Trading Ahead of Barbarians' Arrival at the Gate: Insider Trading on Non-Inside Information[☆]

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Abstract

Privately informed about firm fundamentals, corporate insiders detect activism-motivated trades better than other traders. This paper presents empirical evidence and solves the model of this novel form of insider trading motivated by non-insider information. Corporate insiders preserve their ownership (restraining from selling, or even buying more) before activist interventions go public, to benefit from price appreciation and to defend their private benefits of control. Response to real-time (pre-disclosure) activist trading is stronger precisely when positive information about firm fundamentals is absent, supporting the mechanism that insiders attribute order flows to activist interest when speculation on fundamentals could be ruled out.

Informed trading is a key driver to market efficiency (in that value-relevant information gets impounded into prices) and real efficiency (in that market signals direct resource allocation). At the same time, there is also a consensus that unbridled trading of a public company's stock or other securities by people who possess material, nonpublic information about the company is inherently unfair to other investors. A significant presence of such trades drains market participation and liquidity, and eventually stunts economic growth, as outside investors lose confidence in the leveling of the playing field (Bhattacharya and Daouk, 2002). For this reason, all major securities markets have developed laws, rules, and systems that regulate trades by insiders (which usually include senior management, board directors, and controlling shareholders, among others) and their affiliates who have privileged access to material nonpublic information, and criminalize insider trades that are based on, or misappropriate, such information.

While the theory and practice of insider trading laws and regulations have evolved over time, the boundary of insider trading remains blurry and becomes more so with new developments in the market. In this study, we explore a setting where an insider (e.g., a CEO) makes trading decisions regarding her firm's stock based on assessed possibilities of trading by activist shareholders, which do not constitute insider information. Shareholder activism aggressively pursued by hedge funds or hedge fund-like institutional investors has become a mainstream venue of non-control-based corporate governance (see a recent review by Brav, Jiang, and Li, 2021). Although the insider does not have direct information indicating the arrival of the "barbarians at the gate,"[1] privileged information about her own firm's fundamentals helps her filter public information and eventually trade on that information with a distinct advantage. We elaborate the set-up as follows.

[1]The term was coined in the namesake book by Burrough and Helyar (1990) on corporate raiders. More recently media have likened hedge fund activists to a new class of barbarians at the gate. See, e.g., "The Barbarians Return to the Gate," in *Financial Times*, April 24, 2014.

Activist hedge funds accumulate a minority stake, usually 5%−10%, stake in target companies (usually via open-market purchases) and then agitate for changes in operations, governance, and asset reallocation. Compared with other forms of informed trading by outsiders (such as those betting on takeover prospects or earnings surprises), activists are better positioned to camouflage their trades, except during the last ten days prior to disclosure, reflecting their ability to spread trades to time market liquidity (Collin-Dufresne and Fos, 2015). This is because the deadline for disclosing private information, in the form of a Schedule 13D,[2] is largely self-imposed. Now the question becomes: Are insiders better equipped to detect activist trading than outsider investors and market makers prior to Schedule 13D filings?

We hypothesize that the answer to this question is "yes" based on both incentives and capabilities. First, insiders have stronger incentives than general investors to inform themselves about activist plans. Information about an upcoming Schedule 13D filing is valuable to general investors—especially large shareholders, including insiders—because of the significantly positive average announcement return.[3] Such information is of additional value to incumbent managers. Because job turnover increases and compensation drops for senior executives at targeted firms, hedge fund activism often meets resistance from management.[4] Being prepared is a premise of an effective defense. As activism goes mainstream, firms have, with the help of financial advisors and other intermediaries,

[2]Schedule 13D is an SEC form serving to disclose beneficial ownership that is above 5% of shares outstanding, mandated within ten days after an investor crosses that threshold.

[3]Brav, Jiang, Partnoy, and Thomas (2008) documented an average 5%−6% return in excess of the market during the 20-day window around an announcement. A similar pattern and of similar magnitude has since been confirmed for the U.S. market (e.g. Clifford, 2008; Greenwood and Schor, 2009; Klein and Zur, 2009; Boyson and Mooradian, 2011) and for activism events in Europe (e.g. Becht et al., 2008). Internet Appendix Figure A2 shows similar price dynamics around Schedule 13D filing dates in our sample.

[4]According to Brav et al. (2008), activists were outright "hostile" or openly confrontational in about one-quarter of the cases; and managers of the target firm accommodated activist requests without major push back in fewer than 30% of the cases.

adapted by deploying defensive strategies ahead of the barbarians' arrival at the gate. In short, companies that recognize their vulnerability to activist targeting are incentivized to detect activist moves ahead of the public.

Second, insiders enjoy an information advantage in an indirect way. Conditional on the idea that both insiders and market makers observe the same order flows and trades, insiders have a more refined information filtration to isolate trades that might be generated by activist interests from those motivated by speculations on firm fundamentals, such as earnings or sales growth. The source of the insider's informational advantage is as follows. The activists in our model have the widest information set which includes the information available to the insider, and hence, their trading strategies are influenced by the insider's information. As a result, some information about the activist intentions can be inferred by the insider even before looking at the order flows. We show that the insider always profits from the additional information learnt from the order flows provided that the speculative demand in the market is not pure noise and is correlated with firm fundamentals.

Two institutional features make insiders' monitoring of and response to activist interest feasible. First, we note that insider's trade based on inferred information does not violate insider trading rule because the nonpublic information about speculative demands serves to filter information but would not have motivated any trade on its own. Interestingly, if insiders buy to counter activists, they do so precisely because of a lack of private positive information about firm fundamentals. Second, technology evolution has made real-time trades/orders essentially public information. In fact, it has been common in the theoretical literature to assume that agents observe order flows at the same level as market makers. Insiders who wish to monitor order flows could be served by the emerging "tape readers" and "market surveillance" firms that specialize in analyzing electronic order and trade books to hypothesize the motives underlying any unusual trading patterns, to

predict stock price directions, and to alert ownership changes.

In a motivating empirical diagnostic test (presented in Section 1.2), we show that corporate insiders engage in abnormal share purchases on days when activists trade, as well as three days afterwards (corresponding to a $T + 3$ settlement). Such a coincidence is intriguing given that activist trading is not publicly observable in real time. We thus present a stylized theoretical model that demonstrates a mechanism that could give rise to this pattern. In our model, a simple economy, lasting over three dates, is populated by an activist, a company insider, the market maker, and a "stock picker" (who speculates based on a noisy but informative signal about fundamentals). The activist can increase cash flows on date 2 in some but not all states of the economy and buys shares on date 0 when they can. The order flow on date 0 is comprised of the activist's and stock picker's demand. The latter demand is imperfectly correlated with cash flows and hence complicates the inference for the market maker, who is not informed about fundamentals. The insiders suffer disutility under activist ownership dominance and trade on date 1 after observing the order flow on date zero. Importantly, they have an informational advantage over the market maker regarding fundamentals and are better able to filter activist trading from the total order flow.

To preserve tractability, we assume that the strategies that activists and insiders adopt are binary, so that activists can only buy or abstain from buying whereas insiders can sell or continue to hold. Such assumptions are consistent with the empirical regularities according to which activists *become* shareholders to profit from their interventions as opposed to pre-existing shareholders who voice their discontent (Brav et al., 2008) and that, for the sake of diversification, insiders sell far more of their own firm's stock than they buy (which we document in Section 2.2). Our model predicts that insider trades bear a non-monotone relationship with total order flows and that insiders abstain from selling

shares when the possibility of activist trading is high. Relaxing the modeling restriction that insiders choose only between selling and keeping their shares, we interpret the result more generally as indicating high net buying or low net selling, corresponding to the acquisition or preservation of shares, by insiders after discerning activist interest. Such a trading strategy, along with financial calculations of trading gains, serves as a defensive tactic. This is because both insiders and dissident shareholders typically own similar percentages of the outstanding target stock,[5] and therefore a marginal change in ownership on either side could be pivotal.

We empirically investigate whether and to what extent insiders trade ahead of Schedule 13D filings and whether the trading pattern is related to insiders' ability to gleam information from both unusual trading volumes and forward-looking information about their own firms. Several patterns and relationships arise. First, we document a significant relationship between activist trading and insider trading during the 60-day window prior to a Schedule 13D filing,[6] which is not publicly observable in real time. We begin by comparing insider trading during the 60-day window prior to a Schedule 13D filing with those outside the time window. We find that the likelihood that insider buying (selling) occurs is 13 (78) basis points higher (lower) insider the time window than outside it. The difference, which is statistically significant, amounts to 15% (37%) of the normal pace of insider buying (selling). The combination of more buying and less selling leaves more shares, and hence voting and control power, in the hands of management at the dawn of an activist campaign.

We discover, within the 60-day window, a significant concurrence between activist

[5] Fos and Jiang (2016) report that the activist and insider blocks at proxy contests are 9.6% and 10.9%, respectively, on average.

[6] The 60-day window is dictated by the SEC rule that Schedule 13D filers are required to disclose trading during the previous 60 days. Collin-Dufresne and Fos (2015) show, however, that shares accumulated during this window constitute 51% of total activist stakes.

and insider buys. Although the relation becomes stronger during the last ten days when activists face fixed deadlines before disclosure,[7] some insiders seem to be able to detect activist footprints when they are more than ten days away and when their trades do not trigger notable market impact. The combined results indicate that insiders both refrain from selling and further engage in buying when they discern a threat of activism ahead of when the knowledge becomes available in the market.

Second, we rule out the alternative hypothesis that the concurrence of activist and insider trading could be the result of activists' piggybacking on insider buying as the latter might be motivated by private positive information about the firm. Under the T+3 settlement rule that prevailed during most of our sample period (until 2017), a transaction will complete the ownership record change three days after the trade. If companies or investors actively monitor ownership changes—with the help of such intermediaries as proxy solicitors—they might also become informed three days after the trade. In the reverse direction, activists could potentially be informed of trades placed by insiders after just two days given that insider trading requires disclosure within 48 hours. Importantly, we further find that insider buying is significantly higher (at the 5% level) than usual on T+3 days relative to activist trading; there is, however, no significant correlation between activist trading and insider trading two days (or any days) prior. Therefore, these results attribute the "source" trades to activists while insiders trade in response.

Third, we empirically test the mechanism through which insiders are better positioned to isolate unusual trade flows from activist interests from those motivated by speculation on firm fundamentals. We show that insiders respond to activist buys even when ex-ante

[7] If we treat average ownership at filings of 7.5% (Collin-Dufresne and Fos, 2015) as a proxy for the ownership level activists desired before making their intention public, they then need to acquire an additional 2.5%. It becomes a challenge for those activists to continue to camouflage their trades given the limited opportunity they have to time market liquidity as they face a hard deadline of ten days triggered by crossing the 5% ownership threshold.

firm vulnerability to activist intervention is low, suggesting that the source of information is more refined than a probabilistic assessment of activist arrivals based on firm- and market-level conditions. A key model prediction built on the mechanism is that insiders are able to respond to activist trading more decisively precisely when there is an absence of upcoming positive news about the firm's performance. We test this hypothesis in the context of earnings surprises, about which insiders are most likely to be informed ahead of the public. We find that the abnormal insider buying that we observe on the days when activist trading occurs is driven solely by the subsample that lacks positive earning surprises. In fact, within the subsample of positive earning surprises, there is no significant insider trading (buying or selling) on days when activists trade. This test affirmatively differentiates insider buying (and not selling) in response to activist interest in our set-up from the conventional insider trading based on private information about fundamentals.

Finally, we provide empirical tests that affirm the dual motives—control and financial gains—for insider trading in response to anticipated activism. First, we find that insider responses to activist trading are the strongest when insider ownership is close to the expected activist ownership, around 5% to 10%. Within this range, preserving and acquiring additional share ownership is most pivotal to enable insiders to defend their control. Second, we hypothesize that another piece of fundamental information insiders potentially have pertains to room for improvement if the company undergoes operational and governance reforms under activist pressure. Consistent with this hypothesis, we show that the announcement return around activist public emergence (the filing of 13D) is significantly higher when insiders engage in excess share purchasing as well as when they exhibit shortfalls from normal selling, after controlling for other firm- and event-related variables. In combination, we show that insiders act on and benefit from two motives: They counter activist power and benefit from price appreciation with added ownership

stakes.

While this study's main contribution is to present and test a novel form of insider trading without insider information regarding the direct motive to trade, we also aim to achieve a better understanding of corporate strategies facing activist attacks—a relatively understudied corner of the activism literature, as most of that literature bears the perspective of activist investors and other institutional investors, as estimates of the impact on target firms. A few studies adopt the lens of the defensive side. Fos and Jiang (2016) show that CEOs in firms that are targets of proxy contests change their option exercise patterns to preserve voting power. Bourveau and Schoenfeld (2017) show how firms that are vulnerable to activist attack increase and strategize voluntary disclosure. Fos (2018) and Gantchev et al. (2018) both show that firms start taking corrective measures after their peers have been targeted by activists. Our study differs from these earlier papers in that we model insider responses to activist plans that are not yet public and cannot be predicted from public information, presenting new evidence that a corporate defense starts before the opponents' arrival at the gate.

1. Institutional Background

1.1. Informed and insider trading around Schedule 13D filings

In the United States, Sections 16(b) and 10(b) of the Securities Exchange Act of 1934 serve as the basis for regulating insider trading. Under the current interpretation of the law, anyone who misappropriates material non-public information and trades while in possession of such information may be guilty of insider trading.[8] Activist investing introduces novel

[8]Where illegal insider trading is concerned, "insiders," despite the term, are not limited only to corporate officials/directors and large shareholders but can include any individual who trades shares while in possession of material non-public information about the firm (the issuer) obtained in some direct or imputed duty of trust.

nuances to insider trading. The first new question is whether information about an activist's plan to target a company constitutes material, nonpublic information, a criterion for insider trading. On the surface, such information predicts stock returns (hence its materiality) and is not known to the public until the filing of a Schedule 13D (hence its nonpublic nature).[9] Though some observers have advocated for extending insider information to activists even before Schedule 13D filings, however, information about activists does not originate from the firm and is not obtained through or with any breach of trust or duty. Instead, the information is created by the activists, who are outsiders when accumulating shares; moreover, the information concerns activists' plans which is not proprietary to the firm.[10]

The second new issue, which this study exposes, is that corporate insiders may have an advantage in filtering public information with the help of their private information about firm fundamentals. Even if insiders and outside speculators observe the same trade flows, the private knowledge of fundamental information (such as earnings and sales growth) enables insiders to rule in or rule out trades motivated by fundamentals and therefore to achieve better estimation of the likelihood that activist interests come into play. If insiders trade (or change pre-existing trading plans for) because of assessed activist interests, such trades are innocent when viewed through the conventional lens of insider trading because activist interests do not constitute insider information (as discussed above). This situation is compounded by the "safe harbor" that allows insiders to cancel pre-committed trades (e.g., via 10b-5 Plans which allow insiders to buy and sell—usually sell—shares according to pre-set plans to clear themselves of insider trading liabilities), reflecting the U.S. Supreme Court's holding that there can be no liability for insider trading without an actual securities

[9]Schedule 13D is an SEC form serving to disclose beneficial ownership that captures more than 5% of shares outstanding, mandated within ten days after an investor crosses that threshold.

[10]See Back, Collin-Dufresne, Fos, Li, and Ljungqvist (2018) for a theoretical model for such a setting.

transaction. Lenkey (2019) and Fos and Jiang (2016) provide theoretical predictions and empirical evidence of the cancellation of planned trading by informed insiders. Our setting incorporates both "insider trading based on non-insider information" (but with better filtering of public information) and "informed non-trading" (i.e., insiders restrain themselves from routine selling because of such information).

1.2. Motivating empirical pattern

Figure 1, shown below, provides motivating evidence that corporate insiders seem to trade in response to activist trading, although the latter is not public information in real time. Because the ensuing Schedule 13D filing requires that the filer retrospectively disclose all transactions in the firm's securities during the sixty-day window leading to the filing, we are able to classify activist trading ex post for research purposes. Merging these data with insider trading data from Form-4 filings, we are able to juxtapose transactions from both groups. In Section 2 we describe the data sources and sample construction in greater detail, while we highlight the findings herein.

Figure 1 reveals the excess probability that an insider will buy shares of her own firm from five days prior to an activist purchase as disclosed in Schedule 13D ("Schedule 13D trading") to five days afterwards. The benchmark is the unconditional average: The average daily probability that insiders buy shares in their own firms is 0.80%. It turns out that there is no abnormal trading by insiders during the ten-day window, except on two of those days: The same day that the activist trades and three days later. On these two days, the probabilities that insider buys occur are 0.68 and 0.18 basis points higher than the normal level, with both differences being significant at the 5% level and economically meaningful relative to the unconditional average. The three-day interval also looks fortuitous as it coincides with the $T+3$ settlement prevailing until 2017, which covers most of our sample. The pattern suggests that it is *as if* insiders are able to discern activist trades, from order

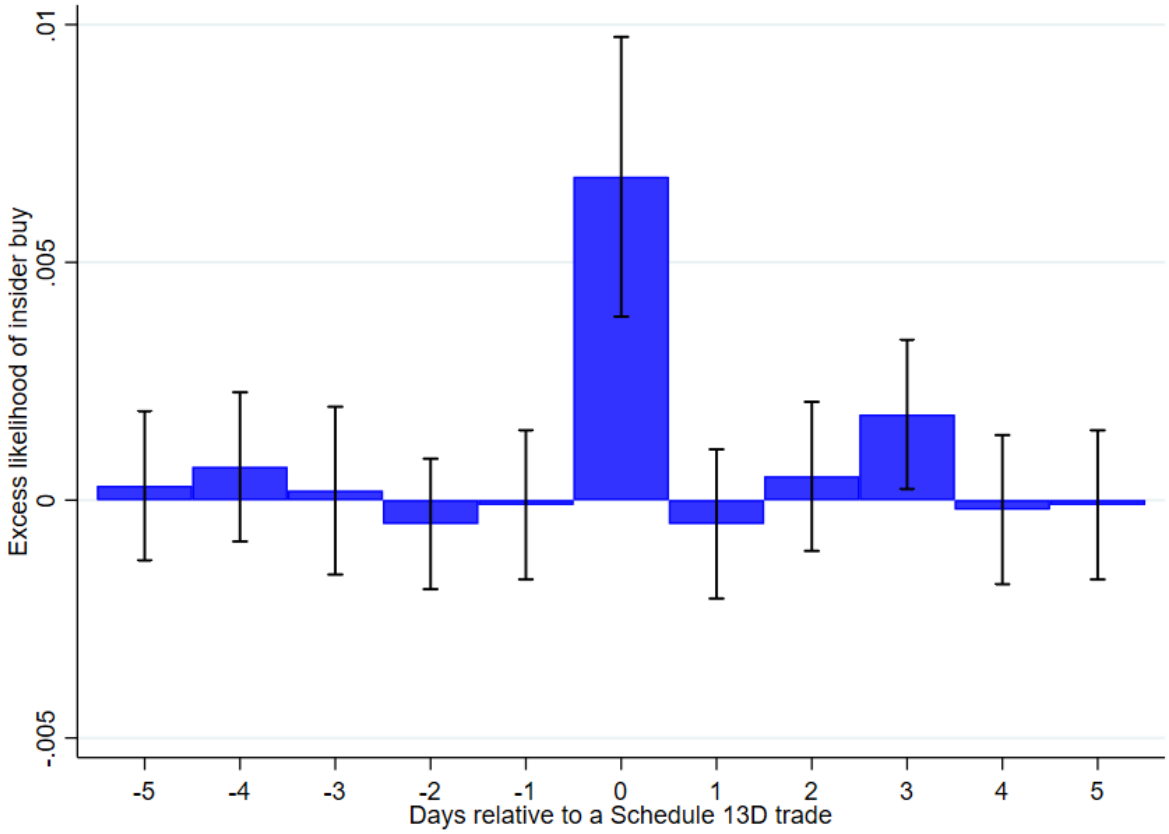

Figure 1: **Concurrence of insider and Schedule 13D trading.**

flows or settlements, although such information is not public in real time.[11] Activist buying is associated with price appreciation leading to the 13D filing date—in fact, the bulk of the abnormal return associated with the Schedule 13D filing occurs during the ten-day window prior to filing (Brav et al., 2008; Collin-Dufresne and Fos, 2015). Therefore it is rational for some insiders to make same-day purchases, if they wish to respond.[12]

[11]Several studies have suggested that an activist may "tip" other traders about her plan prior to a Schedule 13D filing and before the stock price fully reflects the value improvement, especially after the lead activist reaches desired ownership stake (Wong, 2020). Sharing information helps the activist accumulate more voting power by allying like-minded investors who, in turn, can benefit from the expected increase in the target firm's stock price. We do not rule out such a scenario but note that insiders in the target firms are the least desired "tippees" by the activists.

