of potential determinants of insider trading, as identified in earlier studies such as Hillier et al. (2015), Biggerstaff et al. (2020), Liang et al. (2020), and Rahman et al. (2021). *SharesOption* is the total number of shares underlying the option grant scaled by the

number of shares outstanding; it is a measure of the size of option grants, which can affect the magnitude of insider selling in response to option grants. *SharesHeld* is insider stock ownership scaled by the number of shares outstanding; we control for it because insider sales are potentially limited by their shareholdings. 1/*SharesOut* is the inverse of number of shares outstanding; we include it to account for the possible impact from the number of shares outstanding which is the denominator of the dependent variable. *Analysts* is the logarithmic of one plus the number of analysts following the firm; the number of analysts affects a firm's information environment, and hence is an important determinant of insider selling and insider profits (Biggerstaff et al., 2020; Rahman et al., 2021). *MktCap* is the logarithm of market capitalization, and *MTB* is the market-to-book ratio; we control for them because size and value have been shown to have important impact on insider trading and stock performance (Hillier et al., 2015; Liang et al., 2020). We also control for the price run-up measured by the CAR in a 20-trading day window prior to option grants (*CAR20B*), since Bettis et al. (2005) and Bettis et al. (2015) show the importance of previous stock price run-ups in insider decisions. *After SOX* is a dummy which equals 1 if the option grant happens after 2002 and 0 otherwise; we include it to account for the insider trading rule changes after 2002. We include industry and year fixed effects, and winsorize all continuous variables at the 1% and 99% levels.

4. Empirical Analysis

Table 2 provides summary statistics for all the variables used in our tests. On average, insiders' net sale difference scaled by the number of shares outstanding is 0.004% and statistically significant. The mean and median number of shares underlying the option grants relative to the number of shares outstanding are 0.13% and 0.04%, respectively. Insiders who receive option

grants held about 0.7% of shares outstanding. We report the correlation matrix of the variables in Online Appendix A.

[Insert Table 2]

In Table 3, we report the mean differences in net sales and the corresponding t-tests for different groups of insiders. Compared with the three-month period prior to option grants, insiders increase their net sales in the three-month period post option grants by 0.004% and this difference is statistically significant at the 1% level. Note that this 0.004% is the increase in net sales based on all shares outstanding, so the economic magnitude is substantial: consider the median value 36.86 million for the number of shares outstanding, a 0.004% increase corresponds to an increase of 147,000 shares in net selling for a typical insider. These results are consistent with Hypothesis 1 that insiders increase net sales following stock option grants.

[Insert Table 3]

We further investigate key insider groups such as CEOs, CFOs, presidents, and board chairs. We follow Thomas Reuters manual to categorize insiders into directors and officers.[4] Note that insiders can have multiple roles in the company, so the insider categories are not multiple exclusive. We consider this when running all the regressions. While almost all insider groups increase net sales after receiving option grants, the phenomenon is mostly significant for officers (especially CFOs, which is consistent with Wang et al., 2012) and board chairs.

One question is whether our results are driven by insider trading restrictions, i.e., option grants may overlap with the ending of trading restrictions which naturally lead to more insider sales. Whilst insider trading restrictions are common, most of them are in the form of short-term

[4] Board chairs are classified as directors, and CEOs, CFOs, and Presidents are classified as officers.

blackout periods around earnings announcements (Bettis et al., 2000; Roulstone, 2003) and should not affect our analysis spanning three months. For long-term restrictions such as the lock-up periods after share issuance, Chen et al. (2012) find that even in the post-IPO setting (in which many insiders have strong incentives to cash out), a significant portion of insiders do not sell all shares after the lockup periods.

We next analyze the determinants of such increased insider sales following option grants. We regress our dependent variable, difference in net stock sales, on the aforementioned firm risk measures (more specifically, *Idiosyncratic Volatility* and *Crash Risk*) and insider opportunism measures. Control variables described in the previous section are included in regressions. To avoid very small regression coefficient estimates, we multiply our dependent variable *NetSaleDiff* by 10,000 in regressions of Tables 4-7. In all regressions, we include year and industry fixed effects and cluster the standard errors by firms.

