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DO PRICES REVEAL THE PRESENCE OF INFORMED TRADING?

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ABSTRACT

Using a comprehensive sample of trades by Schedule 13D filers, who possess valuable private information when they accumulate stocks of targeted companies, this paper studies whether several liquidity measures reveal the presence of informed trading. The evidence suggests that when Schedule 13D filers trade aggressively, both high-frequency and low-frequency measures of stock liquidity indicate a higher stock liquidity. Importantly, measures that have been used as direct proxies for adverse selection, such the Kyle (1985) lambda, the Easley et al. (1996) pin measure, and the Amihud (2002) illiquidity measure, suggest that the adverse selection is lower when informed trading takes place. The evidence is consistent with informed traders being more aggressive when measured stock liquidity is high.

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Introduction

An extensive body of theory suggests that stock liquidity, as measured by the spread between the bid and ask quotes and by the price impact of trades, should be informative about the magnitude of asymmetric information between market participants (Copeland and Galai, 1983; Glosten and Milgrom, 1985; Kyle, 1985; Easley and O'Hara, 1987; Admati and Pfleiderer, 1988). For example, in his seminal contribution, Kyle (1985) shows how an insider hides his private information and optimally accumulates shares at a rate inversely proportional to his price impact,[3] Kyle's lambda, which measures the dollar change in price due to a dollar change in order flow. In the cross-section stocks with more informed trading relative to noise trading experience larger price impact. Specifically, Kyle's lambda, which can be estimated from a regression of price change on order flow, is higher for stocks with more informed trading (relative to liquidity trading).

Following that literature there have been many attempts to measure trading costs empirically, and to decompose such costs into different components such as a adverse selection, order processing cost, and inventory cost (e.g., early papers include Glosten, 1987; Glosten and Harris, 1988; Stoll, 1989; Hasbrouck, 1991; Amihud, 2002). An extensive empirical literature relies on adverse selection measures assuming they capture information asymmetry (e.g., Barclay and Hendershott, 2004; Vega, 2006; Duarte et al., 2008; Bharath et al., 2009; Kelly and Ljungqvist, 2011).

Do these empirical measures of stock liquidity actually capture information asymmetry?

Most measures rely on some empirical estimate of price impact and its persistence to identify the amount of private information in trades. There is an obvious endogeneity issue with this approach. Ideally, one would want to separate informed from uninformed trades ex-ante, and test their impact on price changes. Unfortunately, since we generally

[3]The insider's optimal trading strategy is to trade as a linear function of the difference between his signal and the current price, at a rate inversely proportional to his price impact, and that increases as maturity approaches so that all the information eventually makes it into prices.

do not know the traders' information sets, this is hard to do in practice. As a result, it is often assumed that some types of investors are informed. For example, Boulatov et al. (2009) use the institutional order flow as a proxy for informed trading.

In this paper, we use a novel data set of trades by investors we can identify as having substantial private information, to study whether proposed liquidity measures reveal the presence of informed trading. Specifically, we exploit a disclosure requirement to identify trades that rely on valuable private information. Rule 13d-1(a) of the 1934 Securities Exchange Act requires investors to file with the SEC within 10 days of acquiring more than 5% of any class of securities of a publicly traded company if they have an interest in influencing the management of the company. In particular, Item 5(c) of Schedule 13D requires the filer to "... describe any transactions in the class of securities reported on that were effected during the past sixty days or since the most recent filing of Schedule 13D, whichever is less." Thus, Schedule 13D filings reveal the date and price at which all trades by the Schedule 13D filer were executed during the 60 days that precede the filing date.[4]

We hand collect a comprehensive sample of trades from the Schedule 13D filings. We view this sample as an interesting laboratory to study the liquidity and the price impact of informed trades. First, an average Schedule 13D filing in our sample is characterized by a positive and significant market reaction upon announcement. For example, the cumulative return in excess of the market is about 6% in the (t-10,t+1) window around the filing date and about 3% in the (t-1,t+1) window around the filing date. Second, we calculate several measures of profits made by Schedule 13D filers and show that these profits are economically significant. For example, an average Schedule 13D filer gains \$1.13 million on a \$30 million stake in a \$404 million market cap company. Third, we document performance of trading strategies that replicate trades of Schedule 13D filers. The evidence suggests that these strategies exhibit positive and significant alpha when

[4]As we explain in Section 2, our sample includes original Schedule 13D filings only, i.e., amendments to previously submitted filings are excluded from the sample.

either one-, three-, or four-factor models are concerned. For example, a trading strategy that replicates trades by Schedule 13D filers exhibits a 0.09% daily alpha in the four-factor model. To summarize, the evidence implies that Schedule 13D filers' information is valuable. Therefore, we can classify the pre-announcement trades by Schedule 13D filers as informed trades. It is also important to realize that, by its very nature, the information held by Schedule 13D filers is likely to qualify as 'private information.' In most cases, these activist share-holders know they can increase the value of the firm they invest in by their own effort. Their effort level is, of course, conditional on their achieving a large stake in the firm. It is their very actions and share-holdership that constitutes the 'private' information in many cases.