[12]A quick response of insiders to activist interests does not necessarily require that insiders themselves monitor order flows in real time. Instead, a burgeoning industry, in the form of software or investor relation services, has emerged to provide real time trade surveillance for purposes ranging from detecting fraud to

2. Data and Overview

2.1. Data sources

The construction of the key data sample for this study follows the methodology developed in Collin-Dufresne and Fos (2015). We start with a universe of Schedule 13D filings from the SEC EDGAR website spanning 1996-2018. We begin from the universe of all Schedule 13D filings available on EDGAR. We then exclude filings by corporate insiders as well as filings that result from non-market transactions (e.g., conversion of pre-held securities, private placements, negotiated block transactions, and gifts of shares), and require that an investor must cross the 5% threshold by purchasing shares in the open market. Finally, we exclude cases where derivatives (such as options) count toward the 5% ownership threshold because our set-up focuses on trades by activists and insiders in the public equity market. Our preliminary sample contains about 3,100 Schedule 13D filings.

For each event, we have access to the usual information on the activist's identity, the filing date, the disclosure trigger date (the 5% crossing date), and the disclosed ownership stake. The key input from the 13D filings for this project is the information indicating all trades made by filers during the 60-day period prior to filings. We are left with 2,847 Schedule 13D filings for which there is disclosed information regarding activist trading. The sample corresponds to 115,841 observations (2,847 times the number of trading days during the 60-calendar-day window). For each trade disclosed on Schedule 13D, we know the date of the trading (and hence we also know the dates when there is no activist trading), the number of shares in every transaction (which could be either buys or sells, the great majority being buys), and the average daily price paid or received.

We then merge the manually collected data with standard databases to obtain

trading pattern recognition. Such systems have quickly become a tool kit for activism defence. See report by Grand View Reach.

stock- and firm-level information (from CRSP and Compustat) as well as insider trading information (from Thomson Reuters). We use purchase and sell transactions reported on Form 4 for directors (role codes CB, D, DO, H, OD, and VC) and officers (role codes AV, CEO, CFO, CI, CO, CT, EVP, O, OB, OP, OT, OS, OX, P, S, SVP, and VP).

2.2. Sample overview and summary statistics

Our Schedule 13D trading sample consists of 2,847 Schedule 13D filings with information on activist trades ("events"). Figure 2 shows the time-series distribution of events. The number of events ranges from 64 during 2004 to 185 during 2007, averaging 124 events per year. During a typical event, Schedule 13D filers trade on 29.2% of trading days (during the 60-day window), suggesting that they trade on selective days rather than continuously. When Schedule 13D filers trade, they capture a large fraction of trading activity. Specifically, the average number of shares traded is 26.3% of daily turnover during the 60-day window; the proportion rises to 30.1% during the last ten days leading to filings. However, because activists tend to trade in a way that best conceals their actions (Collin-Dufresne and Fos, 2015), it is hard to predict when a Schedule 13D filing event occurs or on which days Schedule 13D filers trade, based on public information including order flows.

[Insert Figure 2 here.]

We next turn our attention to data from Thomson Reuters on trading by corporate insiders. Our sample contains 31.9 million firm-trading day observations. The summary statistics are reported in Table 2, after Table 1, where we define all variables. The results reported in Panel A indicate that the average probability that an insider trade (buy or sell) occurs on a given day is 2.97%, with the majority of insider trades being sell transactions as insiders need to cash out their equity-based compensation for liquidity and diversification. For Panel B of Table 2, we restrict the sample to days when Schedule 13D filers trade. The

results indicate that the probability that the insider buys is 1.22% on days when activists trade, as compared with 0.80% on an average day (Panel A); on the selling front, the probability is 1.64% on activist trading days, lower than the 2.15% unconditional average. Thus, the descriptive statistics provide the first indication of a relationship between insider and activist trades, that is, insiders buy to a greater extent and sell to a lesser extent on days when activists trade.

[Insert Table 1 here.]

[Insert Table 2 here.]

In Panel C we report summary statistics for days with insider trading. Consistently with our earlier discussion, we find that insiders are more likely to sell (73%) than to buy (27%) when they trade. Daily returns are higher on days when insiders trade than with the full sample. Finally, we note that a lack of insider trades could reflect imposed restrictions. For this reason, in our empirical analysis we control for the limitations imposed on trading by the common "blackout windows" during which insiders are not allowed to conduct discretionary trades in anticipation of upcoming releases of material information (e.g., earnings). The blackout windows for individual firms are not publicly disclosed in filings. We thus calibrate the upper bound and lower bound based on the survey conducted by Bettis et al. (2000). Specifically, we code [t+4,t+14] relative to quarterly disclosure as the "Free trade" window and [t-14,t+2] as the "Not free trade" window. The results reported in Panel C indicate that trading intensity is 20.4% during the *Free trade* window and 6.9% during the *Not free trade* window, indicating that insider trading restrictions affect the likelihood that insider trading occurs in an expected way.[13]

[13]Insider trading still occurs during the *Not free trade* window because pre-committed trades, especially those authorized by plans that are compliant with Rule 10b5-1, are not restricted. At the same time, such pre-planed transactions are cancellable (see Fos and Jiang, 2016; Lenkey, 2019).

3. Empirical Tests and Results

3.1. Univariate Analyses

In Table 3, we present three sets of results signifying abnormal insider trading prior to Schedule 13D filings. First, we compare insider trades during the 60-day window prior to Schedule 13D filings with those outside the time window, and the results are reported in Panel B. Insider buy frequency increases by 12 basis points or by 15% over the usual level. In contrast, insider selling slows by 0.78 percentage points or by 36%. Both differences are statistically significant at less than the 1% level. The combination of more buying and less selling prior to Schedule 13D filings leaves more shares, and hence voting and control power, in the hands of management at the dawn of an activist campaign.

[Insert Table 3 here.]

For Panel C of Table 3 we further partition the 60-day window into the last ten and the first 50 days. Note that, during most of the 10-day window, activists likely have passed the 5% ownership triggering level and have ten days before having to disclose their blocks.[14] If we treat ownership at filings, on average 7.5% (Collin-Dufresne and Fos, 2015), as a proxy for the ownership level activists desired before making their intentions public (and hence the price fully reflects the value impact of their effort), activists on average need to acquire an additional 2.5% against a hard deadline of ten days. Because of the fixed time limit, it is a challenge for the activists to continue to camouflage their trades as they lose the discretion to time market liquidity.

We thus hypothesize that the pattern we observed in Panel B should be most profound during the last ten days of the 60-day window. The results reported in Panel C confirm

[14] Bebchuk et al. (2013) report the detailed distribution of the interval between 5% threshold crossings and 13D filings. Over 80% of Schedule 13D filings are filed six or more days after triggering transactions.

this hypothesis. While selling in both sub-periods is substantially lower than the normal level, the abnormal insider buying is concentrated mostly during the last ten days. The daily buying frequency is 1.27% during the ten-day window, which is significantly higher (at less than the 1% level) than the 0.86% frequency during the previous 50 days.

Next, we partition the 60-day window into two subsets: Days on which Schedule 13D filers buy shares and those when they do not. Recall that such information is not observable or predictable based on public information in real time. It turns out that insider buying frequency remains normal on days when Schedule 13D filers do not trade but the frequency is 0.43 percentage points higher (or 53% higher) on days when Schedule 13D filers' trades occur. The difference is again significant at the 1% level. The selling rate is also higher by 0.37 percentage points, indicating that in some cases insiders consume the liquidity provided by activist buying. In regression analyses we control for daily turnover to mitigate the effect of stock liquidity on the estimates.

3.2. Insider Response to Activist Trades

In this section we present analyses in the regression framework to connect insider and activist trades while controlling for firm- and stock-level characteristics that are relevant to trading. Saturated fixed effects are deployed to subsume unobserved firm and market heterogeneity. In the first step, we compare insider trades executed during the 60-day window prior to Schedule 13D filings (which is not publicly known in real time) with thoseexecuted outside the time window. The regression is as follows:

$$y_{it} = \alpha_i + \alpha_{ym} + \gamma_1 SC13D\ 60\text{-}day\ window_{it} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}, \quad (1)$$

where y_{it} is a measure of insider trading activity on day t for firm i, α_i represents firm fixed effects and α_{ym} represents year-month fixed effects. Among the independent variables,

SC13D 60-day window is an indicator of the 60-day window prior to Schedule 13D filings, $Return_{it}$ is the stock return on day t for firm i, and $Turnover\ rate_{it}$ is the share turnover rate on day t for firm i. Standard errors are clustered at the firm level. Firm and month fixed effects absorb unobserved firm-level characteristics and market conditions at the monthly level. The results are reported in Table 4.

[Insert Table 4 here.]

When we consider insider stock purchases (columns 1 and 2) and sales (columns 3 and 4), we find that the change in the likelihood that insider trading occurs is driven by the slowing of insider sells by 0.91 percentage points (relative to the normal level of 2.16%). That is, insiders who wish to preserve their ownership facing activists accomplish the end mainly by refrain from selling. For this reason, we empirically examine the outcome of "Insider net sells" (i.e., the difference between sells and buys) and report the results in columns (5) and (6). During the 60-day window prior to Schedule 13D filings, insiders significantly (at the 1% level) reduce net selling by 0.83 to 0.93 percentage points below the normal level.

The slowdown of insider selling of shares corroborates theoretical predictions of Levit et al. (2021) that there is an equilibrium "voting premium," and empirical findings in Fos and Jiang (2016) showing that CEOs exercise options to a lesser extent after proxy contests are announced. Both results indicate insiders' desire to preserve their stock holdings (hence their voting rights or controlling power in general) when they face challenges from activist shareholders. Nevertheless, the two settings are critically different: The earlier papers show insider responses after public announcements of activism (proxy contests) while this paper's setting we discover that some insiders seem to respond to activists before the latters' arrival at the gate.

Based on the finding of the previous regression that the 60-day window prior to Schedule 13D filings is where the action is, the next regression zooms into this window:

$$y_{it} = \alpha_{iym}(\text{or, } \alpha_i + \alpha_{ym}) + \gamma_1 SC13D\ trade_{it} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}, \quad (2)$$

where $t \in [-60, -1]$, and y_{it} as well as the two control variables, are same as in equation (1). The new key independent variable, *SC13D trade*, is an indicator of days when Schedule 13D filers trade. Importantly, the regression incorporates (firm × month) fixed effects, which absorb unobserved and time-varying (up to the monthly frequency) firm-level characteristics as well as real-time market conditions at the monthly level. Standard errors are clustered at the firm level. The results are reported in Table 5.

[Insert Table 5 here.]

In Table 5, the results reported in columns 1 and 2 indicate that insiders are more likely to buy on days when Schedule 13D filers trade. Specifically, the likelihood that insider buying occurs is 62-69 basis points (or about 80%) higher on days when Schedule 13D filers trade than on other days. This relationship, which is significant at the 1% level, incorporates controls for stock returns and turnover rates as well as firm × month fixed effects. Not surprisingly, insider net selling (as reported in columns (5)-(6)) mostly mirrors insider buying because there is no relationship between insider selling and Schedule 13D trades—presumably the slow-down in selling can manifest itself only over a period of time and is hard to measure at daily frequency. Naturally, we should take into account limitations imposed on trading, especially the "blackout windows" during which insiders are not allowed to conduct discretionary trades. Based on the discussion in Section 2.2, we code [t+4,t+14] as the "Free trade" window and [t-14,t+2] as the "No free trade" window, where t is the earnings announcement date. We also include in the regression an

indicator of the 30-day period prior to earnings announcements. We find that both *Free trade* and *No free trade* have the expected coefficients in the regressions, but importantly the relationships between insider and activist trades barely change from those indicated in Table 5.[15]

Prior literature shows that activist trades do not incur price impacts before reaching the disclosure-triggering 5% threshold, but generate upward price pressures afterwards when they face a fixed deadline of ten days to reach the desired ownership level. For this reason, we repeat the analysis associated with Table 5 separately for the separate periods $[-60, -11]$ and $[-10, -1]$. These results are reported in Table 6. Importantly, the concurrence of insider buys and activist trades holds and is significant in both samples. Not surprisingly, the relationship is stronger in the last ten-day window when activist footprints become easier to detect. Nevertheless, the fact that the result remains robust in the earlier window supports an insider advantage as activist trades are well camouflaged from outside market participants during this earlier period.

[Insert Table 6 here.]

After documenting insiders' trading in tandem with activists' trading at the extensive margin, we quantify the relationship at the intensive margin. We repeat the analysis associated with the first two columns of Table 5 but change the dependent variable to equal the number of shares insiders purchase scaled by shares outstanding. The estimation method switches to a tobit regression to reflect the fact that the dependent variables are left-censored at zero. The results indicate overall that on days when activists trade, insiders buy an additional 0.21% to 0.24% of shares outstanding, a statistically significant and economically sizable amount given the closeness of ownership stakes between the two

[15]For details, please see Internet Appendix Table A1.

blocks.[16]

The combined results reported in this section indicate that insiders seem to buy in tandem with accumulations of shares by activists. Moreover, the likelihood of insider selling is lower during the 60-day window prior to Schedule 13D filings (relative to days outside that window). The difference in insider selling and buying results can be attributed to the fact that insider selling is bounded by zero (that is, the most an insider can do is not to sell at all) and "non-action" is difficult to detect at high, daily frequency given the low unconditional rates. On the other hand, insider buying is more easily detectable at high frequency. The "net sell" results are consistent between the daily frequency (Table 5) and a 60-day frequency (Table 4). It is worth noting that the average daily return is 0.25% (significantly different from zero at 1%) on days when Schedule 13D filers buy (while the average of other days is −0.01%). Thus, an insider who becomes informed about activist trading has the financial incentive to buy as soon as possible.

3.3. Who leads the trade?

So far, the evidence shows that insiders and activists tend to trade on the same day during the 60 days leading to Schedule 13D filings. While certain market conditions, such as stock price changes and trading liquidity, could induce both parties to trade, the concurrence that survives the control of such conditions (and an inclusion of a stock-month fixed effect) suggests that the coincidence is likely to reflect non-random factors. Such a finding, while intriguing, does not inform us as to which party leads the trade. While we hypothesize that insiders respond to activist buying, the same evidence could also be construed as indicating that activists piggyback on insider buying as the latter might be motivated by positive information about the firm that is known privately to insiders (e.g.,

[16]For details, please see Internet Appendix Table A2.

Foroughi et al., 2021). To separate insider defensive buying (in response to activist trading) from activist buying that follows insiders (whose buying could be informed),[17] we need to step back and ask how information about trading by either insiders or activists could transmit in the market place. There are potentially three sources.

The first is "tape watching," that is, virtually all equipped market participants could observe real-time order flows and try to discern unusual trading and order flows. If insiders or activists suspect buying from the other side, they can react on the positive signal. Information flow in either direction could produce the correlation of trades by two parties on the same day. The second source would be a record change. Under the T+3 settlement rule that prevailed during most of our sample period (until 2017), a transaction will finish an ownership record change three days after the trade. If companies actively monitor their ownership changes—a common practice in activism defense that often involves intermediaries such as proxy solicitors—then they might become informed on T+3 where the records are updated. If insiders buy in response to activist trades, we could observe a significant response on T+3. Finally, transactions initiated by insiders are disclosed (on Form 4) within two days. If activists buy in response to insiders' trades, we could observe a response on T+2.

We first evaluate possible insider response to activist trade with the following regression:

$$Insider\ trade_{it} = \alpha_{iym} + \sum_{\tau=-5}^{5} \gamma_{1,\tau} SC13D\ trade_{it+\tau} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}, \tag{3}$$

where $SC13D\ trade_{it+\tau}$ is an indicator of τ days relative to the day when a Schedule 13D

[17] Foroughi et al. (2021) provides evidence that hedge funds (not activist funds specifically) tend to trade in the same direction as insiders when insider trades are likely driven by information.

filer trades. All other variables are the same as in regression (2). In Panel A in Table 7 we report the results.

The results reported in column (1) indicate that insiders conducted abnormally high volumes of share purchases (0.68 percentage points, or 85%, above the normal level) on exactly the same day as activists. At the same time, abnormal selling was close to zero in magnitude and significance (column (2)). As a result, net selling (column (3)) essentially provides a negative image of buying. Activist buying is associated with price appreciation leading to Schedule 13D filing dates—in fact, the bulk of the abnormal return associated with Schedule 13D filings occurs during the ten-day window prior to filing (Brav et al., 2008; Collin-Dufresne and Fos, 2015). Therefore it is rational for insiders to make same-day purchases if they wish to respond. The main result remains robust if we control for more lagged returns in the regression to include $Return_i, t-1$, $Return_i, t-2$, and $Return_i, t-3$, suggesting that the insider trades are not motivated by stock returns.[18]

[Insert Table 7 here.]