In Table 4, we report the regression results of differences in net stock sales on the measure of idiosyncratic volatility. In column (1) we control for firm-level characteristics only, and in other columns we include insider role dummies and a variety of insider opportunism measures. In all five regressions, the coefficient estimates of idiosyncratic volatility are statistically positively significant. Based on column (1), one standard deviation increase in idiosyncratic volatility corresponds to an increase of 0.516% increase in insider net sale; based on the median value of shares outstanding, this is approximately 190,000 shares. In addition, the net sale differences increase with the 20-day CAR before option grants. Our findings are consistent with the risk reduction story: insiders are more likely to sell when the risk of their firm's stock is high.[5]

[5] In untabulated results, we regress the level of net sales before and after option grants on risk measures using a difference-in-difference approach. The results are weaker, likely due to the high cross-sectional variance in insider net sales.

[Insert Table 4]

In contrast, we find that almost none of the measures of insider opportunism is significant. For instance, *Routine*, *Profitable Insider*, and *Short Horizon Insider* all have insignificant coefficients. We do not find stronger results for insider groups that are usually believed to have the most information, such as CEOs, presidents, or CFOs. The group for which we observe increased net sales is board chairs. Overall, the regression results do not support the notion that the increase in insider net sales is because of insider opportunism.

Table 5 shows the regression results of differences in net stock sales on crash risk. In column (1), we analyze differences in insider net sale and the crash risk with firm-level characteristics as control variables, while in other columns we add measures of insider opportunism. The coefficient estimates of crash risk in all five regressions are positive and statistically significant. In general, Table 5 conveys the same message as Table 4: insiders tend to sell more when crash risk of the firm is higher. The economic significance is similarly high: one standard deviation increase in crash risk corresponds to an increase of 0.465% increase in insider net sale; based on the median value of shares outstanding, this is approximately 171,500 shares. Like Table 4, we also see greater increases in insider net sales following recent stock price run-ups. Measures of insider opportunism do not show statistical significance, except *Profitable Insider* which is marginally significant but the coefficient sign is opposite to what the opportunism view predicts.

[Insert Table 5]

Our findings thus far are consistent with the risk reduction story where insiders increase net stock sales after receiving options to lower their risk exposure. Next, we address a possible source of endogeneity: institutional ownership. Prior research has shown that both idiosyncratic

volatility and crash risk are associated with institutional ownership (Brandt et al., 2010; An and Zhang, 2013; Chen et al., 2024), which could restrict the occurrence and profitability of insider trading (Dai et al., 2016). However, as shown in Table 6, 13F institutional ownership does not significantly explain the difference in net sales after option grants. We therefore conclude that the positive association between the increased insider net sales and firm risk is not driven by institutional ownership.

[Insert Table 6]

Another question is whether our results reflect insiders' superior information and ability to time their trades in volatile times. For instance, an informed insider may only sell in response to option grants when the perceived volatility or crash risk is high. To examine this, we interact the risk measures with measures of insider opportunism: insider roles, routine trading, profitable insider, and insider investment horizon. We also interact risk with three more measures of information asymmetry: firm size, number of analysts following, and research and development expenses. Including all these interaction terms in regressions leads to a large number of tables, which we do not include in the paper due to the length limit. These untabulated results show that the interaction terms are largely insignificant regardless of the measure used, inconsistent with the insider opportunism story but consistent with Gider and Westheide (2016).