Our main empirical result is that standard liquidity measures *do not* reveal the presence of informed traders. Instead, we find that standard liquidity measures suggest that a stock is more liquid when there is significant informed trading in that stock. Specifically, we find that all high-frequency measures of stock liquidity we consider are lower on days on which Schedule 13D filers trade. For example, on an average day when Schedule 13D filers trade, the measured price impact is almost 30% lower relative to the sample average. Similarly to the high-frequency measures, the low-frequency measures of stock liquidity suggest that liquidity is higher when Schedule 13D filers trade. For example, Amihud's illiquidity measure decreases by more than 45% on days when Schedule 13D filers trade. Importantly, we show that days when Schedule 13D filers trade are characterized by positive and significant market-adjusted returns, which suggests that informed trades do impact prices. Liquidity measures, however, fail to detect that price impact.

Importantly, some of the liquidity measures we consider, such as the Kyle (1985) lambda, the Easley et al. (1996) pin measure, and the Amihud (2002) illiquidity measure, have been widely used in the literature as proxies for adverse selection. To summarize, the evidence constitutes a serious challenge to the argument that standard measures of stock price liquidity, and in particular of the adverse selection component, reveal

the presence of informed trading, at least not trading based on the long-lived type of information that Schedule 13D filers hold. Perhaps these measures are better at capturing short-lived information, for which selection issues (i.e., the optimal timing of his trades by the informed agent) are less of an issue. Collin-Dufresne and Fos (2012) present a theoretical model where, because of time-variation in abnormal volume unrelated to the information possessed by the insider, in equilibrium, standard price impact measures may be uninformative about his trading.

Consistent with this theoretical analysis, we show that Schedule 13D filers trade more aggressively not only when the stock they are purchasing is more liquid, but also when market-wide conditions change. For example, high aggregate volume and low market return positively affect the likelihood of a trade by Schedule 13D filers on a given day.

This paper is related to several strands of literatures.

First, this paper contributes to the empirical literature that relies on liquidity measures as a proxy for information asymmetry (e.g, Barclay and Hendershott, 2004; Vega, 2006; Duarte et al., 2008; Bharath et al., 2009; Kelly and Ljungqvist, 2011). Our evidence suggests that empirical measures of information asymmetry might not reveal the presence of informed traders. Therefore, empirical researchers should be cautious when relying on a liquidity measure as a proxy for information asymmetry.

Second, our paper is related to the large literature on the estimation of the asymmetric information component of transaction costs (e.g., Easley and O'Hara, 1987; Glosten and Harris, 1988; Stoll, 1989; Hasbrouck, 1991; Lin et al., 1995). In contrast to this literature, our paper does not rely on time-series properties of stock prices to identify informed trades, but uses well-identified trades executed by informed traders to study the impact of asymmetric information on stock price liquidity measures.

Third, our paper is related to the empirical literature that studies the impact of informed trading on the stock liquidity. One strand of this literature studies the impact of share repurchases on stock liquidity and finds mixed results (Barclay and Smith, 1988; Singh et al., 1994; Franz et al., 1995; Miller and McConnell, 1995; Brockman and Chung,

2001; Ginglinger and Hamon, 2007). Another strand of this literature studies the impact of insider trading on stock liquidity.[5] While some studies conclude that insider trading impairs stock liquidity (Bettis et al., 2000; Cheng et al., 2006), others show that there is no significant effect of insider trading on stock liquidity (Chung and Charoenwong, 1998; Charoenwong and Chung, 2000; Cao et al., 2004). Our papers differs from this literature in that it uses trades by investors we can identify as having significant private information, as traders make substantial profits and their trades constitute a significant fraction of the stock's daily volume. Instead, in the extant insider trading literature it is often not clear that the trades are based on substantial private information. Share repurchases, for example, can be motivated not only by private information, but also by liquidity needs (excess cash leads to higher stock repurchases), investment policy (deterioration in investment opportunities leads to higher payouts), and compensation policy (repurchasing shares in anticipation of option expirations). In addition, (legal) insider trading usually constitute only a very small fraction of the daily stock trading activity.

One notable exception is the paper by Cornell and Sirri (1992), which our study is closely related to. Cornell and Sirri (1992) present a clinical study of one case of illegal insider trading during Anheuser-Busch's 1982 tender offer for Campbell Taggar, for which they obtained ex-post court records to identify trades by corporate insiders and their tippees. They find that surprisingly liquidity increases when there is active informed trading. Our findings are consistent with their case study, but uses a comprehensive data-set of trades by legal 'insiders.'

Fourth, in a recent paper, Obizhaeva (2011) provides evidence on selection bias in liquidity estimates. Obizhaeva shows that liquidity is lower than what is usually

[5]Whether trades by corporate insiders contain valuable information is an empirical question. For example, Lakonishok and Lee (2001) show that very little market movement is observed when insiders trade and when they report their trades to the SEC. Recently, Cohen et al. (2012) decompose insider trading into routine (i.e., uninformed) and opportunistic (i.e., informed) and show that only the opportunistic trades yield positive abnormal return. However, even in that case the dollar profits realized by the insiders are trivial.

measured, especially in high volume markets, because traders employ price-dependent strategies and often choose not to execute their orders entirely. Related, our results point to another distinct selection bias in liquidity measures due to the endogenous timing of the trading strategies of informed investors.