An interesting additional result emerges indicating that insider buys (but not sells) are significantly higher (at the 5% level) than usual on T+3 days relative to activist trading. Thus, the evidence is consistent with the idea that insiders trade in response to activist trading. Figure 1 visualizes the relationship presented in Table 7 Panel A. It is hard to argue that the observed insider trading is not a response to activist trading given the two significant bars on day 0 and day 3 and the near-zero levels everywhere else. Because the trading relationship we uncover in Tables 5 and 7 holds at daily frequency with a lead-lag specification, it is important to ensure that the relationship is not confounded by multi-day sequential trades by activists. In a sensitivity check, we confirm that the results reported in

[18]For details, please see Internet Appendix Table A3.

the two tables remain robust and qualitatively similar if we exclude observations of activist trades involving trades by the same activist-firm pair within two days before or after the focal trade.[19].

In the reverse direction, we estimate the following regression:

$$SC13D\ trade_{it} = \alpha_{iym} + \sum_{\tau=-5}^{5} \gamma_{1,\tau} Insider\ trade_{it+\tau} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}, \tag{4}$$

where $Insider\ trade_{it+\tau}$ is an indicator of τ days after a day when an insider trades. All other variables are the same as in regression (2). If activists trade in response to insider trades, then we should observe abnormal activist trading two days after insider trading (when the trades are disclosed). In Panel B of Table 7, we find no significant correlation of activist trading with insider trading on any days prior to or after days when insiders trade, including on $T + 2$ when insider trades are disclosed.[20] Combined results from the dual regressions support the hypothesis that the "source" trades are placed by the activists and then the insiders trade in response.

3.4. Insider filtering of information

The body of tests presented in the previous section provides strong evidence that some insiders seem to be informed of the imminent arrival of activists ahead of public knowledge. While our model attributes this foreknowledge to the insider's ability to separate trades by activists from those from speculators based on private information about firm fundamentals, we do not rule out other information channels. In particular we consider the two most plausible alternative explanations: Leakage of activist plans and estimated vulnerability to

[19]For details, please see Internet Appendix Table A4.

[20]While the SEC rule mandates that insiders disclose their trades within 48 hours, some may choose to do so immediately—which may blur the relationship between activist trades and insider trades two days prior to fillings. For Internet Appendix Table A5, we re-run the analysis while excluding insider trades that are disclosed early. The results continue to support the absence of a relationship.

activism.

First, activist plans could leak to the market through various involved parties such as the brokerage system (Barnon et al., 2019), or even activists themselves for the purpose of building up "wolfpacks" or to trade favors with like-minded fellow investors (Wong, 2020; Flugum et al., 2022; Brav et al., 2022). This line of research still suggests that incumbent managers are the last to be tipped off about such information given the playbook of the "barbarians."[21] To assess the possibility of activist plan leakage, we conduct a sensitivity check with the subsample of hostile engagements, i.e., activist campaigns that are openly confrontational with firm management based on the classification developed in Brav et al. (2008). Activists are most likely to ensure that their opponents are not tipped off with the information before they choose to make it public, when the engagements are adversarial. We find that the relationship between insider buys and activist trades during the 60-day window remains robust and significant with this subsample.[22]

Second, firms that are prone to activist attacks could be, with the help of a growing intermediary, conducting "vulnerability" tests from time to time and actively monitoring the formation of shareholder blocks that could turn activist. If insider knowledge about activist arrivals comes from such monitoring activities, we would then expect insider responses to activist trades to be stronger when firm vulnerability is higher. We estimate vulnerability based on the predicted probability that activism occurs based on a set of firm-level characteristics and performance variables following Brav et al. (2008), and sort the full sample into high- and low-vulnerability subsamples at the median value. Interestingly, the insider response to activist trading is stronger in the low-vulnerability subsample,

[21]Elliott Management, a prominent activist fund, often called the CEOs of the target firms as a "courtesy" moments before their 13D filings. See "Doomsday Investor" by Paul Singer, https://www.newyorker.com/magazine/2018/08/27/paul-singer-doomsday-investor.

[22]For details, see Internet Appendix Table A6

suggesting that the source of insider knowledge of activist plans goes beyond what general vulnerability monitoring would typically reveal.[23]

Next we test the central mechanism of insider information filtering, that is, insiders are better positioned to isolate unusual trades by activists from those motivated by leakage of or speculation about firm fundamentals on which the insiders enjoy superior information. According to this hypothesis, insiders should be able to respond to activist trading more decisively precisely when there is an absence of upcoming positive news about the firm's performance. We test the hypothesis in the context of earnings surprises, about which insiders are most likely to be better and earlier informed than the investor public.

To operationalize, we construct a standard unexpected earnings (SUE) measure, $(Actual\ earnings - Expected\ earnings)/Stock\ price$. *Actual earnings* is announced earnings in quarterly disclosures. *Expected earnings* is the analyst consensus forecast, defined as the average of all *non-updated* forecasts made by analysts in the IBES database during the 90 days before the earnings announcement. When a firm is not covered by the IBES, we adopt the standard practice in the accounting literature and impute the expected earnings in quarter t using past quarterly earnings with both season- and drift-level adjustment, calculated as $EPS_{t-4} \times \Sigma_{i=1}^{4} EPS_{t-i}/\Sigma_{i=5}^{8} EPS_{t-i}$. Finally, *Stock price* is the closing price at the quarter's end. We cross check the summary statistics to ensure that they are consistent with those reported in the literature (e.g. Livnat and Mendenhall, 2006): the average (median) SUE in our sample is –0.06% (0.03%), with an interquartile range of –0.15% to 0.25%.

For Table 8 we repeat the exercise associated with Table 5 but separate the subsample with positive upcoming earnings surprises (defined as 30-day periods prior to positive earnings surprises) from one without such positive news. Insiders likely know about

[23]For details, see Internet Appendix Table A7.

the positive earnings news, or the lack thereof, before the earnings announcement. The results show that abnormal insider net sells (driven by insider buy trades, as shown in table 5) on days when activist trading occurs are driven solely by the subsample that *lacks* positive SUE. The relation between insider response (to activist trade) and lack of positive fundamental news is a unique implication from information filtering, and cannot be explained by alternative channels of information leakage (such as EDGAR search activities analyzed in Flugum et al. (2022). In contrast, within the subsample of positive SUE, there is no significant insider trades (buys or sells) concurrent with activists' trades. It could be that insiders refrain from buying close to announcements of positive earnings news as it raises the burden to avoid insider trading liability. It could also be that it is difficult for insiders to discern activist trades from order flows, which could be informed trading motivated by earnings.

[Insert Table 8 here.]

3.5. Dual motives of insiders: Control and financial gains

Insiders have dual motives to respond to share accumulation by activists: Insiders wish to preserve their ownership stakes so that they can counter activist influence and defend their private benefits of control; and insiders' ownership also provides them with financial gains from stock-price appreciation associated with activist intervention. In this section we discuss our empirical tests of both motives.

In a control contest, additional insider ownership is potentially pivotal when the insider ownership stake is close to the expected activist ownership stake. In 65% of Schedule 13D filings, activists' ownership stakes are between 5% and 10%, indicating a focal range of activist ownership. For this reason, we trisect the full sample into sub-samples where insider ownership falls below 5%, between 5% and 10%, and above 10%, based on insider

ownership reported on Form-4 filings just before 60-day windows. The results reported in Table 9 indicate that insider reactions to activist trades are the strongest—in terms of both economic magnitude and statistical significance—with the intermediate sample (columns (3) and (4)) where additional insider acquisition of shares is the most pivotal ex ante. It is also interesting to observe that, when insider ownership is low (columns (1) and (2)), the coefficient on $SC13D$ *trade* is close to zero, consistent with a lack of motives for both control considerations and financial gains. Finally, the results reported in last two columns of Table 9 indicate that the main coefficient is about half the magnitude of those reported in columns (3) and (4), with marginal statistical significance. When insider ownership was already expected to out-weigh activist stakes, control-motivated purchasing is weakened but the financial motive to acquire additional shares remains in place.

[Insert Table 9 here.]

Another piece of firm fundamental insiders might have an informational advantage is the potential for improvement if the company undergoes operational and governance reforms under activist pressure. This is because insiders are likely to be informed about their "room for improvement" including the rents they themselves have been enjoying. This implies that insider trading prior to Schedule 13D filings has predictive power for Schedule 13D announcement returns. In Table 10 we report the results of putting this prediction to the test. For this table, the sample is the cross section of all Schedule 13D filings in our full sample. The dependent variable is the stock return in excess of the market (defined as the value-weighted CRSP total market return) during the $[-5, +5]$ day window, where day 0 marks the filing of a Schedule 13D. The two key independent variables are *Excess insider buy*, which indicates whether insiders engage in abnormal share purchases during the 60-day window prior to a Schedule 13D filing, and to provide a contrast, *Shortfall in insider sell*, which indicates cases when insiders engage in an abnormally small number of

share sales during the 60-day window prior to a Schedule 13D filing. Finally, in the table we report results with and without controls for firm-level characteristics.

[Insert Table 10 here.]

The results reported in column 1 indicate that, when insiders engage in excess share purchases during the [-60, -1] day window relative to the Schedule 13D filing, the Schedule 13D announcement return is on average 1.76% higher than returns on Schedule 13D filings before which insiders did not engage in excess share purchases, and the effect is statistically significant at the 1% level. Equally informative is the insider's selling behavior. The results reported in column 2 indicate that, when there is a shortfall in insider sales, the Schedule 13D announcement return is on average 0.97% lower than returns on Schedule 13D filings before which there was no shortfall in insider sales, and the effect is statistically significant at the 5% level.

Note that about 70% of the insider trading involves selling, as insiders like executives and directors need to dispose of their shares acquired via compensation to achieve liquidity and diversification. Hence, any slowdown in selling is isomorphic to buying as they both reflect a desire to accumulate more shares. To this point, Fos and Jiang (2016) document that CEOs significantly slow share sales from option exercises when facing proxy contests. This duality also emerges in our setting: when anticipating a Schedule 13D filing with a strong positive market reaction, insiders buy more *and* sell less during the 60-day window, allowing them to ride the market response to activism more profitably in addition to strengthening their own ownership stakes as well as their bargaining and voting power vis-a-vis the activists at the gate.

The results reported in column (4) indicate that the Schedule 13D announcement return is higher when activists accumulate a larger number of shares during the 60-day window. Specifically, the announcement returns are 0.18% percentage points higher when

activists accumulate an additional 1% of shares outstanding. Finally, the results reported in column (5) indicate that our main findings hold when we include firm-level characteristics in the regression.

4. A Model of Insider Trading Based on Non-Insider Information

4.1. Model overview

Though our empirical tests builds on the setting of insider trading ahead of announced activist intervention, the underlying mechanism is more generally about a novel form of informed trading by insiders. We thus devote this section to a parsimonious theoretical model on how the informational advantage that insiders enjoy enables them to detect and optimally respond to an external event for which insiders do not have direct superior information. Throughout the section we will link the model setup as well as the predictions to the empirical findings. The model explains the main empirical finding that insiders learn about activist trades ahead of the public, and further demonstrates how the information about activist trades could be gleaned from aggregate order flows, via insiders' superior knowledge about firm fundamentals.

Our model contributes to two strands of literature based on the sources of superior information. First, our paper adds to the literature of insider trading by highlighting a novel source of the insider advantage over the market maker. While the idea that insiders can learn about activist presence from the order flows is intuitive, our model adds to the literature by discussing conditions under which order flows generate valuable information for the insider which is not contained in the firm's fundamentals. Second, this study also connects to the "feedback effect" literature (see a survey by Bond et al. (2012)) where the value of the firm is endogenously determined by trading strategies that are both motivated by fundamentals and affect firm valuation (e.g., activism and the responses that ensue). A

premise of the feedback effect is that insiders, despite being more informed than outsiders overall, could still learn from the stock market in critical ways.

4.2. Model setup: Players, incentives, and information structure

The model sets up a two-period economy with three dates, $t = 0, 1, 2$, and three types of investors: the activist (with subscript A), the insider (I), the stock picker or outside speculator (N), and the market maker (M). The firm, in the absence of an activist intervention, pays final dividend D_2 on date $t = 2$, where D_2 equals $D_H > 0$ with probability π_D or $D_L = 0$ with probability $1 - \pi_D$. The insider represents agents, e.g., managers and board members, who run the firm and who enjoy the benefits of control. The activist can acquire shares in the firm and boost its output by bringing new skills, reducing inefficiencies, or monitoring the insiders' rent-seeking. Specifically, by acquiring stock holding θ_A in the firm, the activist increases the firm's output by $\psi\nu\theta_A$, where ν is a random variable, taking the value of 0 or 1, representing the activist's ability to increase output, and ψ is a scaling constant capturing the importance of actvism on firm value. Consequently, the firm's cash flow in the presence of activism is $D_2 + \psi\nu\theta_A$.[24] Finally, the stock picker receives an informative but noisy signal of D_2.

The type of the firm is given by $s \in \{L, H\}$, indicating whether it generates high or low dividends, and is known at $t = 0$ only to the activist and the insider. The ability to improve the firm, ν, is known only to the activist.[25] The market maker attempts to filter out the information about D_2 and ν while the insider focuses on learning about ν from

[24]The assumption that activists enhance the value of targeted firms is supported by the prevailing evidence across different time periods and markets. See a survey of existent evidence as well as an updated analysis in Brav et al. (2021).

[25]Activist investors engage in intensive research over candidates of target companies. Prominent activists such as Trian Partners and Starboard Value, are known for presenting in-depth reports running hundreds of pages at the launching of campaigns and for uncovering issues that even the mangers were not aware of. For simplicity, we assume that activists have the same level of information as the insiders about the firm fundamentals; but the key results remain as long as activists are more informed about D_2 than the outside speculators.

the observables. Consequently, the information set, regarding the firm's dividend process, of the activist strictly dominates that of the insider, which in turn dominates that of the market maker, so that $\mathcal{F}_M \subset \mathcal{F}_I \subset \mathcal{F}_A$, where $\mathcal{F}_A$, $\mathcal{F}_I$, and $\mathcal{F}_M$ denote the information sets of the various groups of investors. All investors know the unconditional joint distribution $\text{Prob}(\nu, D_2)$ of the activist improvement ν and dividend D_2. For tractability we adopt an "upper triangular" structure specifying that the activist can always create additional value for a "good" type firm but may not be able to save a fundamentally "bad" firm. Such a structure corresponds to a realistic situation, as argued by Brav et al. (2008), in which activists create value by bringing expertise and by mitigating agency problems but cannot rescue a firm from distress as a result of fundamental business issues such as obsolete technology or sun-setting markets. More details are elaborated in the Appendix A.

In terms of trading strategies, we assume that the activist only buys or abstains from trading, so that her trading strategy is constrained to $\theta_A \in \{0, \bar{\theta}\}$. Such an assumption is motivated by the fact that activist investors tend not to be pre-existing shareholders but choose to acquire most of their stakes in firms within a few months prior to targeting (Brav et al., 2008; Collin-Dufresne and Fos, 2015). Moreover, we are analyzing activists who benefit from value improvement and therefore they would not short the stock in equilibrium. On the insider's side, we assume that her trading strategy takes two possible values $\theta_I \in \{-\bar{\theta}, 0\}$, which captures the empirical regularity in virtue of which insiders routinely sell but infrequently buy stocks in their own firms. This is because managers and board members receive a significant portion of their compensation in the form of shares and options such that insiders are significant net sellers for the sake of liquidity and diversification.

The activist and the insider trade with the market maker. This trading is sequential in that the activist trades with the market maker on date $t = 0$ and then the insider trades on date $t = 1$ after observing prices and order flows at date $t = 0$. Such sequential

trading allows us to model the optimal response of the insider to the informed trading by the activist, which is the focus of this study.

The stock picker N in our model trades along with the activist and the insider and obfuscates the order flow. The stock picker's trades take values $\theta_{N,0} \in \{-\bar{\theta}, 0, \bar{\theta}\}$ on date $t = 0$ and $\theta_{N,1} \in \{-\bar{\theta}, 0, \bar{\theta}\}$ on date $t = 1$. Following the model developed in Lambert, Ostrovsky, and Panov (2018), we assume that the orders submitted by these traders are imperfectly correlated with the dividend D_2, such that N serves the dual role of informed and noise traders in the microstructure setting. The structure of conditional probabilities of the stock picker's order flows in the first and second periods, $\text{Prob}(\theta_{N,0} = k\bar{\theta}|D_s)$ and $\text{Prob}(\theta_{N,1} = k\bar{\theta}|D_s)$, where $k = -1, 0, 1$, is discussed in the Appendix A. To capture the idea that the stock pickers possess some information about the firm type $s \in \{L, H\}$, we assume that, when the type is good (i.e., $s = H$) they buy more frequently than sell, and vice versa when the type is bad (i.e., $s = L$).

The insider has an advantage over the market maker regarding the presence of activism, though the former does not possess any direct knowledge about activism. Because the insider observes type s she is better positioned than the market maker to filter out potential trading by the activist from the aggregate flow. Given activist's motivation by her ability to improve the firm ν, the insider can partially filters out activist interest from the order flows with insider's knowledge of D_2 and the joint distribution of D_2 and ν, and from the fact that stock picker's demand is correlated with D_2. The information in the stock picker demand is crucial for inducing the insider to learn from the order flows. If the stock picker's trades are pure noise then any abnormal buying could be attributed to a higher probability that an activist arrives, and no filtering would be necessary.[26]

[26]If stock picker's signal is pure noise, then, $\text{Prob}(\theta_{N,0} = \bar{\theta}|D_s) = \text{Prob}(\theta_{N,0} = 0|D_s) = \text{Prob}(\theta_{N,0} = -\bar{\theta}|D_s) = 1/3$. At such a limit, equation (A3) for the activist trading strategy θ_A and equation (A24) in the Appendix imply that, for example, $\text{Prob}(\theta_A = \bar{\theta}|D_L, \theta_A + \theta_{N,0} = x) = \text{Prob}(\theta_A = \bar{\theta}|D_L)$, where

By $p_1(\theta_A + \theta_{N,0})$ we denote the first-stage stock price on date $t = 0$ as a function of the combined order flow $\theta_A + \theta_{N,0}$ in the eyes of the market maker. The activist solves the following optimization on date $t = 0$:

$$\max_{\theta_A \in \{0,\bar{\theta}\}} \mathbb{E}\Big[(D_2 + \psi\nu\theta_A)\theta_A - \theta_A p_1(\theta_A + \theta_{N,0})|\mathcal{F}_A\Big], \tag{5}$$

where $\mathcal{F}_A$ is the activist's information set, which includes the information about D_2 and ν. We assume that the activist's initial stock holding is 0.