Aboody and Kasznik (2000) argue that when examining insider trading, it is important to consider both insider trading frequency and profitability together as both contribute to the total profits earned by insiders. We analyze the profitability of insider trades within three months before or after option grants, measured by the *30-day value-weighted CAR*. Note that while some studies favor the 6-month CAR due to the short-swing rule, we limit our CAR window to 30 days to minimize the risk of overlapping event windows because a longer window after insider trades

following option grants could overlap insider trades before next year's option grants. In addition, CAR estimates based on different event windows after insider trading tend to show very strong correlation (Seyhun and Bradley, 1997; Dang et al., 2021). The average *30-day CAR* following insider purchases and sales in our sample are 5.49% and -3.88%, respectively, and are comparable to those reported in earlier studies such as Seyhun and Bradley (1997) and Frankel and Li (2004). In Table 7, we report regression results of *30-day value-weighted CAR* on a dummy variable *AFTER* which equals 1 if the trade occurs within three months after the option grant, and 0 otherwise.[6] Because insider purchases and sales often precede opposite price movements, we analyze insider purchases in Panel A and sales in Panel B separately. To avoid very small regression coefficient estimates, we multiply our dependent variable *30-day CAR* by 100 in all regressions. We include the same control variables and industry and year fixed effects in regressions.

[Insert Table 7 here]

For insider purchases, the coefficient estimates of *AFTER* are insignificant: there is no statistical difference in *30-day CAR* following insider purchases three-month before or three-month after option grants. Purchases by CEOs and CFOs after option grants precedes higher CAR, as suggested by the positive and significant interaction terms. For insider sales, the coefficient estimates of *AFTER* are positive in all regressions and significant in six out of nine regressions: there is a significant increase in *30-day CAR* following insider sales three-month after compared with three-month before option grants. This remains true when we analyze insiders who often possess more information: CEOs, presidents, CFOs, chairmen, other officers and other directors.

[6] Our results are robust to the 10-day and 20-day CAR windows.

Overall, despite some evidence that certain groups of insiders may buy on private information, the increased selling following option grants do not appear to be more informative on average.[7] We conclude that the increase in insider selling more likely stems from risk considerations rather than insider opportunism.

5. Conclusion

Insider ownership plays a crucial role in shaping insider incentives to maximize shareholder value. A common rationale for granting options is that by increasing insider ownership, it aligns the interests of insiders and shareholders. We show that insiders tend to increase their sales after receiving options, and these sales are far more common than the use of derivatives described by Bettis et al. (2015). This highlights the need to account for ownership hedging through open market trading when designing insider compensation plans. These findings present challenges for both researchers and practitioners involved in corporate compensation plans: if one important reason for insider compensation plans is to increase insider ownership and better align managerial and shareholder interests, then the increased insider sales after option grants could potentially undermine the incentive effect. Our findings call for more research into the optimal design of option grants and other incentive plans.

Additionally, we find that the increases in insider net sales are largely influenced by firm risk measures such as idiosyncratic volatility and crash risk, rather than insider opportunism measures. Although insiders sell more after getting options, these sales on average do not predict

[7] In further analysis, we show that the interaction terms are more pronounced if we only analyze purchases prior to positive earnings news, suggesting that opportunistic insider trading cannot be completely ruled out. However, we do not observe the same for sales before negative earnings news.

more negative future returns. Our measure of the net sale difference may hence help researchers and practitioners better understand the information content in insider trading.

Our study has a few limitations. First, we lack access to vesting data, preventing us from analyzing insider inventory as in Edmans et al. (2017, 2018), and we cannot rule out the possibility that some option grants coincide with the vesting of previous grants. Second, our analysis excludes stock grants and other scenarios where insiders experience similar increases in risk exposure. We leave these areas for future research.

Conflict of Interest Statement

No potential competing interest was reported by the author(s).

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Data Availability Statement

The data that support the findings of this study are available from Thomson Reuters, Standard and Poor's, Center for Research in Security Prices (CRSP), and Institutional Brokers' Estimate System (I/B/E/S). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of the respective third parties.

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Table 1 Employee Option Grants and Insider Stock Trading

This table shows descriptive statistics of insider option grants (Panel A) and insider stock transactions around option grants from month -3 to month +3 (Panel B). The sample period is from April 1996 to March 2019.