Finally, the paper contributes to the corporate governance literature by showing how activist shareholders benefit from liquid stock markets. Kyle and Vila (1991), Bolton and von Thadden (1998), and Maug (1998) predict that greater liquidity trading facilitates monitoring and shareholder activism. While recent empirical papers show that stock liquidity facilitates hedge fund activism and proxy contests (Brav et al., 2008; Klein and Zur, 2009; Fos, 2012), this paper provides direct evidence on the magnitude of these profits. Importantly, in this paper we show that trading strategies of activist shareholders depend on stock liquidity. That is, we provide the micro-level data to support the conjecture that higher stock liquidity benefits activist shareholders who actively intervene in corporate governance.

The rest of the paper is organized as follows. Section 1 provides an overview of the institutional background. Section 2 describes the data. The magnitude of information asymmetry is analyzed in Section 3. Section 4 describes liquidity measures used in the analysis. Section 5 presents the main evidence on the effect of informed trading on liquidity measures. Section 6 documents the effect of exogenous variation in stock liquidity on trading strategies of Schedule 13D filers. Finally, Section 7 concludes.

1. Institutional Background

In this section we summarize the institutional background and describe what information we exploit in empirical tests. Rule 13d-1(a) of the 1934 Securities Exchange Act requires investors to file with the SEC within 10 days of acquiring more than 5% of any class of securities of a publicly traded company if they have an interest in influencing

the management of the company.[6]

Item 5(c) of Schedule 13D requires the filer to "... describe any transactions in the class of securities reported on that were effected during the past sixty days or since the most recent filing of Schedule 13D, whichever is less." Importantly, we restrict our sample to original Schedule 13D filings only, i.e., amendments to previously submitted filings are excluded from the sample (this maximizes the 'asymmetric information' content of the trades by the insider). Thus, our Schedule 13D filings reveal the date and price for all transactions by the Schedule 13D filer that were executed during sixty days that precede the filing date. Figure 1 presents a typical time line of a Schedule 13 filing.

[Insert Figure 1 here]

For each event we extract the following information from the Schedule 13D filings: CUSIP of the underlying security, date of every transaction, transaction type (purchase or sell), transaction size, and transaction price. In addition, we extract filing date, event date (date of crossing the 5% threshold), and the beneficial ownership of the Schedule 13D filer at the filing date. In the vast majority of cases transaction data are reported at daily frequency. If the transaction data are at higher-than-daily frequency, we aggregate it to the daily level. Specifically, for every day we calculate the total change in stock ownership and the average purchase price. The average price is the quantity-weighted average of transaction prices.

[6]In general, an investor who has an interest in influencing the management of the company is required to file Schedule 13D in the following cases: (i) an investor's position exceeds the legal threshold of 5%, (ii) a group of investors decides to act as a legal group and the ownership of the group exceeds the legal threshold of 5%, and (iii) an investor's previously established position changes by more than 1% of stocks outstanding, either positive or negative. This study exploits cases (i) and (ii) only, since the incentive to trade on private information is the strongest when an investor's position exceeds the legal threshold of 5%.

2. Sample Description

2.1. The Sample of Schedule 13D Filings with Information on Trades

The sample is constructed as follows. First, using an automatic search script, we identify 9,580 Schedule 13D filings during 2001-2010. Next, we check the sample of 9,580 filings manually and identify events with information on trades. Since the trading characteristics of ordinary equities might differ from those of other assets, we retain only assets whose CRSP share codes are 10 or 11, i.e., we discard certificates, ADRs, shares of beneficial interest, units, companies incorporated outside the U.S., Americus Trust components, closed-end funds, preferred stocks, and REITs. We exclude stocks whose prices are below $1 and above $1,000. Moreover, we exclude events that involve derivatives, such as options, warrants, and swaps. Finally, we exclude Schedule 13D/A filings (i.e., amendments to previously submitted filings) that are mistakenly classified as original Schedule 13D filings.

The final sample is the universe of all Schedule 13D filings that satisfy the above criteria during 2001-2010 and consists of 1,725 events. Figure 2 presents the time distribution of the Schedule 13D filings with information on trades in common stocks during 2001-2010. During the sample period, on average 173 events take place each year.

[Insert Figure 2 here]

Next, we examine the trading strategy of Schedule 13D filers. The trading strategy is described using the following three measures, which we describe in detail below: (1) the probability that a Schedule 13D filer trades at least one share on a given day, (2) the percentage of outstanding shares traded by Schedule 13D filers, and (3) the probability of trading with a Schedule 13D filer. Each measure of the trading activity is calculated at daily frequency. Figure 3 presents the cross-event average of each measure for the sixty days prior to the filing date, plotted as a function of the distance to the filing day.

[Insert Figure 3 here]

For every distance to the filing day, the probability that a Schedule 13D filer trades at least one share is the number of filings with a non-zero trade by the filer divided by the total number of Schedule 13D filings in the sample. Figure 3 indicates that the probability that a Schedule 13D filer trades at least one share on a given day is approximately 30% and it reaches a 50% level closer to the filing day.

To further understand the trading strategy of Schedule 13D filers, we calculate the percentage of outstanding shares traded by Schedule 13D filers. For every distance to the filing day, the percentage of outstanding shares traded by Schedule 13D filers is the ratio of the number of shares traded by the Schedule 13D filer to the number of total shares outstanding. Figure 3 suggests that a Schedule 13D filer gradually increases the percentage of outstanding shares purchased on every trading day. Closer to the filing day Schedule 13D filers trade more aggressively. For example, the average percentage of outstanding shares purchased on every trading day by the Schedule 13D filers increases from 0.03%-0.07% to 0.2%-0.3% closer to the filing day.