By $p_2(\theta_I + \theta_{N,1}, \theta_A^* + \theta_{N,0})$ we denote the second-stage stock price on date $t = 1$ as a function of the combined order flow $\theta_I + \theta_{N,1}$. We also model the fact that the insider suffers a disutility from activism that aims at reducing private benefits through monitoring.[27] The insider solves the following optimization problem:

$$\max_{\theta_I \in \{-\bar{\theta},0\}} \mathbb{E}\left[(D_2 + \psi\nu\theta_A)\theta_I - \phi\theta_A(-\theta_I) - \theta_I p_2(\theta_I + \theta_{N,1}, \theta_A^* + \theta_{N,0})|\mathcal{F}_I\right], \tag{6}$$

where $\mathcal{F}_I$ is the insider's information set. The insider has a positive initial endowment of shares so that the total wealth from the holding should be $(D_2 + \psi\nu\theta_A)(X_I + \theta_I)$. The initial position X_I does not, however, affect other terms or optimization and hence is simplified to the first term in (6), $(D_2 + \psi\nu\theta_A)\theta_I$.

The second term in (6), $-\phi\theta_A(-\theta_I)$, is related to the insider's disutility from activism—hence the negative sign in front of the term. Such disutility is greater when activist acquires a higher stake (θ_A) and when the insider sells more shares (i.e., if

$x \in \{0, \bar{\theta}\}$, and hence the information in the order flow is redundant for predicting the activist buying.

[27] Brav et al. (2008) show that CEO turnover rates more than double and their compensation experiences significant downsizing after the firm was targeted by an activist. Fos and Jiang (2016) discover that in extreme cases the insiders of firms targeted by activists exercise options out-of-money to boost their voting power prior to a proxy contest, providing sufficient evidence of private benefits of control.

$\theta_I = -\bar{\theta}$). In other words, the insider's disutility is related to the difference in ownership power (and hence influence over the firm) between the activists and the insiders.[28] It is worth noting that insiders, as significant shareholders themselves, benefit from value improvement brought about by activism. Therefore insiders, when facing the threat of activism, fight more fiercely to retain their jobs and benefits, instead of thwarting value-enhancing plans, in their negotiations or settlements with the activists (Corum, 2020). The negatively-signed term $-\theta_I$ captures the situation where high insider ownership significantly reduces the likelihood that an activism campaign will escalate to a state unfavorable to the insiders, such as a proxy contest. Bebchuk et al. (2020) provide empirical evidence that high insider ownership is associated with an outcome that is more "friendly" to the incumbent management. Based on these findings from the earlier literature, we adopt the simple specification that insider trading does not impact the value improvement created by activism (ψ) but does impact the insider's disutility from activism.

The private benefits of control and the financial gains generated by value-improving activism are two distinct economic channels that induce the insider to trade in the same direction as the activist in our model. The former factor, which is not priced, induces the insider to buy shares whenever there is a substantial possibility of activism whereas the latter channel is activated when the insider enjoys a sufficient informational advantage that gives rise to a gap between the asset price and the fundamental value, which allows the insider to make a financial profit.[29] Tables 9 and 10 provides empirical support to both channels.

[28] Fos and Jiang (2016) show that both insiders and dissident shareholders typically own similar and strictly minority percentages of the outstanding target stock, around 10 percent on average. Hence a marginal change in ownership on either side could be pivotal.

[29] We note that in our calibration of the model in Section A1 of the Appendix the financial gains channel is sufficiently strong to align the trading directions of the insider and the activist even absent the private benefits of control. However, the private benefits of control lend realism and robustness to the changes in model parameters.

The market maker, who observes neither D_2 nor ν, forms his expectation about the firm value based on order flows. Following the standard literature, we assume that the market maker is risk-neutral, behaves competitively, and sets the first-stage and second-stage prices to the expected values:

$$p_1(\theta_A + \theta_{N,0}) = \mathbb{E}\Big[D_2 + \psi\nu\theta_A | \theta_A + \theta_{N,0}\Big], \tag{7}$$

$$p_2(\theta_I + \theta_{N,1}, \theta_A + \theta_{N,0}) = \mathbb{E}\Big[D_2 + \psi\nu\theta_A | \theta_I + \theta_{N,1}, \theta_A + \theta_{N,0}\Big]. \tag{8}$$

4.3. Trading strategies and equilibrium

The model solution is presented in section A1 of the Appendix. We here discuss main features of the trading strategies and summarize the intuition. The activist's trading strategy is straightforward, and is given by equation (A3) in the Appendix. The market maker and the insider can learn the exact date-0 activist's strategy in two cases in which the aggregate order flows are given by $\theta_A + \theta_{N,0} = -\theta$ and $\theta_A + \theta_{N,0} = 2\theta$. Given the restrictions imposed on the activist's and the stock picker's trading strategies, the activist's trading strategies in the latter cases are given by $\theta_A = 0$ and $\theta_A = \bar{\theta}$, respectively. When $\theta_A + \theta_{N,0} \in \{0, \bar{\theta}\}$, the order flow is not fully revealing, and hence, the market maker needs to infer the trading strategy and the firm fundamentals using Bayesian updating by taking into account joint distribution of D_2 and ν and the structure of the stock picker's demand $\theta_{N,0}$. We show that the activist always buys shares when the firm is good (because she can always improve value for this firm type). If the firm is bad, though, the activist buys with some probability, only when she can implement the improvement (that is, when $\nu = 1$).

In the second stage at date $t = 1$, the insider observes the date $t = 0$ order flow $\theta_A + \theta_{N,0}$ and filters out the information about θ_A using the information in the order flow, the fundamentals D_2, and the distribution of the stock-picker's demands. After that, the

insider chooses the trading strategy that maximizes the objective function (6). When the firm type is good, the insider knows that the activist is always present because she can always further improve the firm. When the firm type is bad, the insider and the market maker can only perfectly learn the activist's strategy in the fully revealing cases, as in the first stage, but need to apply Bayesian reasoning in the other, more realistic non-revealing cases.[30]

The insider has an informational advantage over the market maker when the order flow is not fully revealing due to more refined filtration that includes the information about the fundamentals D_2. We show (under some parametric restrictions) that, when knowing that the firm fundamental is weak, the insider sells when $\theta_A + \theta_{N,0} = 0$ and buys when $\theta_A + \theta_{N,0} = \theta$. The intuition is that the insider deduces that the activist is more likely to be present in the latter case. Given the weak firm fundamentals ($D_2 = 0$), the insider down-weights the probability that a buy order might originate with the stock picker (who has an informative albeit noisy signal), leaving a greater chance that the positive order flow was generated by the activist (who buys in case the firm is fixable, i.e., $\nu = 1$). An activist buy in this scenario is more likely than in the scenario of zero aggregate order flow, which could reflect either the offsetting of the activist's buy order by the bearish stock picker (when the activist can improve the firm's value and the stock picker draws a negative signal) or no action by both (when the activist knows she cannot fix the firm and the stock picker did not receive a directional signal).

An important feature of the insider strategy in equation (A5) is that the insider's action (to sell or not to sell) is non-monotonic in the aggregate order flow, which highlights the pivotal role played by private managerial information (regarding firm fundamentals).

[30] Fully revealing cases arise because the trading strategies of activists and insiders take two values and the trading strategies of stock pickers take three values. In reality, investors have wider set of trading strategies, and hence, fully revealing cases are rare. Hence, our main focus is on non-revealing cases.

The non-monotonicity could not be brought by market surveillance alone (i.e., inferring corporate actions based on abnormalities in trading volume and order flows). In all our empirical tests, we demonstrating insider trades in response to activist trades controlling for market conditions, including returns and turnover volume.

4.4. Economic and empirical implications

We now summarize the main economic and empirical implications of our model. First, the model highlights two (related) sources of the informational advantage that insiders enjoy over the market makers, the knowledge of firm fundamentals, D_2, and the ability to efficiently separate activist trades from trades by the stock picker, given by equation (A2), because the latter trades are correlated with D_2, which the market maker does not observe.

Second, the model predicts that the insider trades respond to activist buys (which is not publicly observable) in addition to publicly observable market conditions, as shown in Figure 1 and Tables 4 to 7. Naturally, the order flow $\theta_A + \theta_{N,0}$ contains information about activist trading, but the filtering by the insider is much more refined because of the insider's knowledge about firm dividend D_2, as long as the stock picker's trades are at least somewhat informative about the fundamentals. Moreover, in reality, activist trades remain mostly under 30% of the total daily trading volume (Collin-Dufresne and Fos, 2015) and hence the pattern revealed in Figure 1 requires help from additional filtering.

Third, the model incorporates the insider's dual motive to exploit mispricing by the less-informed market maker (about firm fundamentals and the activist presence) and to mitigate her disutility from activism. Insiders refrain from selling (or even buy more) when they believe that activists are more likely to be present than the market maker expects due to their knowledge about a lack of positive fundamental news. Table 8 illustrate the relation using earnings surprise as a proxy for fundamental news. Insiders also buy more (and sell less) when they expect activists to greatly improve firm value so that they enjoy

the financial gain (Table 10) while defending their private benefits when insider ownership (and hence control power) is, a priori, similar to that of activists (Table 9).

5. Conclusion

We show empirically and theoretically that corporate insiders are better equipped to detect activist trading than outsider investors prior to Schedule 13D filings. Whereas the existing literature shows that insiders have incentives to do so because they recognize their vulnerability to activist targeting and resort to various defensive tactics (from poison pills to campaigning), this paper is the first to provide a novel channel, both theoretically and empirically, through which insiders can learn about and act on activist trading. Our key insight is that, conditional on the idea that both insiders and outsiders observe the same order flows and trades, insiders have more highly refined information filtration to isolate trades potentially generated by activist interests from those motivated by leakage of or speculation on firm fundamentals, such as earnings in upcoming quarters. Whereas this paper focuses on interaction between corporate insiders and activist investors, the implications apply to a general setting in which insiders obtain an informational advantage via better filtering of public information so that they are able to conduct informed trading that is not based directly on insider information.

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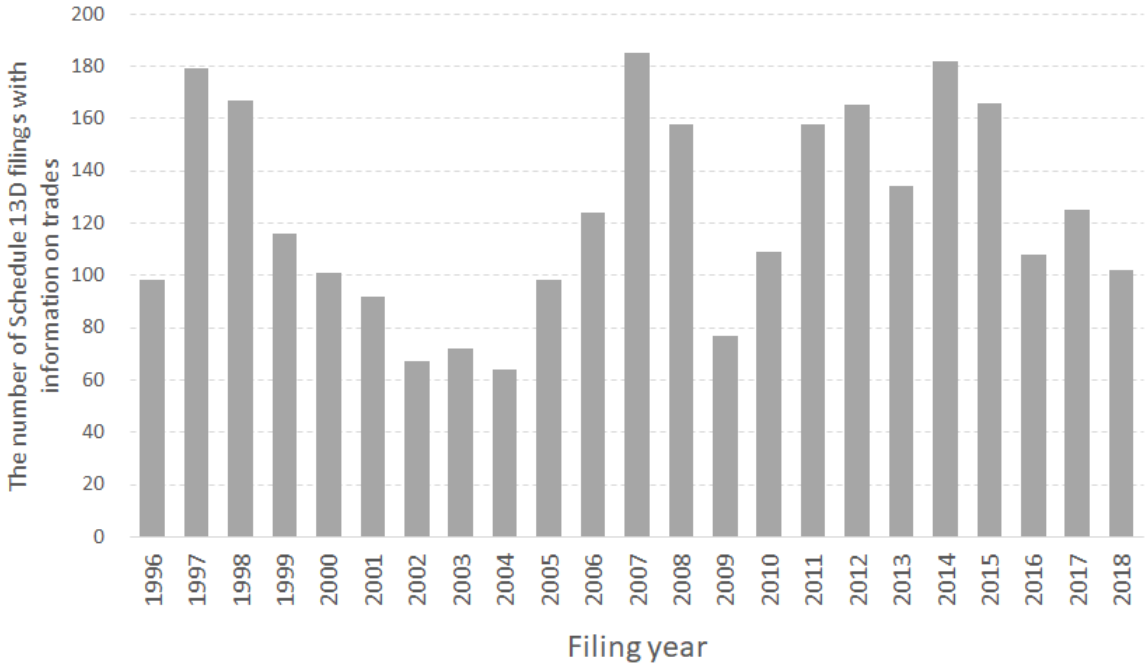

Figure 2: **Sample of Schedule 13D filings** The figure reports the time-series distribution of 2,847 Schedule 13D filings that constitute our sample.

Table 1: **Variable Definitions.**

Variable	Definition
Insider trade	Equals one on days when an insider trades, and zero otherwise.
Insider buy	Equals one on days when an insider purchases shares, and zero otherwise.
Excess insider buy	Equals one if average of *Insider buy* during the 60-day window is higher than the average of *Insider buy* during the same calendar window one year prior to a Schedule 13D filing.
Insider sell	Equals one on days when an insider sells shares, and zero otherwise.
Shortfall in insider sell	Equals one if the average of insider sales during the 60-day window is lower than the average of insider sales during the same calendar window one year prior to a Schedule 13D filing.
Net insider sell	Equals one (minus one) on days when an insider sells (buys) shares, and zero otherwise.
SC13D 60-day window	Equals one during 60-day window prior to a Schedule 13D filing, and zero otherwise.
SC13D trade	Equals one on days when a Schedule 13D filer trades, and zero otherwise.
SC13D turnover	The ratio of number shares traded by a Schedule 13D filer to the number of shares outstanding.
SC13D turnover during SC13D 60-day window	The sum of *SC13D turnover* during 60-day window prior to a Schedule 13D filing.
Daily returns	Daily stock returns from CRSP.
Daily turnover	The ratio of daily trading volume to the number of shares outstanding.
Pre-SUE month	Equals one during 30-day window prior to earnings announcement, and zero otherwise.
Free trade	Equals one during [t+4,t+14] window around earnings announcement, and zero otherwise.
Not free trade	Equals one during [t-14,t+2] window around earnings announcement, and zero otherwise.
Market cap	Market capitalization, in $ millions.
Firm age	Number of years since the stock's first appearance on CRSP.
Q	The ratio of market value of assets to the book value of assets.
Previous year stock return	The arithmetic mean of the preceding calendar year's monthly returns.
Sales growth	Annual sales growth over the calendar year.
Amihud illiquidity	Average of all the calendar year's daily statistic: 1000*sqrt(abs(ret)/(abs(prc)*vol)).
Analyst	Number of IBES analyst covering the stock.

Table 2: **Summary statistics.** The table reports summary statistics. Panel A reports summary statistics in the full sample. Panel B reports summary statistics in the sub-sample of trading days when Schedule 13D filers trade. Panel C reports summary statistics in the sub-sample of trading days when insiders trade. All variables are defined in table 1.

Variable	N	Mean	STD	p1	p25	p50	p75	p99
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full sample								
Insider trade	31,899,356	2.97%	16.98%	0.00%	0.00%	0.00%	0.00%	100.00%
Insider buy	31,899,356	0.80%	8.92%	0.00%	0.00%	0.00%	0.00%	0.00%
Insider sell	31,899,356	2.16%	14.55%	0.00%	0.00%	0.00%	0.00%	100.00%
Insider net sell	31,899,356	1.36%	17.16%	0.00%	0.00%	0.00%	0.00%	100.00%
SC13D 60-day window	31,899,356	0.36%	6.02%	0.00%	0.00%	0.00%	0.00%	0.00%
SC13D trade	31,899,356	0.12%	3.43%	0.00%	0.00%	0.00%	0.00%	0.00%
SC13D turnover	31,899,356	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
Daily returns	31,363,966	0.04%	3.30%	-10.86%	-1.28%	0.00%	1.23%	12.60%
Daily turnover	31,371,402	0.63%	0.89%	0.00%	0.11%	0.32%	0.75%	5.54%
Pre-SUE month	31,899,356	19.36%	39.51%	0.00%	0.00%	0.00%	0.00%	100.00%
Free trade	31,899,356	7.13%	25.73%	0.00%	0.00%	0.00%	0.00%	100.00%
Not free trade	31,899,356	11.18%	31.51%	0.00%	0.00%	0.00%	0.00%	100.00%
Panel B: Days when Schedule 13D filers trade								
Insider trade	37,513	2.86%	16.68%	0.00%	0.00%	0.00%	0.00%	100.00%
Insider buy	37,513	1.22%	10.96%	0.00%	0.00%	0.00%	0.00%	100.00%
Insider sell	37,513	1.64%	12.69%	0.00%	0.00%	0.00%	0.00%	100.00%
Insider net sell	37,513	0.42%	16.88%	-100.00%	0.00%	0.00%	0.00%	100.00%
SC13D turnover	37,513	0.23%	0.34%	0.00%	0.03%	0.10%	0.26%	1.51%
Daily returns	37,495	0.24%	3.30%	-10.42%	-0.97%	0.00%	1.17%	12.60%
Daily turnover	37,495	1.23%	1.42%	0.02%	0.29%	0.68%	1.53%	5.54%
Pre SUE month	37,513	23.82%	42.60%	0.00%	0.00%	0.00%	0.00%	100.00%
Free trade	37,513	9.44%	29.25%	0.00%	0.00%	0.00%	0.00%	100.00%
Not free trade	37,513	14.17%	34.88%	0.00%	0.00%	0.00%	0.00%	100.00%
Panel C: Days when insiders trade								
Insider buy	947,758	26.97%	44.38%	0.00%	0.00%	0.00%	100.00%	100.00%
Insider sell	947,758	72.79%	44.50%	0.00%	0.00%	100.00%	100.00%	100.00%
SC13D 60-day window	947,758	0.28%	5.32%	0.00%	0.00%	0.00%	0.00%	0.00%
SC13D trade	947,758	0.11%	3.36%	0.00%	0.00%	0.00%	0.00%	0.00%
SC13D turnover	947,758	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Daily returns	942,533	0.32%	3.29%	-9.87%	-1.11%	0.11%	1.57%	12.60%
Daily turnover	943,790	0.94%	1.10%	0.01%	0.26%	0.58%	1.15%	5.54%
Pre SUE month	947,758	11.28%	31.64%	0.00%	0.00%	0.00%	0.00%	100.00%
Free trade	947,758	20.36%	40.27%	0.00%	0.00%	0.00%	0.00%	100.00%
Not free trade	947,758	6.91%	25.37%	0.00%	0.00%	0.00%	0.00%	100.00%

Table 3: **Insider trading prior to Schedule 13D: Univariate analyses.** Panel A reports the average likelihood of insider buy, insider sell, and the average of insider net sell. The unit of observation is firm-trading day. In Panel B, we compare these likelihoods during the 60-day window prior to Schedule 13D filing and trading days outside this window. In panel C the analysis is restricted to the 60-day window prior to Schedule 13D filing and compares the averages during the first 50 days and the last 10 days of that window. In panel C the analysis is restricted to the 60-day window prior to Schedule 13D filing and compares the averages on days when Schedule 13D filers trade and on days when they do not trade.