Variable	Mean	Q1	Median	Q3	STD
Panel A Option Grants					
Underlying Shares Per Option Grants	44,487	5,000	15,000	40,000	89,204
Dollar Value of Underlying Shares ($)	1,070,506	76,750	263,400	909,720	2,378,601
Panel B Insider Stock Trading					
Shares of Insider Purchases Before Option Grants	2,577	0	0	0	12,097
Shares of Insider Purchases After Option Grants	2,751	0	0	0	12,395
Shares of Insider Sales Before Option Grants	13,678	0	0	6,000	42,609
Shares of Insider Sales After Option Grants	16,537	0	0	9,715	48,737

Table 2 Summary Statistics

The table provides the summary statistics of the variables used in our tests from April 1996 to March 2019. Continuous variables are winsorized at the 1% and 99% levels.

Variable	Number of OBS	Mean	Q1	Median	Q3	Std
NetSaleDiff (%)	53,293	0.004	-0.016	0	0.021	0.202
Idiosyncratic Volatility (%)	50,818	47.26	25.88	40.2	60.45	29.13
Crash Risk	50,818	1.27	1	1	2	0.99
SharesOption (%)	53,293	0.13	0.01	0.04	0.11	0.26
SharesHeld (%)	53,293	0.69	0.01	0.06	0.27	2.27
Analysts	53,293	9.85	2	7	15	9.33
SharesOut (million)	53,293	123.08	16.02	36.86	92.96	272.43
MktCap ($ billion)	53,293	5.16	0.17	0.71	3.03	13.95
MTB	53,293	3.86	1.49	2.43	4.13	4.92
CAR20B (%)	53,293	-0.69	-6.97	-0.44	5.87	14.23
CEO or President	53,293	0.15	0	0	1	0.36
CFO	53,293	0.08	0	0	0	0.27
Board Chair	53,293	0.06	0	0	0	0.23
Other Officer	53,293	0.41	0	0	1	0.49
Other Director	53,293	0.37	0	0	1	0.48
Routine	53,293	0.39	0	0	1	0.49
Profitable Insider	47,763	0.08	0	0	0	0.27
Long Horizon Insider	10,978	0.56	0	1	1	0.50
Short Horizon Insider	10,978	0.24	0	0	1	0.43
CAR30A (%)	20,429	0.10	-8.75	-0.68	8.02	19.40

Table 3 Insider's Net Sale Differences

We report the insider's net stock sales differences three months after and three months before option grants and the corresponding T-statistics for different groups of insiders from April 1996 to March 2019. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Insider Group	# of OBS	Mean *NetSaleDiff* (%)	T-stat	Mean Underlying Shares Per Option Grants	Mean shares of Insider Purchases		Mean Shares of Insider Sales	
					Before Option Grants	After Option Grants	Before Option Grants	After Option Grants
Panel A All Insiders								
	53,293	0.004	4.37***	44,487	2,577	2,751	13,678	16,537
Panel B Different Insiders								
Officers	34,101	0.004	4.57***	56,609	1,581	1,847	13,874	17,423
Directors	27,579	0.004	2.11**	47,711	4,205	4,392	17,419	19,976
Panel C Top Insiders								
CEOs	6,176	0.005	1.44	138,203	4,450	5,538	28,177	33,451
CFOs	4,131	0.007	3.72***	49,525	1,345	1,738	10,015	13,225
Board Chairs	2,980	0.017	2.61***	126,105	5,046	5,066	36,938	45,011
Presidents	5,491	0.002	0.64	114,582	3,301	4,119	22,600	25,888
Panel D Other Insiders								
Other Officers	21,848	0.004	5.40***	37,137	760	792	10,023	13,149
Other Directors	19,884	0.002	1.27	18,164	4,120	4,093	12,845	14,390

Table 4 Regressions of Insiders' Net Stock Sale Differences on Idiosyncratic Volatility