Finally, we observe that the probability of trading with a Schedule 13D filer co-moves with the percentage of outstanding shares purchased by Schedule 13D filers. For every distance to the filing day, the probability of trading with Schedule 13D filer is the cross-event average of the number of shares traded by the filer divided by the security's volume from CRSP. If no trade is reported on a given day by the filer, the percentage of outstanding shares traded by the filer is set to zero. The probability of facing an informed trader in a transaction increases dramatically from 5% to 10%-15% level when approaching the filing day.

Summary statistics of trading strategies adopted by Schedule 13D filers are reported in Table 1. Columns (1) and (4) report summary statistics of all reported trades. The average (median) stock ownership on the filing date is 7.68% (6.20%). The average (median) filer purchases 3.8% (2.8%) of outstanding shares during sixty-day period prior to the filing date. It corresponds to an average (median) purchase of 1,304,126 (393,387) shares at average (median) cost of $25.6 ($3.3) million. On days with non-zero informed

volume the filer purchases 0.5% (0.2%) of outstanding shares.

[Insert Table 1 here]

The summary statistics of trades executed by Schedule 13D filers during the pre-event days are reported in columns (2) and (4) and the summary statistics of trades during the post-event days are reported in columns (3) and (6). The event day is the day when the filer's ownership exceeds the 5% threshold. The evidence suggests that Schedule 13D filers trade more aggressively in the post-event period. For example, the average (median) increase in the ownership per trading day with non-zero informed volume is 0.8% (0.3%) during the post-event period compared with 0.3% (0.1%) during the pre-event period. Similarly, the average (median) percentage of trading days with informed trades increase from 34.7% (29.4%) during the pre-event period to 57.1% (57.2%) during the post-event period.

To summarize, the evidence suggests that (1) Schedule 13D filers do not trade every day (but rather every two or three days), (2) when they trade, they trade a relatively large fraction of the daily volume (around one quarter of the daily volume), (3) Schedule 13D filers trade more aggressively closer to the filing date.

In our sample, 65% of companies are listed on the NASDAQ, 27% are listed on the NYSE, and the remaining 8% are listed on the AMEX. Garfinkel and Nimalendran (2003) suggest that there is a difference in the degree of anonymity between NASDAQ and NYSE market structures. Specifically, they find evidence that is consistent with less anonymity on the NYSE specialist system compared to the NASDAQ dealer system. Consistently with Garfinkel and Nimalendran (2003), we find that Schedule 13D filers trade more aggressively on the NASDAQ. For example, when Schedule 13D filers target companies listed on the NASDAQ, the average trading strategy is shorter (15 trading days on the NASDAQ vs. 17 trading days on the NYSE), filers purchase more shares on every trading date (0.57% of outstanding shares on the NASDAQ vs. 0.30% of outstanding shares on the NYSE), and end up with a larger block (7.61% on NASDAQ vs. 7.00% on NYSE).

2.2. Case Study: Icahn Capital LP vs. Chesapeake Energy Corporation

To illustrate the informed trades that are the focus of this paper, we give a detailed description of one specific case.

On May 25, 2012, Icahn Capital LP filed a Schedule 13D indicating that it owned 7.56% of Chesapeake Energy Corporation (50,085,202 shares of common stock), which operates in the Oil & Gas Operations industry. The filer in a letter to the Chesapeake board included in the Schedule 13D filing, said that Icahn Capital LP planned to force the break up of Chesapeake's board and the installation of new directors nominated by Icahn Capital LP and other leading shareholders. Therefore, the filer explicitly highlighted the possibility of active engagement in company's corporate governance.

Figure 4 presents the percentage of outstanding shares owned by Icahn Capital LP during the $(fday-36, fday)$ period, where $fday$ is the filing day.[7] The filer's ownership prior to the sixty-day disclosure period was 0.11% of Chesapeake Energy (702,367 shares of common stock). During the sixty-day period before the filing date the filer purchased 7.46% of Chesapeake Energy (49,382,835 shares of common stock). All these shares where purchased during the $(fday-36, fday-1)$ period. The filer's ownership crossed the five-percent threshold on May 17, 2012 (the "event day").

[Insert Figure 4 here]

The filer disclosed that the 50,085,202 shares of common stock were purchased for $785,300,000, i.e., $15.68 per share. The filing reveals that the 702,367 shares purchased prior to the sixty-day period were acquired at an average price of $14.54 per share while the 49,382,835 shares that were purchased during the sixty-day period were acquired at an average price of $15.70 per share. The average price of Chesapeake Energy shares reached $17 per share level in the ten days after the filing and remained at $17.52 per share during the post-filing month, suggesting that the filer gained $1.82 on average per

[7]Since during the $(t-60, t-37)$ period the filer did not trade stocks of Chesapeake Energy, this period is not plotted in this figure.

share purchased. This gain aggregates to $91,981,854. In the forty days after the filing the stock price reached $19.36 per share, raising Icahn Capital LP's gain to $183,311,839.

The price of Chesapeake Energy shares increased by 4.95% during the filing day (May 25, 2012) and the following trading day (May 29, 2012). Therefore, the market's perception of the value created by Icahn Capital LP was clearly positive.