Transaction type:	Insider buy (1)	Insider sell (2)	Insider net sell (3)
Panel A			
Average	0.80%	2.16%	1.36%
N	31,899,356	31,899,356	31,899,356
Panel B			
SC13D 60-day window	0.93%	1.39%	0.46%
N	115,841	115,841	115,841
Outside SC13D 60-day window	0.80%	2.17%	1.36%
N	31,783,515	31,783,515	31,783,515
difference	0.12%	-0.78%	-0.90%
t-statistic	4.17	-22.49	-20.13
Panel C: SC13D 60-day window			
Last 10 days	1.27%	1.63%	0.36%
N	19,143	19,143	19,143
First 50 days	0.86%	1.34%	0.48%
N	96,698	96,698	96,698
difference	0.41%	0.29%	-0.12%
t-statistic	4.78	2.91	0.92
Panel D: SC13D 60-day window			
SC13D trade = 1	1.22%	1.64%	0.48%
N	78,328	78,328	78,328
SC13D trade = 0	0.79%	1.27%	0.42%
N	37,513	37,513	37,513
difference	0.43%	0.37%	0.06%
t-statistic	6.62	4.76	0.60

Table 4: **Insider trading prior to Schedule 13D filings: Regression analyses.** The table reports estimates of regression (1): $y_{it} = \alpha_i + \alpha_{ym} + \gamma_1 SC13D\ 60\text{-}day\ window_{it} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}$, where y_{it} is a measure of insider trading activity on day t for firm i, α_i are firm fixed effects, α_{ym} are year-month fixed effects, *SC13D 60-day window* is an indicator of the 60-day window prior to Schedule 13D filings, $Return_{it}$ is stock return on day t for firm i, and $Turnover\ rate_{it}$ is share turnover rate on day t for firm i. Sample covers all firm-trading day observations during 1996-2018. All variables are defined in table 1. Standard errors are reported in brackets and are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
SC13D 60-day window	0.0006	0.0002	-0.0077***	-0.0091***	-0.0083***	-0.0093***
	[0.0005]	[0.0005]	[0.0008]	[0.0008]	[0.0010]	[0.0010]
Return		0.0070***		0.0529***		0.0459***
		[0.0009]		[0.0015]		[0.0018]
Turnover rate		0.2182***		0.6866***		0.4684***
		[0.0058]		[0.0174]		[0.0184]
R^2	0.017	0.018	0.045	0.046	0.039	0.039
N	31,899,356	31,363,930	31,899,356	31,363,930	31,899,356	31,363,930
Fixed effects:						
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: **Concurrence of insider and activist trades: 60-day prior to Schedule 13D.** The table reports estimates of regression (2): $y_{it} = \alpha_i + \alpha_{ym} + \alpha_{iym} + \gamma_1 SC13D\ trade_{it} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}$, where y_{it} is a measure of insider trading activity on day t for firm i, α_i are firm fixed effects, α_{ym} are year-month fixed effects, α_{iym} are firm-year-month fixed effects, *SC13D trade* is an indicator of days when Schedule 13D filers trade, $Return_{it}$ is stock return on day t for firm i, and $Turnover\ rate_{it}$ is share turnover rate on day t for firm i. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
SC13D trade	0.0062***	0.0069***	0.0004	0.0002	-0.0057***	-0.0066***
	[0.0014]	[0.0016]	[0.0011]	[0.0012]	[0.0018]	[0.0020]
Return	0.0165	0.0130	0.0248**	0.0214*	0.0083	0.0086
	[0.0110]	[0.0106]	[0.0115]	[0.0113]	[0.0162]	[0.0157]
Turnover rate	0.2868***	0.2167***	0.4135***	0.4476***	0.1267*	0.2299***
	[0.0411]	[0.0430]	[0.0625]	[0.0661]	[0.0757]	[0.0802]
R^2	0.098	0.193	0.132	0.228	0.119	0.213
N	115,712	115,499	115,712	115,499	115,712	115,459
Fixed effects:						
Firm	Yes	No	Yes	No	Yes	No
Year-Month	Yes	No	Yes	No	Yes	No
Firm x Year-month	No	Yes	No	Yes	No	Yes

Table 6: **Concurrence of insider and activist trades: Decomposing 60-day window.** The table repeats the analysis in table 5 for two sub-periods. In panel A, the sample covers all firm-trading day observations during the [t-60,t-11] window prior to Schedule 13D filings. In panel B, the sample covers all firm-trading day observations during the [t-10,t-1] window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: [t-60,t-11] window prior to Schedule 13D filings						
SC13D trade	0.0053***	0.0063***	-0.0006	-0.0007	-0.0059***	-0.0069***
	[0.0015]	[0.0016]	[0.0012]	[0.0014]	[0.0019]	[0.0021]
Return	0.0095	0.0109	0.0203	0.0171	0.0109	0.0062
	[0.0110]	[0.0112]	[0.0126]	[0.0126]	[0.0170]	[0.0171]
Turnover rate	0.3085***	0.2495***	0.3794***	0.4138***	0.0709	0.1643*
	[0.0463]	[0.0483]	[0.0670]	[0.0733]	[0.0830]	[0.0892]
R^2	0.103	0.186	0.143	0.23	0.127	0.211
N	96,587	96,191	96,587	96,191	96,587	96,191
Panel B: [t-10,t-1] window prior to Schedule 13D filings						
SC13D trade	0.0104***	0.0118***	0.0018	0.0005	-0.0086**	-0.0113**
	[0.0031]	[0.0034]	[0.0025]	[0.0027]	[0.0040]	[0.0044]
Return	0.0338	0.0194	0.0459*	0.0438	0.0121	0.0245
	[0.0321]	[0.0328]	[0.0270]	[0.0274]	[0.0414]	[0.0423]
Turnover rate	0.0909	0.0489	0.5344***	0.6215***	0.4436***	0.5726***
	[0.1008]	[0.1040]	[0.1252]	[0.1369]	[0.1635]	[0.1736]
R^2	0.296	0.349	0.354	0.386	0.326	0.371
N	19,121	18,849	19,121	18,849	19,121	18,849
Fixed effects:						
Firm	Yes	No	Yes	No	Yes	No
Year-Month	Yes	No	Yes	No	Yes	No
Firm x Year-month	No	Yes	No	Yes	No	Yes

Table 7: **Dynamic relationship between insider and Schedule 13D trading.** Panel A reports estimates of regression (3): $y_{it} = \alpha_{iym} + \sum_{\tau=-5}^{5} \gamma_{1,\tau} SC13D\ trade_{it+\tau} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}$, where $SC13D\ trade_{it+\tau}$ is an indicator of τ days after day when a Schedule 13D filer trades. All other variables are as in table 5. Panel B reports estimates of regression (4): $SC13D\ trade_{it} = \alpha_{iym} + \sum_{\tau=-5}^{5} \gamma_{1,\tau} Insider\ trade_{it+\tau} + \gamma_2 Return_{it} + \gamma_3 Turnover\ rate_{it} + \varepsilon_{it}$, where $Insider\ trade_{it+\tau}$ is an indicator of τ days after day when an insider trades. All other variables are as in Panel A. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

Dependent variable:	Insider buy (1)	Insider sell (2)	Insider net sell (3)
SC13D trade (t-5)	0.0003	-0.0008	-0.0011
	[0.0008]	[0.0010]	[0.0012]
SC13D trade (t-4)	0.0007	-0.0013	-0.0021*
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t-3)	0.0002	-0.0001	-0.0004
	[0.0009]	[0.0009]	[0.0013]
SC13D trade (t-2)	-0.0005	-0.0004	0.0001
	[0.0007]	[0.0009]	[0.0012]
SC13D trade (t-1)	-0.0001	0.0013	0.0015
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t)	0.0068***	0.0003	-0.0064***
	[0.0015]	[0.0011]	[0.0019]
SC13D trade (t+1)	-0.0005	-0.0018*	-0.0012
	[0.0009]	[0.0009]	[0.0013]
SC13D trade (t+2)	0.0005	-0.0006	-0.0013
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+3)	0.0018**	0.0005	-0.0012
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+4)	-0.0002	-0.0002	0.0000
	[0.0008]	[0.0010]	[0.0013]
SC13D trade (t+5)	-0.0001	0.0003	0.0004
	[0.0008]	[0.0010]	[0.0013]
Return	0.0124	0.0211*	0.0089
	[0.0106]	[0.0114]	[0.0157]
Turnover rate	0.2204***	0.4578***	0.2365***
	[0.0435]	[0.0668]	[0.0810]
R^2	0.191	0.228	0.212
N	115,110	115,110	115,110
Fixed effects:			
Firm-Year-Month	Yes	Yes	Yes

(Table continues...)

Table 7: continued

Panel B

Dependent variable:	SC13 trade (1)
Insider trade day (t-5)	0.0030
	[0.0088]
Insider trade day (t-4)	0.0001
	[0.0085]
Insider trade day (t-3)	0.0130
	[0.0084]
Insider trade day (t-2)	0.0029
	[0.0087]
Insider trade day (t-1)	-0.0006
	[0.0093]
Insider trade day (t)	0.0475***
	[0.0128]
Insider trade day (t+1)	0.0131
	[0.0091]
Insider trade day (t+2)	0.0023
	[0.0087]
Insider trade day (t+3)	0.0083
	[0.0094]
Insider trade day (t+4)	0.0042
	[0.0087]
Insider trade day (t+5)	0.0029
	[0.0092]
Return	0.1356***
	[0.0413]
Turnover rate	11.0502***
	[0.2301]
R^2	0.427
N	115,070
Fixed effects:	
Firm-Year-Month	Yes

Table 8: **The role of upcoming earnings surprises.** This table repeats the analyses of *Insider net sell* in table 5, while considering the effect of insider trading restrictions during 30-day period prior to earnings announcements. All variables are defined in table 1. In column 1, sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. In column 2, sample is limited to 30-day periods prior to positive earnings surprises during the 60-day window prior to Schedule 13D filings. Earnings surprise is the difference between the actual EPS and the median EPS forecast in the one-quarter period before the earnings announcement (source: IBES). In column 3, sample excludes 30-day periods prior to positive earnings surprises during the 60-day window prior to Schedule 13D filings. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Sample:	Full sample (1)	Positive SUE sample (2)	Drop positive SUE sample (3)
SC13D trade	-0.0066***	-0.0009	-0.0068***
	[0.0020]	[0.0033]	[0.0021]
Return	0.0086	0.0180	0.0112
	[0.0157]	[0.0304]	[0.0169]
Turnover rate	0.2299***	0.3947*	0.2254***
	[0.0802]	[0.2094]	[0.0858]
R^2	0.213	0.267	0.228
N	115,459	13,614	101,673
Fixed effects:			
Firm-Year-Month	Yes	Yes	Yes

Table 9: **The role of insider stock ownership.** The table repeats the analysis in table 5, while splitting the sample based on stock ownership of CEOs and board members. Beneficial ownership of CEOs and board members is obtained from Form-4 filings. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Ownership sample:	Below 5%		Between 5% and 10%		Above 10%	
Average stock ownership:	1.45%		7.35%		28.13%	
Dependent variable:	Insider net sell					
	(1)	(2)	(3)	(4)	(5)	(6)
SC13D trade	-0.0030	-0.0031	-0.0204***	-0.0204***	-0.0113*	-0.0135*
	[0.0020]	[0.0021]	[0.0068]	[0.0072]	[0.0066]	[0.0070]
Return	0.0319	0.0322	0.0385	0.0334	-0.0580	-0.0539
	[0.0215]	[0.0211]	[0.0592]	[0.0589]	[0.0421]	[0.0400]
Turnover rate	0.0844	0.1749*	0.3563	0.2507	0.4000	0.5092*
	[0.0859]	[0.0946]	[0.3076]	[0.3259]	[0.3023]	[0.2894]
R^2	0.131	0.207	0.148	0.199	0.140	0.230
N	60,711	60,571	13,455	13,427	24,047	23,985
Fixed effects:						
Firm	Yes	No	Yes	No	Yes	No
Year-Month	Yes	No	Yes	No	Yes	No
Firm x Year-month	No	Yes	No	Yes	No	Yes

Table 10: **Activism CARs and changes in insider ownership.** This table reports estimates of cross-sectional regressions, where the dependent variable is the stock return in excess of the market (defined as the value-weighted CRSP total market return) during the $[-5, +5]$ day window, where day 0 marks the filings of a Schedule 13D. All variables are defined in table 1. Firm characteristics are measures at the end of the fiscal year that precedes a Schedule 13D filing. Heteroscedasticity robust standard errors are reported in brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable: Schedule 13D filing CAR	(1)	(2)	(3)	(4)	(5)
Excess insider buy	0.0176***		0.0171***	0.0180***	0.0142**
	[0.0054]		[0.0054]	[0.0054]	[0.0057]
Shortfall in insider sell		0.0097**	0.0092**	0.0083**	0.0076*
		[0.0038]	[0.0038]	[0.0038]	[0.0042]
SC13D turnover during SC13D 60-day window				0.1723**	0.1822**
				[0.0746]	[0.0826]
Market cap (lagged log)					-0.0011
					[0.0020]
Firm age (lagged)					-0.0002
					[0.0001]
Q (lagged)					-0.0014
					[0.0010]
Previous year stock return					-0.2118***
					[0.0560]
Sales growth (lagged)					0.0022
					[0.0035]
Amihud illiquidity (lagged)					-0.0013
					[0.0054]
Analyst (lagged)					0.0001
					[0.0003]
Constant	0.0254***	0.0252***	0.0232***	0.0179***	0.0328***
	[0.0018]	[0.0020]	[0.0020]	[0.0028]	[0.0114]
R^2	0.004	0.002	0.006	0.009	0.021
N	2,823	2,823	2,823	2,823	2,449

Internal Appendix for the paper

"Insider Trading Ahead of Barbarians' Arrival at the Gate: Insider Trading on Non-Insider Information"

Appendix A. Model solution and proofs

A1. Model solution

In this section, we solve for equilibrium, present investors' trading strategies, and explain the intuition for our results. To solve the model analytically, we impose the following structure on the joint distribution of the activist improvement ν and dividend D_2:

$$\begin{aligned} \text{Prob}(\nu = 1, D_2 = D_H) &= \eta_1, \qquad \text{Prob}(\nu = 0, D_2 = D_H) = 0, \\ \text{Prob}(\nu = 1, D_2 = D_L) &= \eta_2, \qquad \text{Prob}(\nu = 0, D_2 = D_L) = \eta_3. \end{aligned} \tag{A1}$$

The "upper triangular" structure specifying $\text{Prob}(\nu = 0, D_2 = D_H) = 0$ serves as a simplification of asymmetric activist effectiveness in relation to firm fundamentals. Equation (A1) implies that the activist can always create additional value for a "good" firm but may not be able to save a fundamentally "bad" firm. Such a structure captures a realistic situation, as argued by Brav et al. (2008), in which activists create value by bringing expertise and by mitigating agency problems but cannot rescue a firm from distress as a result of fundamental business issues such as obsolete technology or sun-setting markets.

To further streamline the analysis, we assume that the conditional probabilities of particular orders submitted by stock pickers N on dates $t = 0, 1$ are given by:

$$\text{Prob}(\theta_{N,0} = k\bar{\theta}|D_s) = \pi_k^s; \qquad \text{Prob}(\theta_{N,1} = k\bar{\theta}|D_s) = \tilde{\pi}_k^s; \tag{A2}$$

where $s \in \{L, H\}$ is the firm's type, and $k = -1, 0, 1$. To capture the idea that the stock pickers possess some information about the underlying type $s \in \{L, H\}$, we assume that, when the type is good (i.e., $s = H$) they buy more frequently than sell, so that $\pi_1^H \geq \pi_0^H \geq \pi_{-1}^H$ and $\tilde{\pi}_1^H \geq \tilde{\pi}_0^H \geq \tilde{\pi}_{-1}^H$, and vice versa when the type is bad (i.e., $s = L$). Moreover, they are more likely to buy in a good state and are more likely to sell in a bad state so that $\pi_1^H \geq \pi_1^L$ and $\pi_{-1}^L \geq \pi_{-1}^H$, and similarly, in the second period, $\tilde{\pi}_1^H \geq \tilde{\pi}_1^L$ and $\tilde{\pi}_{-1}^L \geq \tilde{\pi}_{-1}^H$. Such a structure essentially combines noisy traders and (outside) informed traders in the typical microstructure model so that our model remains tractable with the addition of an activist trader.

The feasible trading strategies of the investors restrict the aggregate order flow observed by the market maker to one of four values, $-\bar{\theta}$, 0, $\bar{\theta}$, or $2\bar{\theta}$ on date $t = 0$ and $-2\bar{\theta}$, $-\bar{\theta}$, 0, $\bar{\theta}$ on $t = 1$. The limited discrete set of values is necessary to make the updating of beliefs tractable and to solve for asset prices,

especially given the fact that on date $t = 1$ the market maker updates using two order flows, one from date 0 and the other from date 1.

We start by solving the first-stage equilibrium on date $t = 0$ when the activist trades with the market maker in the presence of the stock picker. We conjecture a certain trading strategy on the part of the activist, verify that it is an equilibrium strategy under certain conditions, and then derive the equilibrium stock prices. Proposition 1 summarizes our results.