This table reports the regression results of insiders' net stock sales difference on the firm's idiosyncratic volatility with year and industry fixed effects. The regression standard errors are clustered by firm. T-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Idiosyncratic Volatility	1.77***	1.85***	1.79***	1.60**	2.76*
	(2.70)	(2.82)	(2.72)	(2.33)	(1.74)
SharesOption	-60.37	-89.33	-60.74	-90.14	127.23
	(-0.79)	(-1.09)	(-0.79)	(-1.13)	(0.71)
SharesHeld	10.78	10.16	10.54	5.23	21.37
	(0.82)	(0.76)	(0.80)	(0.36)	(0.95)
Analysts	0.23*	0.21	0.23*	0.23*	0.42
	(1.72)	(1.53)	(1.67)	(1.68)	(1.44)
1/SharesOut	7.69***	7.98***	7.68***	7.58***	3.91
	(2.82)	(2.92)	(2.82)	(2.77)	(0.70)
1/MktCap	-38.63**	-37.39**	-38.47**	-37.31**	-63.58*
	(-2.52)	(-2.44)	(-2.51)	(-2.43)	(-1.91)
MTB	-0.00***	-0.00***	-0.00***	-0.00**	-0.03*
	(-2.95)	(-2.74)	(-2.95)	(-2.56)	(-1.81)
CAR20B	9.36***	9.38***	9.35***	8.99***	12.00***
	(9.08)	(9.10)	(9.07)	(8.64)	(5.13)
AFTER SOX	1.15	1.12	1.16	0.73	-0.63
	(1.34)	(1.30)	(1.35)	(0.88)	(-0.50)
CEO or President		-0.29			
		(-0.36)			
CFO		0.56			
		(0.75)			
Board Chair		1.43**			
		(2.06)			
Other Officer		0.08			
		(0.12)			
Other Director		-0.39			
		(-0.55)			
Routine			0.12		
			(0.61)		
Profitable Insider				-0.60	
				(-1.41)	
Long Horizon Insider					0.39
					(0.73)
Short Horizon Insider					0.10
					(0.15)
Constant	-0.58	-0.53	-0.61	0.24	-2.10
	(-0.40)	(-0.33)	(-0.42)	(0.16)	(-1.12)
Industry & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	50818	50818	50818	45702	10641
R^2	0.008	0.009	0.008	0.008	0.016

Table 5 Regressions of Insiders' Net Stock Sale Differences on Crash Risk

This table reports the regression results of insiders' net stock sale differences on the firm's crash risk with year and industry fixed effects. The regression standard errors are clustered by firm. T-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Crash Risk	0.47**	0.47**	0.47**	0.56**	0.74*
	(1.97)	(1.98)	(1.98)	(2.37)	(1.67)
SharesOption	-44.81	-69.36	-44.94	-66.24	199.82
	(-0.59)	(-0.85)	(-0.59)	(-0.85)	(1.07)
SharesHeld	11.84	11.30	11.70	6.36	26.74
	(0.90)	(0.84)	(0.88)	(0.45)	(1.21)
Analysts	0.14	0.11	0.13	0.14	0.22
	(1.03)	(0.84)	(0.99)	(1.03)	(0.77)
1/SharesOut	6.57**	6.79**	6.56**	6.98**	2.37
	(2.41)	(2.49)	(2.41)	(2.52)	(0.40)
1/MktCap	-27.70*	-26.15*	-27.53*	-29.44**	-60.25*
	(-1.89)	(-1.78)	(-1.87)	(-1.99)	(-1.79)
MTB	-0.00**	-0.00*	-0.00**	-0.00**	-0.03
	(-2.26)	(-1.95)	(-2.25)	(-2.22)	(-1.54)
CAR20B	9.39***	9.41***	9.38***	9.82***	11.40***
	(9.12)	(9.14)	(9.11)	(9.42)	(4.73)
AFTER SOX	0.88	0.85	0.89	0.39	-0.92
	(1.03)	(0.99)	(1.04)	(0.47)	(-0.69)
CEO or President		-0.35			
		(-0.43)			
CFO		0.55			
		(0.74)			
Board Chair		1.37**			
		(1.98)			
Other Officer		0.03			
		(0.04)			
Other Director		-0.39			
		(-0.55)			
Routine			0.07		
			(0.37)		
Profitable Insider				-0.79*	
				(-1.88)	
Long Horizon Insider					0.36
					(0.67)
Short Horizon Insider					0.06
					(0.08)
Constant	0.32	0.45	0.31	1.46	-0.70
	(0.23)	(0.29)	(0.22)	(1.01)	(-0.41)
Industry & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	50818	50818	50818	45704	10640
R^2	0.008	0.008	0.008	0.009	0.016