Consistent with the evidence in Table 1, Figure 4 suggests that Icahn Capital LP did not trade on every trading day during the sixty-day pre-filing period. Specifically, the filer traded on eighteen trading days during the sixty-day period. Interestingly, the filer traded when stock liquidity was high. For example, during the sixty-day period, the average level of the Amihud (2002) illiquidity measure during days with trades by Icahn Capital LP was 38% *lower* than during days with no trades by Icahn Capital LP.[8]

3. Are Schedule 13D filers informed?

At the core of this study is the following assumption: Schedule 13D filers possess valuable information on the underlying securities when they trade in the pre-announcement period. We use three approaches to assess the extent of the filer's private information. First, we use short-term announcement event-day returns upon Schedule 13D filing. The short-term announcement event-day returns summarize the market's perception of the value created by Schedule 13D filers. Second, we use profits made by Schedule 13D filers on purchasing stocks at the pre-announcement prices. Finally, we evaluate the performance of trading strategies that replicate trades of Schedule 13D filers.

Note that Schedule 13D filers trade on long-lived information that, by its very nature, is not likely to be available to other market participants. In most cases, it is their own future actions, such as shareholder activism, that will increase the value of the firm. Of course, this depends closely on their decision, and ability, to take a sizable stake in the

[8] Amihud (2002) illiquidity measure is the ratio of absolute value of daily stock return to the dollar trading volume, multiplied by 1000.

firm. In some sense, it is their very trading that constitutes the private information. Only when they reach the 5% threshold, does the information, due to the disclosure requirement, become public. We can measure the extent to which the market believes their future action have value by looking at announcement returns. This also allows us to measure the private information content of their trades.

3.1. Announcement Returns

Figure 5 plots the average buy-and-hold return, in excess of the buy-and-hold return on the value-weighed NYSE/AMEX/NASDAQ index from CRSP, from sixty days prior to the filing date to forty days afterward. Panel A includes data from the 2001-2010 sample period. There is a run-up of about 7% between sixty days to one day prior to the filing day. The two-day jump in excess return observed at the filing date is around 3%. After that the excess return remains positive and so that the post-filing 'drift' cumulates to a total of 13%.[9] Thus, the short-term announcement event-day returns suggest that Schedule 13D filers indeed possess valuable private information during the pre-announcement period.

[Insert Figure 5 here]

By studying the abnormal returns around the filing day we implicitly assume that Schedule 13D filings become public when filed with the SEC. While the 3% two-day jump in excess return observed at the filing date is consistent with this assumption, to further validate it we checked a representative sample of events 'by hand' and found that most of the Schedule 13D filings become public within one day after filing with the SEC. There are, however, some exceptions in the early part of the sample when filings

[9]The evidence is consistent with Brav et al. (2008) and Klein and Zur (2009), who report significant positive stock reaction to announcement of hedge fund activism, where the announcement is triggered by Schedule 13D filings. There are two main differences between our samples. First, we consider all Schedule 13D filings while Brav et al. (2008) and Klein and Zur (2009) consider only filings by hedge funds. Second, a Schedule 13D filing is required to have information on trades in order to be included in our sample. That is, we restrict our sample to cases in which the Schedule 13D filer actively accumulate shares and crosses the 5% threshold.

became public with a short delay. Such delays might explain the post-filing drift in returns which is evident in Panel A of Figure 5. To further investigate this, we replicate Panel A while restricting the sample period to 2003-2010. The results are reported in Panel B of Figure 5. It shows that the post-filing drift in returns does not exist in the later part of the sample. Specifically, there is no trend in the abnormal return after the filing date. Therefore, the overall evidence suggests that market participants learn almost immediately about Schedule 13D filings in recent years, and also incorporate the resulting information about the stock price fairly efficiently into prices.

3.2. Profits

We calculate three measures of profits. First, we calculate Schedule 13D filers' profits from purchasing shares at the pre-announcement prices:

$$Trading\ Profit = \mathbf{q}'(p_{post} - \mathbf{p}), \tag{1}$$

where $\mathbf{q}$ is the vector of trades (purchases are positive and sales are negative) during the sixty-day period, p_{post} is the post-announcement price, and $\mathbf{p}$ is the vector of transaction prices. The post-announcement price is the average stock price during the week that follows the Schedule 13D filing.

If Schedule 13D filers indeed own valuable private information, they would be expected to purchase shares at a discount relative to the post-announcement price. Of course, by purchasing securities schedule 13D filers may also push up prices. Thus their cumulative profits also depend on the price impact of their trades. If price impact is large, then we expect realized profits of insiders to be lower than if price impact is low. Thus the trading profits of Schedule 13D filers depend both on the value of their private information and on the stock price liquidity.

Second, we calculate the total profit realized by informed investors:

$$Total\ Profit = Trading\ Profit + (p_{post} - p_0)w_0, \tag{2}$$

where p_0 is the price of the first transaction and w_0 is the initial ownership, which is established before the sixty-day period. This measure assumes that a Schedule 13D filer purchases the initial stake at the price of the first transaction. As our case study on "Icahn vs. Cheasapeake" suggests, this assumption is most likely to cause a downward bias in estimated total profits.

Finally, we report the total value created for the shareholders of a company that experience a Schedule 13D filing:

$$Value\ Created = (p_{post} - p_0)SHOUT, \tag{3}$$

where $SHOUT$ is the number of shares outstanding.