Proposition 1. *Consider the following trading strategy of the activist on date $t = 0$:*

$$\theta_A^*(D_2, \nu) = \begin{cases} \bar{\theta}, & \text{if} \quad D_2 = D_H; \\ \bar{\theta}, & \text{if} \quad D_2 = D_L, \ \nu = 1; \\ 0, & \text{if} \quad D_2 = D_L, \ \nu = 0. \end{cases} \tag{A3}$$

Then, for sufficiently large $\bar{\theta} \geq d$, where d is given by equation (A11) in the Appendix, θ_A^* is the unique equilibrium strategy, and the equilibrium first-stage price $p_1(x)$ is given by

$$p_1(x) = \begin{cases} 0, & x = -\bar{\theta}; \\ D_H \dfrac{\pi_{-1}^H \pi_D}{\pi_{-1}^H \pi_D + \pi_{-1}^L \eta_2 + \pi_0^L \eta_3} + \psi\bar{\theta} \dfrac{\pi_{-1}^H \eta_1 + \pi_{-1}^L \eta_2}{\pi_{-1}^H \eta_1 + \pi_{-1}^L \eta_2 + \pi_0^L \eta_3}, & x = 0; \\ D_H \dfrac{\pi_0^H \pi_D}{\pi_0^H \pi_D + \pi_0^L \eta_2 + \pi_1^L \eta_3} + \psi\bar{\theta} \dfrac{\pi_0^H \eta_1 + \pi_0^L \eta_2}{\pi_0^H \eta_1 + \pi_0^L \eta_2 + \pi_1^L \eta_3}, & x = \bar{\theta}; \\ D_H \dfrac{\pi_1^H \eta_1}{\pi_1^H \eta_1 + \pi_1^L \eta_2} + \psi\bar{\theta}. \end{cases} \tag{A4}$$

While the proof is provided in the Appendix, we outline the intuition herein, paving the way to the next proposition. First, the activist's trading strategy is straightforward. Because she can always increase the value of a "good" firm (see condition (A1)), the activist always buys when the firm type is $s = H$. If the firm is of type $s = L$, though, the activist can improve the firm only at some probability and, consequently, buys only when she can implement the improvement ($\nu = 1$).

Second, we note that the realization of the order flow $\theta_A + \theta_{N,0} = -\bar{\theta}$ is fully revealing. Specifically, given the structure of the trading strategy (A3), the latter order flow implies that $\theta_A = 0$, and hence, $s = L$.

Consequently, the market maker infers that $\theta_A = 0$ and $D_2 = 0$ and sets the price to zero. Similarly, the order flow $\theta_A + \theta_{N,0} = 2\bar{\theta}$ reveals that $\theta_A = \bar{\theta}$. There is, however, some uncertainty remaining about whether the firm is of type L or H. When $\theta_A + \theta_{N,0} \in \{0, \bar{\theta}\}$, the market maker needs to make an inference about both the firm type and the activist's trading by taking into account the structure of θ_A in (A3) and the conditional probabilities (A2) describing the stock picker's trading activity. Consequently, even zero order flow $\theta_A + \theta_{N,0} = 0$ causes the insider and the market maker to update their information sets.

Next, in the second stage, starting on date $t = 1$, the insider observes the date $t = 0$ order flow $\theta_A + \theta_{N,0}$. The insider then filters out the information about θ_A using the information contained in the order flow, the fundamentals D_2, and the structure of the distribution of stock-picker demands conditional on value D_2, given by equations (A2). Then, the insider chooses the trading strategy θ_I that maximizes the objective function (6).[31] In Proposition 2 below, we conjecture a trading strategy for the insider and derive the stock price implied by that strategy. We then show that the conjectured strategy is an equilibrium under some model parameters.

Proposition 2. *Consider the trading strategy of the insider, given by*

$$\theta_I^* = \begin{cases} 0, & D_2 = D_H; \\ -\bar{\theta}, & D_2 = D_L, \quad \theta_A^* + \theta_{N,0} = -\bar{\theta}; \\ -\bar{\theta}, & D_2 = D_L, \quad \theta_A^* + \theta_{N,0} = 0; \\ 0, & D_2 = D_L, \quad \theta_A^* + \theta_{N,0} = \bar{\theta}; \\ -\bar{\theta}, & D_2 = D_L, \quad \theta_A^* + \theta_{N,0} = 2\bar{\theta}. \end{cases} \tag{A5}$$

Given this strategy, the second-stage stock price is $p_2(\theta_I + \theta_{N,1}, \theta_A + \theta_{N,0})$*, where function* $p_2(x, y)$ *is given by equation* (A12) *in the Appendix. Moreover, the strategy* (A5) *is the equilibrium if and only if conditions* (A26) *in the Appendix are satisfied.*

The trading strategy (A5) is conditional on the insider's private information about the firm fundamentals and the information learned from the order flow in period 1. The second-period price p_2

[31] From the equation for the first-stage price (A4), we observe that the probabilities π_k can be chosen such that there is one-to-one mapping between prices and order flows $\theta_A + \theta_{N,0}$ on date $t = 0$. Hence, the insider effectively observes $\theta_A + \theta_{N,0}$ via her observation of the stock price.

aggregates information from the order flows in both periods 1 and 2. Consequently, price p_2 has a more intricate structure than its first-period counterpart, and is given by equation (A12) in the Appendix.

Next, we provide the economic intuition underlying the insider's strategy θ_I^*. When the firm's type is good, $s = H$, the insider knows that the activist will be present and unambiguously prefers to keep shares (and not to sell). By keeping her shares, the insider enjoys the high dividend, benefits financially from the value improvement brought about by the activist, and at the same time counters activist control by preserving her ownership stake and, hence, also the voting power.

In the alternative situation, both the insider and the activist know that the firm is of type $s = L$. Unconditionally, the insider knows that the activist will buy with probability η_2; but the insider's belief could be further refined by observing the order flow from stage 1, combined with her knowledge that $s = L$. If the order flow is $\theta_A^* + \theta_{N,0} = -\bar{\theta}$, then the equilibrium is fully revealing. Both the insider and the market maker infer that $\theta_A^* = 0$. Further, the market maker learns with certainty that $s = L$, because $\theta_A^* = 0$ is possible only for the bad type of firm, as can be seen from the activist strategy (A3). Consequently, the fundamental value and the price are equal to zero, $p_2 = D_2 + \psi\widehat{\theta}_A = 0$, where $\widehat{\theta}_A$ represents the insider's best estimate of the activist's strategy. In this case, the insider is indifferent between keeping shares or selling because the price is fair. For modelling simplicity, we assume that the insider sells when she is indifferent with respect to trading profits as a result of the motive to diversify her portfolio, which is not formally modeled in our set-up. The selling motive in this situation can also be attributed to general desire among investors to avoid the (unmodelled) costs of carrying on with a bad firm.

The cases in which $\theta_A^* + \theta_{N,0} = \bar{\theta}$ or $\theta_A^* + \theta_{N,0} = 0$ are not fully revealing, as in both cases the insider and the market maker know that there is an interior probability that the activist has arrived. If the insider infers that $\theta_A^* = \bar{\theta}$ is likely, this is good news as the activism will increase the final dividend. It is also bad news, though, because the insider suffers disutility from activism in losing the private benefits of control. Both economic forces (captured by the first and second terms in the insider's optimization (6)) discourage the insider from selling in an effort to benefit financially from the value improvement as well as to counter activist dominance. For the market maker, who does not have knowledge regarding a key fundamental (that $s = L$), the inference of activist presence is less precise. Hence the price set by the market maker is under-valued, conditional on the insider's knowledge that $s = L$, when $\theta_A^* + \theta_{N,0} = \bar{\theta}$, further discouraging the insider from selling. The market maker also over-prices when $\theta_A^* + \theta_{N,0} = 0$, prompting the insider to

sell, provided that the disutility associated with the selling parameter ϕ is not too large.[32]

Here comes the highlight of the model: The strategy (A5) demonstrates how the insider's informational advantage regarding her own firm's fundamentals enables her to detect and optimally respond to activist trading, with respect to which the insider has no more direct information than any other non-activists. Such a filtration manifests itself in the contingency of insider trading on the realization of the aggregate order flow even when the insider already knows that the firm's fundamentals are weak, i.e., $D_2 = D_L$. In this situation, the insider sells when $\theta_A^* + \theta_{N,0} = 0$ and does not sell when $\theta_A^* + \theta_{N,0} = \bar{\theta}$. The intuition is that the insider deduces that the activist is more likely to be present in the latter case. Knowing that the fundamentals are weak, the insider down-weights the probability that a buy order might originate with the stock picker (who has an informative albeit noisy signal), leaving a greater chance that the positive order flow was generated by the activist (who buys in case the firm is fixable, i.e., $\nu = 1$). An activist buy in this scenario is more likely than in the scenario of zero aggregate order flow, which could reflect either the offsetting of the activist's buy order by the bearish stock picker (when the activist can improve the firm's value and the stock picker draws a negative signal) or no action by both (when the activist knows she cannot fix the firm and the stock picker did not receive a directional signal).

Finally, when the insider and the market maker observe $\theta_A^* + \theta_{N,0} = 2\bar{\theta}$ and the type is $s = L$, they can both infer that $\theta_A^* = \bar{\theta}$ but they nevertheless valuate the firm differently. The market maker, who does not know the true state of the firm, would set the price to $\mathbb{E}[D_2|\mathcal{F}_M] + \psi\bar{\theta}$. On the other hand, the insider's valuation is $D_L + \psi\bar{\theta} < \mathbb{E}[D_2|\mathcal{F}_M] + \psi\bar{\theta}$, because she knows that the firm's type is L. Consequently, the firm is overvalued from the insider's point of view, and the insider therefore prefers to sell in this case, despite the activist's buying. We observe that the market maker overvalues the fundamental value D_2 but prices the additional value $\psi\bar{\theta}$ created by the activist correctly. Consequently, by selling, the insider profits from the mispriced fundamental value D_2 and is fairly compensated for the additional value $\psi\bar{\theta}$.[33]

Admittedly, the fully revealing cases in the model arise as a result of our tractability-related restriction that trading strategies take only two values for both the activist (who can stay put or buy) and the insider (who can stay put or sell). Although the parameterization is motivated by institutional

[32]Subsection A3 in the Appendix provides the calibration in which the insider strategy (A5) is the equilibrium for a wide range of model parameters.

[33]The investor may abstain from selling if parameter ϕ capturing the disutility of selling is very large. However, for the ranges of ϕ considered in our calibrations in subsection A3, the investor chooses to sell shares. The situation in which the insider buys shares when $\theta_A^* + \theta_{N,0} = 2\bar{\theta}$ requires unrealistically large values of ϕ.

features and empirical regularities in the insider trading and activism setting, we acknowledge that the fully revealing states are unlikely to arise in a more general setting with a full range of trading strategies. Lemma A1 in the Appendix shows formally that the fully revealing order flow $\theta_A^* + \theta_{N,0} = 2\bar{\theta}$ is less likely to occur than the order flows $\theta_A^* + \theta_{N,0} = 0$ and $\theta_A^* + \theta_{N,0} = \bar{\theta}$ under the assumption that the stock picker's signal is informative so that they are more likely to sell than buy or do nothing when the firm type is bad.

A2. Proofs of Propositions 1 and 2

Proof of Proposition 1. There are 4 possible combinations $\theta_A^* + \theta_{N,0} \in \{-\bar{\theta}, 0, \bar{\theta}, 2\bar{\theta}\}$. Assume that the trading strategy of the activist is given by equation (A3). Note that two states $\theta_A^* + \theta_{N,0} \in \{-\bar{\theta}, 2\bar{\theta}\}$ are fully revealing because $\theta_A^* \in \{0, \bar{\theta}\}$. In particular, $\theta_A^* + \theta_{N,0} = -\bar{\theta}$ implies that $\theta_A^* = 0$, and hence, from equation (A3), we observe that the latter trading strategy implies $\nu = 0$. Consequently, the market maker sets the price equal to $p(-\bar{\theta}) = D_L = 0$. Similarly, $\theta_A^* + \theta_{N,0} = 2\bar{\theta}$ implies that $\theta_A^* = \bar{\theta}$ and $\theta_{N,0}^* = \bar{\theta}$, and hence

$$P(2\bar{\theta}) = \mathbb{E}[D_2 = D_H | \theta_A^* = \bar{\theta}, \theta_{N,0}^* = \bar{\theta}] + \psi\bar{\theta} = \frac{D_H \pi_1^H \eta_1}{\pi_1^H \eta_1 + \pi_1^L \eta_2} + \psi\bar{\theta}.$$

Suppose, $\theta_A^* + \theta_{N,0} = 0$. We note the following conditional probabilities.

$$\begin{aligned} \text{Prob}(\theta_{N,0} = -\bar{\theta} | \theta_A = \bar{\theta}) &= \text{Prob}(\theta_{N,0} = -\bar{\theta} | \theta_A = \bar{\theta}, D_H) \, \text{Prob}(D_H | \theta_A = \bar{\theta}) \\ &\quad + \text{Prob}(\theta_{N,0} = -\bar{\theta} | \theta_A = \bar{\theta}, D_L) \, \text{Prob}(D_L | \theta_A = \bar{\theta}) \\ &= \frac{\pi_{-1}^H \eta_1 + \pi_{-1}^L \eta_2}{\eta_1 + \eta_2}. \end{aligned} \tag{A6}$$

This is because $\text{Prob}(D_H | \theta_A = \bar{\theta}) = \text{Prob}(D_H | \nu = 1)$ since $\theta_A = \bar{\theta}$ is observed if and only if $\nu = 1$. Then, from equations (A1) we observe that $\text{Prob}(D_H | \nu = 1) = \eta_2/(\eta_1 + \eta_2)$. $\text{Prob}(D_H | \theta_A = \bar{\theta})$ is computed in a similar way. Next probability is computed similarly:

$$\begin{aligned} \text{Prob}(\theta_{N,0} = 0 | \theta_A = 0) &= \text{Prob}(\theta_{N,0} = 0 | \theta_A = 0, D_H) \underbrace{\text{Prob}(D_H | \theta_A = 0)}_{=0} \\ &\quad + \text{Prob}(\theta_{N,0} = 0 | \theta_A = 0, D_L) \underbrace{\text{Prob}(D_L | \theta_A = 0)}_{=1} \\ &= 0 + \pi_0^L = \pi_0^L. \end{aligned} \tag{A7}$$

Using the latter two equations (A6) and (A7), we obtain:

$$\begin{aligned}\text{Prob}(\theta_A = \bar{\theta}|\theta_A + \theta_{N,0} = 0) &= \frac{\text{Prob}(\theta_A + \theta_{N,0} = 0|\theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta})}{\text{Prob}(\theta_A + \theta_{N,0} = 0)} \\ &= \frac{\text{Prob}(\theta_A + \theta_{N,0} = 0|\theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta})}{\text{Prob}(\theta_{N,0} = -\bar{\theta}|\theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}) + \text{Prob}(\theta_{N,0} = 0|\theta_A = 0)\,\text{Prob}(\theta_A = 0)} \\ &= \frac{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2}{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.\end{aligned}$$

Here we used that $\text{Prob}(\theta_A + \theta_{N,0} = 0|\theta_A = \bar{\theta}) = \text{Prob}(\theta_{N,0} = -\bar{\theta}|\theta_A = \bar{\theta})$, and then use equation (A6).

Next, we compute the conditional probability $\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0)$. Before that, we compute two auxiliary probabilities below.

$$\text{Prob}(\theta_{N,0} = -\bar{\theta}|D_H) = \pi^H_{-1}. \tag{A8}$$

$$\begin{aligned}\text{Prob}(\theta_A + \theta_{N,0} = 0|D_L) &= \text{Prob}(\theta_A + \theta_{N,0} = 0|D_L, \theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}|D_L) \\ &\quad + \text{Prob}(\theta_A + \theta_{N,0} = 0|D_L, \theta_A = 0)\,\text{Prob}(\theta_A = 0|D_L) \\ &= \frac{\pi^L_{-1}\eta_2 + \pi^L_0\eta_3}{\eta_2 + \eta_3}.\end{aligned} \tag{A9}$$

Using the latter two equations (A8) and (A9), we obtain:

$$\begin{aligned}\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0) &= \frac{\text{Prob}(\theta_A + \theta_{N,0} = 0|D_H)\pi_D}{\text{Prob}(\theta_A + \theta_{N,0} = 0|D_H)\pi_D + \text{Prob}(\theta_A + \theta_{N,0} = 0|D_L)(1 - \pi_D)} \\ &= \frac{\pi^H_{-1}\pi_D}{\pi^H_{-1}\pi_D + \pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.\end{aligned}$$

Using probabilities $\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0)$ and $\text{Prob}(\theta_A = \bar{\theta}|\theta_A + \theta_{N,0} = 0)$, we obtain:

$$\begin{aligned}P(0) &= D_H\,\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0) + \psi\bar{\theta}\,\text{Prob}(\theta_A = \bar{\theta}|\theta_A + \theta_{N,0} = 0) \\ &= \frac{D_H\pi^H_{-1}\pi_D}{\pi^H_{-1}\pi_D + \pi^L_{-1}\eta_2 + \pi^L_0\eta_3} + \psi\bar{\theta}\frac{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2}{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.\end{aligned}$$

Price $P(\bar{\theta})$ can be found analogously.