Table 6: Regressions of Insiders' Net Stock Sale Differences on Institutional Ownership

This table reports the regression results of insiders' net stock sale differences on the firm's institutional ownership with year and industry fixed effects. The regression standard errors are clustered by firm. T-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Institutional Ownership	-0.22	-0.25	-0.22	-0.19	0.02
	(-0.78)	(-0.88)	(-0.78)	(-0.67)	(0.04)
SharesOption	-44.15	-68.81	-44.27	-34.26	223.02
	(-0.58)	(-0.85)	(-0.58)	(-0.43)	(1.26)
SharesHeld	11.81	11.27	11.68	6.33	11.69
	(0.90)	(0.84)	(0.88)	(0.45)	(0.54)
Analysts	0.16	0.13	0.15	0.11	0.24
	(1.18)	(1.00)	(1.14)	(0.84)	(0.83)
1/SharesOut	6.70**	6.92**	6.69**	6.76**	1.93
	(2.46)	(2.54)	(2.45)	(2.46)	(0.32)
1/MktCap	-27.79*	-26.27*	-27.63*	-32.43**	-54.13
	(-1.89)	(-1.78)	(-1.88)	(-2.22)	(-1.51)
MTB	-0.00**	-0.00*	-0.00**	-0.00**	-0.02
	(-2.14)	(-1.83)	(-2.13)	(-2.18)	(-1.09)
CAR20B	9.32***	9.34***	9.32***	9.40***	11.20***
	(9.06)	(9.08)	(9.05)	(9.07)	(4.77)
AFTER SOX	1.02	0.98	1.02	0.77	-1.36
	(1.18)	(1.14)	(1.19)	(0.92)	(-1.07)
CEO or President		-0.36			
		(-0.43)			
CFO		0.56			
		(0.74)			
Board Chair		1.37**			
		(1.97)			
Other Officer		0.02			
		(0.03)			
Other Director		-0.39			
		(-0.56)			
Routine			0.07		
			(0.35)		
Profitable Insider				-0.73*	
				(-1.74)	
Long Horizon Insider					0.74
					(1.43)
Short Horizon Insider					0.49
					(0.73)
Constant	0.47	0.61	0.46	1.07	-0.18
	(0.33)	(0.38)	(0.32)	(0.75)	(-0.11)
Industry & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	50818	50818	50818	45712	10978
R^2	0.008	0.008	0.008	0.008	0.016

Table 7 Cumulative Abnormal Return After Insider Stock Trades

This table reports the regression results of firm's 30-day value-weighted CAR after stock purchases (Panel A) or sales (Panel B) within six-month window of option grants on variables of interests with year and industry fixed effects. The regression standard errors are clustered by firm. The dummy variable *After* equals to 1 if the if the stock transaction happens within three months after option grants and 0 otherwise. T-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A Stock Purchases

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
After	0.70	0.70	-2.98	0.70	1.24	0.53	0.45	1.29	3.25
	(0.96)	(0.96)	(-0.97)	(0.96)	(1.45)	(0.73)	(0.29)	(0.94)	(1.11)
CEO or President		1.14	-1.65						
		(0.62)	(-0.80)						
CFO		2.50	-1.28						
		(1.26)	(-0.57)						
Board Chair		-0.84	-2.06						
		(-0.46)	(-0.99)						
Other Officer		1.58	-0.52						
		(0.90)	(-0.27)						
Other Director		1.28	-0.11						
		(0.73)	(-0.06)						
CEO or President×After			5.44*						
			(1.67)						
CFO×After			7.42**						
			(2.07)						
Board Chair×After			2.31						
			(0.71)						
Other Officer×After			4.03						
			(1.33)						
Other Director×After			2.56						
			(0.84)						
Routine				-0.80	0.05				
				(-1.21)	(0.06)				
Routine×After					-1.72				
					(-1.34)				
Profitable Insider						0.98	0.94		
						(1.19)	(0.87)		
Profitable Insider × After							0.08		
							(0.05)		
Long Horizon Insider								-0.76	0.45
								(-0.49)	(0.20)
Short Horizon Insider								2.56	3.61
								(1.41)	(1.53)
Long Horizon Insider × After									-2.52
									(-0.80)
Short Horizon Insider × After									-2.26
									(-0.67)
Constant	8.41	6.78	9.05	8.50	8.29	7.60	7.63	20.48	19.90
	(0.67)	(0.53)	(0.70)	(0.68)	(0.66)	(0.58)	(0.59)	(0.89)	(0.88)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8556	8556	8556	8556	8556	6766	6766	997	997
R^2	0.072	0.072	0.074	0.072	0.072	0.078	0.078	0.189	0.190