[Insert Table 2 here]

Table 2 presents the distribution of trading profits. We split the sample into five market cap quantiles and report mean and median profit measures for every quantile. The evidence suggests that informed traders profit significantly from trading. For example, a Schedule 13D filer who acquires a \$30 million stake in a \$404 million market cap company (i.e., 7.42% stake, which is an average stake in our sample) expects to benefit \$1.13 million. This can be further broken down into a \$0.60 million profit on trades during the sixty-day period and a \$0.53 million profit on the initial ownership, purchased prior to the sixty-day window.

The evidence also suggests that the main beneficiaries are shareholders who own shares on the announcement date. For example, shareholders of companies in the fifth market cap quantile gain \$46.2 million during an average event whereas the Schedule 13D filer gains \$3.0 million. Therefore, while Schedule 13D filers benefit from uninformed traders who sell their shares during the pre-announcement period, they create significant value for all other shareholders by deciding to file Schedule 13D and to intervene in a company's governance.

3.3. Trading Strategies

Next we evaluate the performance of trading strategies that exploit the information from Schedule 13D filings. Note that some of these strategies are not implementable based only on public information and without the knowledge of the insider's information or trading. The results are nevertheless interesting to measure the quality of (and returns to) private information. Table 3 reports estimates of one-, three-, and four-factor models, where the left-hand-side variable is a daily return on the portfolio of Schedule 13D stocks.

[Insert Table 3 here]

Panel A reports the performance of an equal-weighted portfolio return, constructed as follows. For every trading day, we calculate the equal-weighted average of returns on stocks held by Schedule 13D filers. We report results for three investment horizons: from 90 days before filing to 30 days after filing, from 60 days before filing to 30 days after filing, and from 30 days before filing to 30 days after filing. The evidence in Panel A suggests that all portfolios exhibit positive and significant daily alphas, varying from 0.13% to 0.21%.

Panel B reports the performance of a value-weighted portfolio return, constructed as follows. For every trading day, we calculate the dollar investment of Schedule 13D filers in every stock. Then we calculate the average return on these stocks for every trading date, where the weights are proportional to the dollar investment in each stock. We assume that Schedule 13D filers do not change their position until 30 days after the filing date. The evidence suggests that this portfolio exhibits economically and statistically significant positive alpha. For example, the four-factor model daily alpha is 0.09% with 3.04 t-statistic.

The evidence suggests that the informational advantage of Schedule 13D filers is substantial, and that taken together a strategy that could replicate their investments would be extraordinarily successful at generating 'alpha,' i.e., outperforming significantly the benchmark return predicted by standard linear asset-pricing factor models.

4. Liquidity Measures

We use four measures of stock liquidity that rely on high-frequency data: the Kyle lambda, the effective spread, the realized spread, and price impact. Kyle's lambda is a measure of price impact, which can be interpreted as the cost of demanding a certain amount of liquidity over some given time period. In constructing this measure, we follow Hasbrouck (2009) and Goyenko et al. (2009) and calculate the price impact as the slope coefficient λ_{it} in the regression:

$$ret_{itn} = \delta_{it} + \lambda_{it} S_{itn} + \varepsilon_{itn}, \tag{4}$$

where for the nth five-minute period on date t and stock i, ret_{itn} is the stock return and S_{itn} is the sum of signed square-root dollar volume, that is, $\sum_k sign(dvol_{itnk})\sqrt{|dvol_{itnk}|}$. The trades are signed according to the Lee and Ready (1991) algorithm.

The effective spread is the difference between the natural logarithm of the actual transaction price and the natural logarithm of the midpoint prevailing at the time of the trade:

$$espread_{itk} = 2|ln(P_{itk}) - ln(M_{itk})|, \tag{5}$$

where P_{itk} is the price of the kth trade and M_{itk} is the midpoint of the consolidated BBO prevailing at the time of the kth trade (Hasbrouck, 2010).[10] Aggregating over day t, a stock's effective spread $espread_{it}$ is the dollar-volume-weighted average of the effective spread $espread_{itk}$ computed over all trades on day t. The wider the effective spread, the less liquid is the stock.

The realized spread is the temporary component of the effective spread. It measures the revenue to liquidity providers assuming that the liquidity provider is able to close her position at the midpoint prevailing five minutes after the trade. For a given stock i

[10] We exclude NBBO crossed and locked observations from the analysis (Holden and Jacobsen, 2011).

and day t, the realized spread on the kth trade is defined as:

$$rspread_{itk} = 2q_{itk}(ln(P_{itk}) - ln(M_{itk+5})), \tag{6}$$

where M_{itk+5} is the midpoint of the consolidated BBO prevailing five-minutes after the kth trade and q_{itk} is the buy–sell indicator (+1 for buys, –1 for sells). Aggregating over day t, a stock's realized spread $rspread_{it}$ is the dollar-volume-weighted average of the realized spread $rspread_{itk}$ computed over all trades on day t.

The five-minute price impact is the permanent component of the effective spread. It measures gross losses to liquidity demanders due to adverse selection (Glosten and Harris, 1988). For a given stock i and day t, the five-minute price impact of the kth trade is defined as:

$$pimpact_{itk} = 2q_{itk}(ln(M_{itk+5}) - ln(M_{itk})), \tag{7}$$

Aggregating over day t, a stock's price impact $pimpact_{it}$ is the dollar-volume-weighted average of price impact $pimpact_{itk}$ computed over all trades on day t.