Now, we derive constant d such that the trading strategy is the equilibrium when $\bar{\theta} \geq d$. Rewrite

the price function (A4) as follows

$$p_1(x) = \begin{cases} 0, & x = -\bar{\theta}; \\ D_H a_0 + \psi\bar{\theta} b_0, & x = 0 \\ D_H a_1 + \psi\bar{\theta} b_1, & x = \bar{\theta} \\ D_H a_2 + \psi\bar{\theta} b_2, & x = 2\bar{\theta}, \end{cases} \tag{A10}$$

where a_k and b_k are coefficients that match the corresponding coefficients in (A4). Substituting (A10) and (A3) into the activist's optimization problem (5), we obtain the following conditions for (A3) to be the equilibrium strategy:

$$\begin{aligned} D_H + \psi\bar{\theta} &\geq D_H \mathbb{E}^H[a] + \psi\bar{\theta}\mathbb{E}^H[b] \quad (\theta_A = \bar{\theta} \text{ is optimal when } \ D_2 = D_H), \\ \psi\bar{\theta} &\geq D_H \mathbb{E}^L[a] + \psi\bar{\theta}\mathbb{E}^L[b] \quad (\theta_A = \bar{\theta} \text{ is optimal when } \ D_2 = D_L, \nu = 1), \\ 0 &\leq D_H \mathbb{E}^L[a] + \psi\bar{\theta}\mathbb{E}^L[b] \quad (\theta_A = 0 \text{ is optimal when } \ D_2 = D_L, \nu = 0), \end{aligned}$$

where $\mathbb{E}^s[x] = \pi^s_{-1} x_0 + \pi^s_0 x_1 + \pi^s_1 x_2$, $s = H, L$. The first and third of the above inequalities are always satisfied because $0 < a_k \leq 1$ and $0 < b_k \leq 1$. From the second inequality we then obtain that

$$\bar{\theta} \geq d D_H, \quad d = \frac{\mathbb{E}^L[a]}{1 - \mathbb{E}^L[b]} \frac{1}{\psi}. \quad \blacksquare \tag{A11}$$

Proof of Proposition 2. Take trading strategies (A3) and (A5) as given. Then, we show that the price

function $p_2(x,y)$ is given by:

$$p_2(x,y) =$$

$$\begin{cases} 0, & y=-\bar{\theta}; \\ \psi\bar{\theta}\frac{\pi_{-1}^L\eta_2}{\pi_{-1}^L\eta_2+\pi_0^L\eta_3}, & x=-2\bar{\theta}, y=0; \\ D_H\frac{\tilde{\pi}_i^H\pi_{-1}^H\pi_D}{\tilde{\pi}_i^H\pi_{-1}^H\pi_D+\tilde{\pi}_{i+1}^L(\pi_{-1}^L\eta_2+\pi_0^L\eta_3)} & \\ \quad +\psi\bar{\theta}\frac{\pi_{-1}^H\eta_1+\pi_{-1}^L\eta_2}{\pi_{-1}^H\eta_1+\pi_{-1}^L\eta_2+\pi_0^L\eta_3}\frac{\tilde{\pi}_i^Hv_0+\tilde{\pi}_{i+1}^L(1-v_0)}{\tilde{\pi}_i^Hu_0+\tilde{\pi}_{i+1}^L(1-u_0)}, & x=i\bar{\theta}, y=0; \\ D_H+\psi\bar{\theta}, & x=\bar{\theta}, y=0; \\ \psi\bar{\theta}\frac{\pi_0^L\eta_2}{\pi_0^L\eta_2+\pi_1^L\eta_3}, & x=-2\bar{\theta}, y=\bar{\theta}; \\ D_H\frac{\tilde{\pi}_j^H\pi_0^H\pi_D}{\tilde{\pi}_j^H\pi_0^H\pi_D+\tilde{\pi}_j^L(\pi_0^L\eta_2+\pi_1^L\eta_3)} & \\ \quad +\psi\bar{\theta}\frac{\pi_0^H\eta_1+\pi_0^L\eta_2}{\pi_0^H\eta_1+\pi_0^L\eta_2+\pi_1^L\eta_3}\frac{\tilde{\pi}_j^Hv_1+\tilde{\pi}_j^L(1-v_1)}{\tilde{\pi}_j^Hu_1+\tilde{\pi}_j^L(1-u_1)}, & x=j\bar{\theta}, y=\bar{\theta}; \\ \psi\bar{\theta}, & x=-2\bar{\theta}, y=2\bar{\theta}; \\ D_H\frac{\tilde{\pi}_i^H\pi_1^H\pi_D}{\tilde{\pi}_i^H\pi_1^H\pi_D+\tilde{\pi}_{i+1}^L\pi_1^L\eta_2}+\psi\bar{\theta}, & x=i\bar{\theta}, y=2\bar{\theta}, \\ D_H+\psi\bar{\theta}, & x=\bar{\theta}, y=2\bar{\theta}, \end{cases} \tag{A12}$$

where $i=-1,0$ and $j=-1,0,1$, and u_k and v_k are given by:

$$u_k = \text{Prob}(D_H|\theta_A+\theta_{N,0}=k\bar{\theta}) = \frac{\pi_{k-1}^H\pi_D}{\pi_{k-1}^H\pi_D+\pi_{k-1}^L\eta_2+\pi_k^L\eta_3}, \tag{A13}$$

$$v_k = \text{Prob}(D_H|\theta_A+\theta_{N,0}=k\bar{\theta},\theta_A=\bar{\theta}) = \frac{\pi_{k-1}^H\pi_D}{\pi_{k-1}^H\pi_D+\pi_{k-1}^L\eta_2}, \tag{A14}$$

for $k=0,1$. Equations (A13) and (A14) can be derived using Bayes' theorem, and the derivation is omitted for brevity.

We provide the derivation of the price function only for the case $x=i\bar{\theta}$, $y=0$. All other cases can be studied analogously. First, we need to find two conditional probabilities: $\text{Prob}(D_2=D_H|\theta_I+\theta_{N,1}=$

$i\bar{\theta}, \theta_A + \theta_{N,0} = 0)$ and $\text{Prob}(\theta_A = \bar{\theta} | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0)$.

$$\text{Prob}(D_2 = D_H | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0) =$$

$$\frac{\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0 | D_H)\pi_D}{\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0 | D_H)\pi_D + \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0 | D_L)(1 - \pi_D)} \tag{A15}$$

$$\frac{\text{Prob}(\theta_{N,1} = i\bar{\theta}, \theta_{N,0} = -\bar{\theta} | D_H)\pi_D}{\text{Prob}(\theta_{N,1} = i\bar{\theta}, \theta_{N,0} = -\bar{\theta} | D_H)\pi_D + \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0 | D_L)(1 - \pi_D)},$$

where the third line of derivations uses the fact that $\theta_I = 0$ and $\theta_A = \bar{\theta}$ when $D_2 = D_H$. In the latter equation,

$$\text{Prob}(\theta_{N,1} = i\bar{\theta}, \theta_{N,0} = -\bar{\theta} | D_H) = \tilde{\pi}_i^H \pi_{-1}^H, \tag{A16}$$

because $\theta_{N,0}$ and $\theta_{N,1}$ are uncorrelated conditional on D_H. Moreover,

$$\begin{aligned}
&\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0 | D_L) \\
&= \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta} | \theta_A + \theta_{N,0} = 0, D_L) \, \text{Prob}(\theta_A + \theta_{N,0} = 0 | D_L) \\
&= \text{Prob}(\theta_{N,1} = (i+1)\bar{\theta} | D_L) \Big[\text{Prob}(\theta_A + \theta_{N,0} = 0 | \nu = 1, D_L) \, \text{Prob}(\nu = 1 | D_L) + \\
&\quad \text{Prob}(\theta_A + \theta_{N,0} = 0 | \nu = 0, D_L) \, \text{Prob}(\nu = 0 | D_L) \Big] \\
&= \tilde{\pi}_{i+1}^L \Big[\pi_{-1}^L \frac{\eta_2}{\eta_2 + \eta_3} + \pi_0^L \frac{\eta_3}{\eta_2 + \eta_3} \Big].
\end{aligned} \tag{A17}$$

Here we used the fact that $\theta_I = -\bar{\theta}$ when $D_2 = D_L$ and $\theta_A + \theta_{N,0} = 0$.

Substituting (A16) and (A17) into (A15), we obtain:

$$\text{Prob}(D_2 = D_H | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0) = \frac{\tilde{\pi}_i^H \pi_{-1}^H \pi_D}{\tilde{\pi}_i^H \pi_{-1}^H \pi_D + \tilde{\pi}_{i+1}^L (\pi_{-1}^L \eta_2 + \pi_0^L \eta_3)}. \tag{A18}$$

Next, we compute the conditional probability

$$\begin{aligned}
&\text{Prob}(\theta_A = \bar{\theta}|\theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0) \\
&= \frac{\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}|\theta_A + \theta_{N,0} = 0)}{\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0)}.
\end{aligned} \tag{A19}$$

In the above equation (A19),

$$\begin{aligned}
&\text{Prob}(\theta_A = \bar{\theta}|\theta_A + \theta_{N,0} = 0) = \frac{\text{Prob}(\theta_A + \theta_{N,0} = 0|\theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta})}{\text{Prob}(\theta_{N,0} = -\bar{\theta}|\theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}) + \text{Prob}(\theta_{N,0} = 0|\theta_A = 0)\,\text{Prob}(\theta_A = 0)} \\
&= \frac{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2}{\pi^H_{-1}\eta_1 + \pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.
\end{aligned} \tag{A20}$$

$$\begin{aligned}
&\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}) = \\
&= \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}, D_H)\,\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}) \\
&+ \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}, D_L)\,\text{Prob}(D_L|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}) \\
&= \text{Prob}(\theta_{N,1} = i\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}, D_H)\,\text{Prob}(D_H|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}) \\
&+ \text{Prob}(\theta_{N,1} = (i+1)\bar{\theta}|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}, D_L)\,\text{Prob}(D_L|\theta_A + \theta_{N,0} = 0, \theta_A = \bar{\theta}) \\
&= \tilde{\pi}^H_i v_0 + \tilde{\pi}^L_{i+1}(1 - v_0),
\end{aligned} \tag{A21}$$

where v_0 is given by equation (A14). The last equation again uses the fact that D_H and D_L provide most

complete information needed to compute $\theta_{N,1}$. No other variable provides additional information.

$$\begin{aligned}
&\text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta} | \theta_A + \theta_{N,0} = 0) = \\
&= \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta} | \theta_A + \theta_{N,0} = 0, D_H)\, \text{Prob}(D_H | \theta_A + \theta_{N,0} = 0) \\
&+ \text{Prob}(\theta_I + \theta_{N,1} = i\bar{\theta} | \theta_A + \theta_{N,0} = 0, D_L)\, \text{Prob}(D_L | \theta_A + \theta_{N,0} = 0) \\
&= \text{Prob}(\theta_{N,1} = i\bar{\theta} | \theta_A + \theta_{N,0} = 0, D_H)\, \text{Prob}(D_H | \theta_A + \theta_{N,0} = 0) \\
&+ \text{Prob}(\theta_{N,1} = (i+1)\bar{\theta} | \theta_A + \theta_{N,0} = 0, D_L)\, \text{Prob}(D_L | \theta_A + \theta_{N,0} = 0) \\
&= \tilde{\pi}_i^H u_0 + \tilde{\pi}_{i+1}^L (1 - u_0),
\end{aligned} \tag{A22}$$

where u_0 is given by equation (A13).

Substituting probabilities (A20)–(A22) into (A19), we obtain:

$$\begin{aligned}
&\text{Prob}(\theta_A = \bar{\theta} | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0) = \\
&\frac{\pi_{-1}^H \eta_1 + \pi_{-1}^L \eta_2}{\pi_{-1}^H \eta_1 + \pi_{-1}^L \eta_2 + \pi_0^L \eta_3} \frac{\tilde{\pi}_i^H v_0 + \tilde{\pi}_{i+1}^L (1 - v_0)}{\tilde{\pi}_i^H u_0 + \tilde{\pi}_{i+1}^L (1 - u_0)}.
\end{aligned} \tag{A23}$$

The price is given by

$$P(i\bar{\theta}, 0) = \mathbb{E}[D_2 | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0)] + \psi\bar{\theta}\mathbb{E}[\theta_A | \theta_I + \theta_{N,1} = i\bar{\theta}, \theta_A + \theta_{N,0} = 0)].$$

Substituting (A18) and (A23) into the above equation, we obtain the third line of the price function (A12). Other cases are considered analogously.

Finding $\hat{\theta}_{\mathbf{A}} = \mathbb{E}[\theta_{\mathbf{A}}^* | \mathbf{D_2}, \theta_{\mathbf{A}}^* + \theta_{\mathbf{N.0}}]$. Solving the optimization problem of the insider also requires the knowledge of $\widehat{\theta}_A = \mathbb{E}[\theta_A | D_2, \theta_A + \theta_{N,0}]$, which is the insider's expectation of the activist's optimal strategy. From the equation (A3) for θ_A, it can be easily observed that $\mathbb{E}[\theta_A | D_H] = \bar{\theta}$, $\mathbb{E}[\theta_A | D_L, 2\bar{\theta}] = \bar{\theta}$, $\mathbb{E}[\theta_A | D_L, -\bar{\theta}] = 0$. It remains to compute $\mathbb{E}[\theta_A | D_L, \theta_A + \theta_{N,0} = 0]$ and $\mathbb{E}[\theta_A | D_L, \theta_A + \theta_{N,0} = \bar{\theta}]$. We show

how to calculate the first of these expectations, and the second can be computed analogously.

$$\begin{aligned}
&\text{Prob}(\theta_A = \bar{\theta}|D_L, \theta_A + \theta_{N,0} = 0) = \\
&\frac{\text{Prob}(\theta_A + \theta_{N,0} = 0|D_L, \theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}|D_L)}{\text{Prob}(\theta_A + \theta_{N,0} = 0|D_L, \theta_A = \bar{\theta})\,\text{Prob}(\theta_A = \bar{\theta}|D_L) + \text{Prob}(\theta_A + \theta_{N,0} = 0|D_L, \theta_A = 0)\,\text{Prob}(\theta_A = 0|D_L)} \\
&= \frac{\text{Prob}(\theta_{N,0} = -\bar{\theta}|D_L)\,\text{Prob}(\theta_A = \bar{\theta}|D_L)}{\text{Prob}(\theta_{N,0} = -\bar{\theta}|D_L)\,\text{Prob}(\theta_A = \bar{\theta}|D_L) + \text{Prob}(\theta_{N,0} = 0|D_L)\,\text{Prob}(\theta_A = 0|D_L)} \\
&= \frac{\pi^L_{-1}\eta_2}{\pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.
\end{aligned} \tag{A24}$$

Consequently,

$$\mathbb{E}[\theta_A|D_L, \theta_A + \theta_{N,0} = 0] = \bar{\theta}\frac{\pi^L_{-1}\eta_2}{\pi^L_{-1}\eta_2 + \pi^L_0\eta_3}.$$

Summarizing all cases, when $D_2 = D_H$ then $\hat{\theta}_A = \bar{\theta}$ and when $D_2 = D_L$

$$\widehat{\theta}_A(x) = \begin{cases} 0, & D_2 = D_L,\ \theta_A + \theta_{N,0} = -\bar{\theta}; \\ \bar{\theta}\dfrac{\pi^L_{-1}\eta_2}{\pi^L_{-1}\eta_2 + \pi^L_0\eta_3}, & D_2 = D_L,\ \theta_A + \theta_{N,0} = 0; \\ \bar{\theta}\dfrac{\pi^L_0\eta_2}{\pi^L_0\eta_2 + \pi^L_1\eta_3} & D_2 = D_L,\ \theta_A + \theta_{N,0} = \bar{\theta}; \\ \bar{\theta} & D_2 = D_L,\ \theta_A + \theta_{N,0} = 2\bar{\theta}. \end{cases}, \tag{A25}$$

where $x \in \{-\bar{\theta}, 0, \bar{\theta}, 2\bar{\theta}\}$.

Conditions for equilibrium. Next, we derive condition under which (A5) is an equilibrium strategy. Let $\theta^*_A + \theta_{N,0} = x$. The insider's utility is zero when $\theta_I = 0$ and $(D_2 + (\psi + \phi)\widehat{\theta}_A - p_2(-2\bar{\theta}, x)\pi^k_{-1} - p_2(-\bar{\theta}, x)\pi^k_0 - p_2(0, x)\pi^k_1)(-\bar{\theta})$ when $\theta^*_I = -\bar{\theta}$, where $k = L$ or $k = H$ depending on the type of the firm. We also note that price (A12) can be represented as $p_2 = a_{ij}D_H + b_{ij}\psi\bar{\theta}$, where index $i = -1, 0, 1, 2$ corresponds to $\theta^*_A + \theta_{N,0} \in \{-\bar{\theta}, 0, \bar{\theta}, 2\bar{\theta}\}$ and $j = -2, -1, 0, 1$ corresponds to $\theta^*_I + \theta_{N,1} \in \{-2\bar{\theta}, -\bar{\theta}, 0, \bar{\theta}\}$.

First, we check when $\theta_I = 0$ is equilibrium if $D_2 = D_H$. the insider's utility of not selling exceeds

utility of selling if and only if

$$0 \geq (D_2 + (\psi + \phi)\widehat{\theta}_A - p_2(-2\bar{\theta}, x)\tilde{\pi}^H_{-1} - p_2(-\bar{\theta}, x)\tilde{\pi}^H_0 - p_2(0, x)\tilde{\pi}^H_1)(-\bar{\theta}).$$

From the price (A12) it can be easily observed that in its representation $p_2 = a_{ij}D_H + b_{ij}\psi\bar{\theta}$ the parameters are such that $0 \leq a_{ij} \leq 1$ and $0 \leq b_{ij} \leq 1$. Moreover, when $D_2 = D_H$ we have $\hat{\theta}_A = \bar{\theta}$ because the activist always invests. Hence, the above inequality is satisfied when $\phi \geq 0$.

Next, suppose that $D_2 = D_L$ and $\theta^*_A + \theta_{N,0} = x$. When $x = -\bar{\theta}$ the equilibrium is fully revealing so that $\theta^*_A = 0$ and $D_2 = D_L$ are known to the market maker. Consequently, the market maker sets the price equal to zero. The insider is then indifferent between selling or not selling, and hence our strategy is consistent with equilibrium. For other values of x, the strategy (A5) is equilibrium if and only if the following conditions are satisfied:

$$\begin{aligned}
&(\psi + \phi)\hat{\theta}_A(0) - p_2(-2\bar{\theta}, 0)\tilde{\pi}^L_{-1} - p_2(-\bar{\theta}, 0)\tilde{\pi}^L_0 - p_2(0, 0)\tilde{\pi}^L_1 \leq 0,\\
&(\psi + \phi)\hat{\theta}_A(\bar{\theta}) - p_2(-2\bar{\theta}, \bar{\theta})\tilde{\pi}^L_{-1} - p_2(-\bar{\theta}, \bar{\theta})\tilde{\pi}^L_0 - p_2(0, \bar{\theta})\tilde{\pi}^L_1 \geq 0,\\
&(\psi + \phi)\hat{\theta}_A(2\bar{\theta}) - p_2(-2\bar{\theta}, 2\bar{\theta})\tilde{\pi}^L_{-1} - p_2(-\bar{\theta}, 2\bar{\theta})\tilde{\pi}^L_0 - p_2(0, 2\bar{\theta})\tilde{\pi}^L_1 \leq 0. \ \blacksquare
\end{aligned} \tag{A26}$$

Lemma A1. *The distribution of observed order flows $\theta^*_A + \theta_N$ conditional on bad type of the firm is as follows:*

$$\text{Prob}(\theta^*_A + \theta_N = x | D_L) = \begin{cases} \dfrac{\eta_3}{\eta_2 + \eta_3}\pi^L_{-1}, & x = -\bar{\theta},\\ \dfrac{\eta_3}{\eta_2 + \eta_3}\pi^L_0 + \dfrac{\eta_2}{\eta_2 + \eta_3}\pi^L_{-1}, & x = 0,\\ \dfrac{\eta_3}{\eta_2 + \eta_3}\pi^L_1 + \dfrac{\eta_2}{\eta_2 + \eta_3}\pi^L_0, & x = \bar{\theta},\\ \dfrac{\eta_2}{\eta_2 + \eta_3}\pi^L_1, & x = 2\bar{\theta}. \end{cases} \tag{A27}$$

Moreover, under the model assumptions that $\pi_{-1}^L > \pi_0^L > \pi_1^L$*, we have:*

$$\text{Prob}(\theta_A^* + \theta_{N,0} = 0|D_L) > \text{Prob}(\theta_A^* + \theta_{N,0} = \bar{\theta}|D_L) > \text{Prob}(\theta_A^* + \theta_{N,0} = 2\bar{\theta}|D_L). \tag{A28}$$

Proof of Lemma A1. We prove for $x = 0$, and the other cases are analogous.

$$\begin{aligned}\text{Prob}(\theta_A^* + \theta_N = 0|D_L) &= \text{Prob}(\theta_A^* = 0, \theta_N = 0|D_L) + \text{Prob}(\theta_A^* = \bar{\theta}, \theta_N = -\bar{\theta}|D_L) \\ &= \frac{\eta_3}{\eta_2 + \eta_3}\pi_0^L + \frac{\eta_2}{\eta_2 + \eta_3}\pi_{-1}^L.\end{aligned}$$

Inequality (A28) directly follows from (A27) and (A28). ■

A3. Parametric restrictions

As the model has many free parameters, we set probabilities to $\pi_1^H = \tilde{\pi}_1^H = 2/3$, $\pi_0^H = \tilde{\pi}_0^H = 1/6$, $\pi_{-1}^H = \tilde{\pi}_{-1}^H = 1/6$, $\pi_1^L = \tilde{\pi}_1^L = 1/6$, $\pi_0^L = \tilde{\pi}_0^L = 5/12$, $\pi_{-1}^L = \tilde{\pi}_{-1}^L = 5/12$, $\eta_1 = 0.1$, $\eta_2 = 0.3$, $\eta_3 = 0.6$, $\pi_d = \eta_1$, $\phi = 0.1$. Next, we vary parameter ψ and look at the ranges of $\bar{\theta}/D_H$ such that conditions (A26) under which the equilibrium strategy of the insider is given by (A5) are satisfied. Figure A1 shows the set of parameters ψ and $x = \bar{\theta}/D_H$ for which conditions (A26) are satisfied. In particular, for $\psi = 1$ the existence range is $\bar{\theta}/D_H \in (0.35, 0.6)$, for $\psi = 1.5$ the range is $\bar{\theta}/D_H \in (0.37, 0.8)$, and for $\psi = 0.75$ the range $\bar{\theta}/D_H \in (0.4, 0.6)$.