Panel B Stock Sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
After	1.18*	1.14*	0.73	1.18*	1.16	1.16**	3.29**	1.37*	0.08
	(1.86)	(1.81)	(0.27)	(1.85)	(1.56)	(2.02)	(2.27)	(1.72)	(0.05)
CEO or President		-1.21	-1.74						
		(-0.77)	(-0.94)						
CFO		1.51	2.12						
		(0.94)	(1.06)						
Board Chair		0.58	1.14						
		(0.41)	(0.67)						
Other Officer		1.49	1.11						
		(1.14)	(0.74)						
Other Director		0.89	0.64						
		(0.70)	(0.47)						
CEO or President×After			0.91						
			(0.32)						
CFO×After			-1.21						
			(-0.38)						
Board Chair×After			-1.03						
			(-0.43)						
Other Officer×After			0.64						
			(0.24)						
Other Director×After			0.38						
			(0.16)						
Routine				0.66	0.64				
				(1.22)	(0.75)				
Routine×After					0.04				
					(0.04)				
Profitable Insider						-0.12	1.06		
						(-0.17)	(1.06)		
Profitable Insider X After							-2.31		
							(-1.58)		
Long Horizon Insider								-0.08	-1.26
								(-0.10)	(-0.91)
Short Horizon Insider								-0.67	-0.72
								(-0.66)	(-0.47)
Long Horizon Insider X After									2.22
									(1.30)
Short Horizon Insider X After									0.05
									(0.02)
Constant	-20.83***	-21.91***	-21.66***	-21.02***	-21.01***	-12.99***	-14.09***	-29.34***	-28.16***
	(-4.09)	(-4.18)	(-4.08)	(-4.08)	(-4.07)	(-2.69)	(-2.90)	(-3.70)	(-3.46)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11873	11873	11873	11873	11873	8469	8469	1930	1930
R^2	0.054	0.056	0.056	0.055	0.055	0.047	0.047	0.072	0.074

Online Appendix A. Correlation Coefficients

The table provides the pairwise correlation coefficients of the variables used in our tests from April 1996 to March 2019. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	NetSaleDiff	*Idiosyncratic Volatility*	*Crash Risk*	*SharesOption*	*SharesHeld*	*Analysts*	*1/SharesOut*	*1/MktCap*	*MTB*	*CAR20B*	*CAR30A*
NetSaleDiff	1										
Idiosyncratic Volatility	0.005	1									
Crash Risk	0.008*	-0.005	1								
SharesOption	-0.007	0.244***	-0.002	1							
SharesHeld	0.014***	0.160***	-0.000	0.218***	1						
Analysts	0.011**	-0.287***	0.049***	-0.239***	-0.152***	1					
1/SharesOut	0.004	0.149***	-0.013***	0.242***	0.150***	-0.536***	1				
1/MktCap	-0.017***	0.430****	0.000	0.288***	0.171***	-0.468***	0.554***	1			
MTB	0.008*	0.056***	-0.037***	-0.036***	-0.008*	0.152***	-0.172***	-0.152***	1		
CAR20B	0.064***	-0.030***	-0.040***	-0.031***	-0.006	0.007*	0.004	-0.019***	0.023***	1	
CAR30A	*-0.019*	*0.198**	*0.072**	*0.059**	*0.028*	*-0.030****	*-0.045*	*0.059**	*0.002*	*0.124**	*1*