In addition, we use seven low-frequency measures of stock liquidity: the Amihud illiquidity, the Amivest liquidity, the daily bid-ask spread, an indicator of a day with zero return ("*zero*"), an indicator of a positive-volume day with zero return ("*zero*2"), the Pastor and Stambaugh (2003) reversal measure, and the probability of informed trade ("*pin*") introduced by Easley et al. (1996).[11]

Amihud's illiquidity measure $illiquidity_{it}$ is defined as:

$$illiquidity_{it} = 1000\frac{|r_{it}|}{volume_{it}}, \tag{8}$$

[11]The indicators are closely related to the proportion of days with zero-returns and the proportion positive-volume days with zero returns defined in Lesmond et al. (1999). Averaging an indicator over a period of time (e.g., month) will produce the corresponding proportion of days.

where r_{it} is the stock i return on day t and $volume_{it}$ is stock i dollar volume on day t. A smaller value of *illiquidity* implies a lower price impact, and therefore a higher stock liquidity.

The Amivest liquidity measure $liquidity_{it}$ is defined as:

$$liquidity_{it} = 0.001 \frac{volume_{it}}{|r_{it}|}. \tag{9}$$

A larger value of *liquidity* implies a lower price impact.

The bid-ask spread $basperad_{it}$ of stock i on day t is defined as:

$$baspread_{it} = \frac{ask_{it} - bid_{it}}{0.5(ask_{it} + bid_{it})}, \tag{10}$$

where ask_{it} and bid_{it} are daily closing ask and bid from CRSP. A smaller value of *baspread* implies a higher stock liquidity.

The Pastor and Stambaugh (2003) reversal measure for stock i in period t (e.g., month) is the ordinary least squares estimate of $\gamma_{i,t}$ in the regression

$$r^e_{i,d+1,t} = \theta_{i,t} + \phi_{i,t} r_{i,d,t} + \gamma_{i,t} sign(r^e_{i,d,t}) v_{i,d,t} + \epsilon_{i,d,t}, d = 1, ..., D, \tag{11}$$

where quantities are defined as follows: $r_{i,d,t}$ is the return on stock i on day d in period t; $r^e_{i,d,t} = r_{i,d,t} - r_{m,d,t}$, where $r_{m,d,t}$ is the return on the CRSP value-weighted market return on day d in period t; $v_{i,d,t}$ is the dollar volume for stock i on day d in period t.[12] A negative γ indicates the presence of reversal. A higher absolute value of γ implies greater expected reversal and therefore lower stock liquidity.

The Easley et al. (1996) *pin* measure is:

$$pin = \frac{\alpha\mu}{\alpha\mu + 2\varepsilon}, \tag{12}$$

[12] We follow Pastor and Stambaugh (2003) in imposing restrictions on the estimation procedure.

where α is the probability of an information event, μ is the arrival rate of of traders who know the new information if it exists, and ε is the arrival rate of uninformed traders. Maximum likelihood estimators of these parameters are described in Easley et al. (1996), pages 1412-1414. A higher value of *pin* implies a higher probability of informed trade.

Table 4 provides summary descriptive statistics of the stock liquidity measures. Panel A describes high-frequency stock liquidity measures and Panel B describes low-frequency stock liquidity measures.

[Insert Table 4 here]

5. Results

The evidence reported in Section 3 suggests that Schedule 13D filers indeed possess valuable private information and benefit from trading with uniformed traders. Thus, we can confidently argue that there is a substantial amount of asymmetric information in Schedule 13D trades. Therefore, it is an ideal environment for testing whether liquidity measures indicate the increase in the information asymmetry between market participants. In this section we test whether liquidity measures, described in Section 4, indicate the presence of informed trading.

5.1. Price Impact of Informed Trades

We begin the analysis by showing that trades by Schedule 13D filers affect prices. First, note from figure 5 that stock prices increase closer to the filing date. Moreover, Figure 3 shows that Schedule 13D filers trade more aggressively closer to the filing date. This suggests that trades by Schedule 13D filers affect prices and specifically, that when Schedule 13D filers buy stocks, their prices appreciate and get closer to the post-filing date level.

Second, we compare the market-adjusted returns and the daily turnover during the sixty-day disclosure period and the sixty-day period during previous year. Panel A in Table 5 suggests that the market-adjusted returns and the daily turnover are higher

during the sixty-day disclosure period. The changes are not only statistically but also economically significant. For example, the market adjusted return increases from 0.02% to 0.11%.

[Insert Table 5 here]

Third, Panel B in Table 5 suggests that market-adjusted returns and daily turnover are higher on days when Schedule 13D filers trade. For example, the average market-adjusted return is 0.62% on days when Schedule 13D filers trade and -0.04% on days when Schedule 13-D filer do not trade. Thus, the adverse selection is worse on days when Schedule 13D filers trade.

Finally, we adopt the regression methodology and estimate the following regression:

$$y_{it} = \alpha + \gamma itrade_{it} + \epsilon_{it}, \tag{13}$$

where y_{it} is either market-adjusted return or daily turnover for company i on day t and $itrade_{it}$ is an indicator that is +1 on a day with trades by Schedule 13D filers and zero else. Table 6 reports the results.