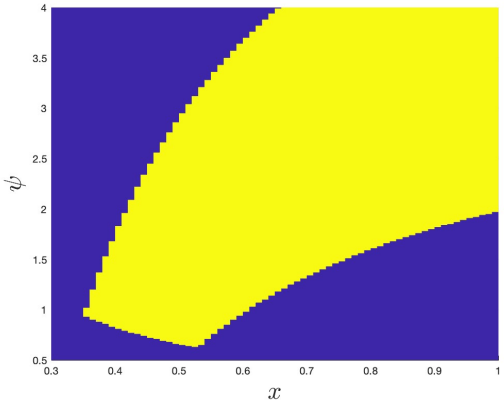

Figure A1: **Parametric restrictions.** The yellow region shows the space of parameters ψ and $x = \bar{\theta}/D_H$ under which the trading strategy of the insider is given by equation (A5).

Appendix B. Supplemental Results

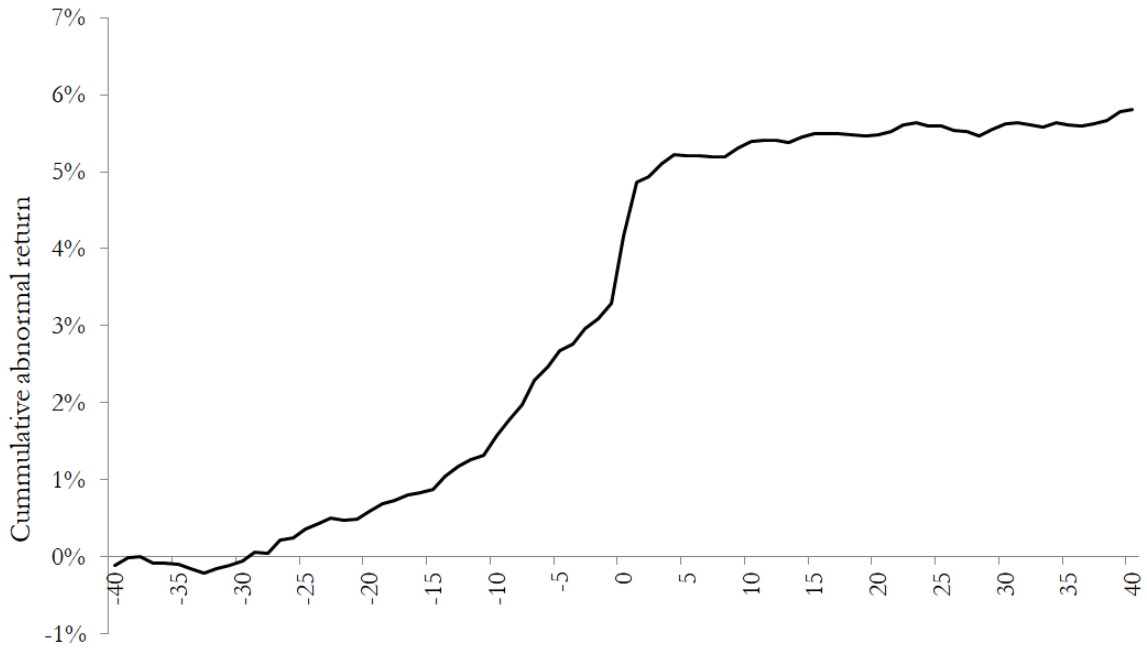

Figure A2: **Buy-and-Hold Abnormal Return around Schedule 13D filings.** This figure plots the average buy-and-hold return around Schedule 13D filing dates, in excess of the Fama-French 3 Factor Model, from 40 days prior the filing date to 40 days afterwards.

Table A1: **Insider trading restrictions.** The table repeats analysis in table 5, while adding the following control variables to the regression: *Free trade*, which equals one during [t+4,t+14] window around earnings announcement, and zero otherwise, *No free trade*, which equals one during [t-14,t+2] window around earnings announcement, and zero otherwise, and *Pre-SUE month*, which equals one during 30-day window prior to earnings announcement, and zero otherwise. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
SC13D trade	0.0066***	0.0065***	0.0000	-0.0001	-0.0066***	-0.0066***
	[0.0016]	[0.0015]	[0.0012]	[0.0012]	[0.0020]	[0.0020]
Return	0.0123	0.0128	0.0206*	0.0210*	0.0082	0.0083
	[0.0106]	[0.0106]	[0.0113]	[0.0113]	[0.0157]	[0.0157]
Turnover rate	0.2249***	0.2108***	0.4588***	0.4434***	0.2339***	0.2326***
	[0.0431]	[0.0427]	[0.0660]	[0.0662]	[0.0802]	[0.0802]
Free trade	0.0156***	0.0143***	0.0083***	0.0068**	-0.0074*	-0.0075*
	[0.0027]	[0.0027]	[0.0028]	[0.0028]	[0.0040]	[0.0040]
Not free date	-0.0058***	-0.0045***	-0.0101***	-0.0087***	-0.0043*	-0.0042*
	[0.0015]	[0.0014]	[0.0020]	[0.0020]	[0.0024]	[0.0024]
Pre-SUE month		-0.0061***		-0.0067***		-0.0006
		[0.0016]		[0.0017]		[0.0023]
R^2	0.195	0.195	0.229	0.229	0.213	0.213
N	115,459	115,459	115,459	115,459	115,459	115,459
Fixed effects:						
Firm-Year-Month	Yes	Yes	Yes	Yes	Yes	Yes

Table A2: **Do insiders trade more when Schedule 13D filers trade?** The table reports estimates of Tobit regression of insider buying quantity on *SC13D trade*, an indicator of days when Schedule 13D filers trade. Insider buying quantity is the number of shares purchased by insider, scaled by the number of shares outstanding, multiplied by 100. All other variables are as defined in table 5. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buying quantity		
	(1)	(2)	(3)
SC13D trade	0.2438***	0.2090***	0.2368***
	[0.0747]	[0.0715]	[0.0744]
Return		1.1998*	0.9717*
		[0.6640]	[0.5584]
Turnover rate		5.6803***	6.7410***
		[2.0191]	[2.0325]
R^2	0.006	0.006	0.087
N	115,799	115,713	115,713
Fixed effects:			
Year-Month	No	No	Yes

Table A3: **The role of lagged returns and trading activity.** The table repeats the analysis in table 7, while controlling for three lags of stock returns and turnover. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy (1)	Insider sell (2)	Insider net sell (3)
SC13D trade (t-5)	0.0003	-0.0008	-0.0011
	[0.0008]	[0.0010]	[0.0012]
SC13D trade (t-4)	0.0008	-0.0013	-0.0021*
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t-3)	0.0002	-0.0001	-0.0003
	[0.0009]	[0.0009]	[0.0013]
SC13D trade (t-2)	-0.0006	-0.0004	0.0001
	[0.0007]	[0.0009]	[0.0012]
SC13D trade (t-1)	-0.0003	0.0013	0.0015
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t)	0.0068***	0.0003	-0.0064***
	[0.0015]	[0.0011]	[0.0019]
SC13D trade (t+1)	-0.0005	-0.0017*	-0.0011
	[0.0009]	[0.0009]	[0.0013]
SC13D trade (t+2)	-0.0003	-0.0007	-0.0004
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+3)	0.0011	0.0003	-0.0008
	[0.0008]	[0.0009]	[0.0013]
SC13D trade (t+4)	-0.0003	-0.0002	0.0001
	[0.0008]	[0.0010]	[0.0013]
SC13D trade (t+5)	0.0000	0.0003	0.0003
	[0.0008]	[0.0010]	[0.0013]
Return	0.0128	0.0253**	0.0125
	[0.0118]	[0.0119]	[0.0169]
Return (lag 1)	0.0075	0.0233**	0.0158
	[0.0130]	[0.0107]	[0.0168]
Return (lag 2)	-0.0201	0.0205*	0.0407**
	[0.0135]	[0.0108]	[0.0175]
Return (lag 3)	-0.0073	0.0099	0.0172
	[0.0135]	[0.0100]	[0.0170]
Turnover rate	0.2066***	0.4611***	0.2545***
	[0.0453]	[0.0653]	[0.0808]
Turnover rate (lag 1)	-0.0420	-0.0346	0.0074
	[0.0384]	[0.0569]	[0.0700]
Turnover rate (lag 2)	0.1868***	-0.0065	-0.1933***
	[0.0454]	[0.0543]	[0.0708]
Turnover rate (lag 3)	0.1284***	0.0325	-0.0959
	[0.0425]	[0.0580]	[0.0723]
R^2	0.191	0.228	0.212
N	115,055	115,055	115,055
Fixed effects:			
Firm x Year-month	Yes	Yes	Yes

Table A4: **The role of consequent trades.** In panel A, we repeat the analysis in table 5, while restricting the analysis to Schedule 13D trades that a preceded and followed by at least two days with no Schedule 13D trading. In panel B, we impose a similar restriction on Schedule 13D trades and repeat the analysis in panel A of table 7. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy (1)	Insider sell (2)	Insider net sell (3)
Panel A			
SC13D trade	0.0086**	-0.0021	-0.0106**
	[0.0038]	[0.0029]	[0.0048]
Return	0.0101	0.0128	0.0027
	[0.0136]	[0.0140]	[0.0198]
Turnover rate	0.3714***	0.4992***	0.1278
	[0.0809]	[0.1071]	[0.1347]
R^2	0.199	0.278	0.247
N	52,546	52,546	52,546
Panel B			
SC13D trade (t-5)	0.0013	0.0001	-0.0012
	[0.0015]	[0.0017]	[0.0022]
SC13D trade (t-4)	-0.0012	-0.0021	-0.0009
	[0.0016]	[0.0016]	[0.0022]
SC13D trade (t-3)	0.0006	-0.0010	-0.0016
	[0.0018]	[0.0019]	[0.0026]
SC13D trade (t)	0.0093**	-0.0021	-0.0114**
	[0.0038]	[0.0029]	[0.0049]
SC13D trade (t+3)	0.0042*	0.0010	-0.0032
	[0.0023]	[0.0020]	[0.0031]
SC13D trade (t+4)	-0.0002	0.0004	0.0006
	[0.0018]	[0.0019]	[0.0026]
SC13D trade (t+5)	-0.0007	0.0018	0.0026
	[0.0017]	[0.0021]	[0.0028]
Return	0.0103	0.0108	0.0005
	[0.0136]	[0.0139]	[0.0197]
Turnover rate	0.3644***	0.4952***	0.1308
	[0.0816]	[0.1077]	[0.1356]
R^2	0.195	0.278	0.245
N	52,436	52,436	52,436
Fixed effects:			
Firm x Year-month	Yes	Yes	Yes

Table A5: **The role of insider trading disclosure.** The table repeats the analysis in table 7, while excluding insider traders that are disclosed to the SEC on the same day. Sample covers all firm-trading day observations during the 60-day window prior to Schedule 13D filings. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy (1)	Insider sell (2)	Insider net sell (3)
SC13D trade (t-5)	0.0005	-0.0008	-0.0012
	[0.0007]	[0.0009]	[0.0012]
SC13D trade (t-4)	0.0006	-0.0005	-0.0011
	[0.0007]	[0.0009]	[0.0011]
SC13D trade (t-3)	0.0005	-0.0006	-0.0011
	[0.0009]	[0.0009]	[0.0013]
SC13D trade (t-2)	-0.0008	-0.0006	0.0002
	[0.0007]	[0.0009]	[0.0011]
SC13D trade (t-1)	0.0005	0.0016*	0.0010
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t)	0.0063***	0.0008	-0.0055***
	[0.0014]	[0.0011]	[0.0018]
SC13D trade (t+1)	-0.0007	-0.0013	-0.0006
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+2)	0.0006	-0.0005	-0.0011
	[0.0008]	[0.0009]	[0.0011]
SC13D trade (t+3)	0.0017**	0.0004	-0.0013
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+4)	-0.0005	-0.0003	0.0002
	[0.0008]	[0.0009]	[0.0012]
SC13D trade (t+5)	0.0004	0.0005	0.0001
	[0.0008]	[0.0010]	[0.0012]
Return	0.0114	0.0185*	0.0072
	[0.0102]	[0.0109]	[0.0150]
Turnover rate	0.1971***	0.4264***	0.2293***
	[0.0417]	[0.0649]	[0.0783]
R^2	0.184	0.211	0.199
N	114,863	114,863	114,863
Fixed effects:			
Firm x Year-month	Yes	Yes	Yes

Table A6: **The role of hostile campaigns.** The table repeats the analysis in table 5 for the sub-sample of hostile engagement by activist hedge funds. Hostile engagement are Schedule 13D filings filed by activist hedge funds who are confrontational with firm management based on classification developed in Brav et al. (2008). All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
SC13D trade	0.0040**	0.0037*	-0.0011	-0.0005	-0.0051	-0.0042
	[0.0018]	[0.0021]	[0.0030]	[0.0033]	[0.0033]	[0.0037]
Return	0.0393	0.0195	0.0072	0.0060	-0.0322	-0.0135
	[0.0382]	[0.0355]	[0.0409]	[0.0411]	[0.0618]	[0.0585]
Turnover rate	0.2635**	0.3055**	0.4342***	0.4267**	0.1706	0.1212
	[0.1337]	[0.1394]	[0.1628]	[0.1740]	[0.2172]	[0.2304]
R^2	0.121	0.179	0.112	0.145	0.105	0.145
N	11,661	11,634	11,661	11,634	11,661	11,634
Fixed effects:						
Firm	Yes	No	Yes	No	Yes	No
Year-Month	Yes	No	Yes	No	Yes	No
Firm x Year-month	No	Yes	No	Yes	No	Yes

Table A7: **The role of likelihood of Schedule 13D filing.** The table repeats the analysis in table 5 for two sub-samples. Sub-samples are generated based on the likelihood of a Schedule 13D filing. The likelihood of a Schedule 13D filing is estimated using the following firm characteristics, market value of equity (log), equity book-to-market ratio, average of monthly returns during fiscal year, firm age (measured as the number of years since firm appears on CRSP), the Herfindahl index of sales among all firms in the same SIC 3-digit industry, share of institutional ownership, Herfindahl index of institutional ownership, Amihud (2002) illiquidity ratio, book leverage ratio, toal payouts to net income ratio, and ROA. In panel A, the sample covers observations with low likelihood of a Schedule 13D filing. In panel B, the sample covers observations with high likelihood of a Schedule 13D filing. All variables are defined in table 1. Standard errors are clustered at the firm level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent variable:	Insider buy		Insider sell		Insider net sell	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Low likelihood of a Schedule 13D filing						
SC13D trade	0.0116**	0.0132***	0.0013	0.0008	-0.0103	-0.0124*
	[0.0048]	[0.0049]	[0.0040]	[0.0041]	[0.0063]	[0.0064]
Return	0.0005	-0.0076	0.0288	0.0277	0.0283	0.0353
	[0.0310]	[0.0292]	[0.0336]	[0.0328]	[0.0467]	[0.0448]
Turnover rate	0.2803*	0.2374	1.0809***	0.9936***	0.8006**	0.7562**
	[0.1589]	[0.1575]	[0.2739]	[0.2766]	[0.3264]	[0.3234]
R^2	0.123	0.192	0.137	0.206	0.136	0.208
N	19,636	19,588	19,636	19,588	19,636	19,588
Panel B: High likelihood of a Schedule 13D filing						
SC13D trade	0.0025	0.0024	0.0038	0.0046	0.0013	0.0022
	[0.0034]	[0.0038]	[0.0029]	[0.0032]	[0.0045]	[0.0051]
Return	0.0192	0.0076	-0.0093	-0.0109	-0.0285	-0.0185
	[0.0344]	[0.0306]	[0.0340]	[0.0337]	[0.0499]	[0.0458]
Turnover rate	0.7090***	0.6413***	0.4280***	0.3014*	-0.281	-0.3399
	[0.1668]	[0.1724]	[0.1610]	[0.1617]	[0.2397]	[0.2461]
R^2	0.115	0.184	0.174	0.254	0.149	0.222
N	19,633	19,580	19,633	19,580	19,633	19,580
Fixed effects:						
Firm	Yes	No	Yes	No	Yes	No
Year-Month	Yes	No	Yes	No	Yes	No
Firm x Year-month	No	Yes	No	Yes	No	Yes