[Insert Table 6 here]

Similarly to evidence in Table 5, Table 6 suggests that market-adjusted returns and daily turnover are higher on days when Schedule 13D filers trade. The results are robust to augmenting the regression with event fixed effects and restricting the sample to the sixty-day disclosure period only.

Overall, the evidence indicates that when Schedule 13D filers trade they move prices up. In addition, days with trades by Schedule 13D filers are characterized by high daily turnover. Next we study whether liquidity measures reveal the presence of informed trading.

5.2. Do Liquidity Measure Reveal the Presence of Informed Trading?

We begin the analysis by plotting the two arguably most popular (il)liquidity measures around the filing date: the Kyle (1985) lambda and the Amihud (2002) illiquidity measure. Figure 6 shows that both lambda and the Amihud (2002) illiquidity measure achieve local minima around the filing date. That is, it is exactly when the informed traders are most active and affect prices, these measures indicate low adverse selection.

[Insert Figure 6 here]

Next, we consider the sixty-day disclosure period and test whether liquidity measures during this period differ from liquidity measures during the same calendar window in the year prior to that when the Schedule 13D is filed. Table 7 presents the results. The evidence suggests that none of the liquidity measures indicate the presence of informed traders during the sixty-day disclosure period. Instead, three high-frequency measures (λ, *espread*, and *rspread*) and five low-frequency measures (*illiquidity*, *liquidity*, *baspread*, *pin*, and *zero*2) indicate higher stock liquidity. For example, *pin* is more than 10% lower during the sixty-day disclosure period.[13] Pastor and Stambaugh (2003) return reversal measure, *psgamma*, is the only measure that indicates lower stock liquidity (i.e., stronger return reversal), but the difference is not statistically significant.

Importantly, while some liquidity measure are affected not only by adverse selection (e.g., *baspread* may also be a function of inventory costs), λ and *pin* are usually associated specifically with the adverse selection component. Therefore, the evidence presented in Table 7 constitutes a major challenge to the argument that these liquidity measures detect informed trades.

[Insert Table 7 here]

[13]Related to our results, evidence in Aktas et al. (2007) suggests that *pin* is lower before merger and acquisition announcements.

The evidence in Section 2 suggests that Schedule 13D filers trade on average only on 15 days during the sixty-day disclosure period. Motivated by this evidence, we next test how liquidity measures behave on days when Schedule 13D filers trade compared to days where they do not trade, during the disclosure period. Table 8 presents the results.[14] The evidence suggests that all liquidity measures except *zero* (which is not statistically significantly different on both types of days) indicate higher stock liquidity on days with trades by Schedule 13D filers. For example, the average λ is 12.35 on days with informed trades and 16.85 on days with no informed trades. That is, it is almost 30% lower on days with informed trades.[15]

[Insert Table 8 here]

Next, we adopt the regression methodology and estimate the following regression:

$$liq_{it} = \alpha + \gamma itrade_{it} + \epsilon_{it}, \tag{14}$$

where liq_{it} is a measure of liquidity for company i on day t and $itrade_{it}$ is an indicator that is +1 on a day with trades by Schedule 13D filers and zero else.[16]

Panel A in Table 9 reports the results. First note the constant in this specification has a simple interpretation: it measures the average level of a liquidity measure during the sample period, which is $(fday - 120, fday + 40)$ around the filing day. For example, the average effective spread is 112 basis points. The coefficient of *itrade* indicates how

[14]This approach does not allow us to study two liquidity measures that have played a significant role in the literature: the Pastor and Stambaugh (2003) *gamma* and Easley et al. (1996) *pin* measure. This is because the estimation of these two measures requires a time series of a certain length, and cannot be performed on adjacent days. For example, it is typically suggested to estimate the *pin* measure over at least a one month horizon.

[15]Motivated by the more aggressive trading strategy of Schedule 13D filers in the post-event period, we test how liquidity measures behave on post-event trading days when Schedule 13D filers trade compared to days where they do not trade, during the disclosure period. Untabulated evidence is very similar to evidence from Table 8, suggesting that all liquidity measures except *zero* and *rspread* (which are not statistically significantly different on both types of days) indicate higher stock liquidity on days with trades by Schedule 13D filers during the post-event period.

[16]Hendershott et al. (2011) use similar specification to study the effect of algorithmic trading on liquidity.

different a measure of liquidity is on days with trades by Schedule 13D filers. The estimates suggest a *higher* stock liquidity on days with trades by Schedule 13D filers. All results are highly economically and statistically significant. For example, the price impact decreases by 12 basis points from 62 to 50 basis points, which is a 19% reduction. None of the liquidity measures, including those that have often being used to proxy for adverse selection, indicate the presence of informed trades.

[Insert Table 9 here]

Next we estimate an augmented version of equation (14), which accommodates event fixed effects:

$$liq_{it} = \alpha + \gamma itrade_{it} + \eta_i + \epsilon_{it}, \tag{15}$$

where η_i are event fixed effects. Panel B reports the results. The evidence suggests that even after including event fixed effects, the main conclusion does not change: liquidity measures do no indicate the presence of informed trades. Instead, stocks appear more liquid when schedule 13D filers trade. For example, the Amihud (2002) *illiquidity* measure decreases by more than 25% (from 0.3389 to 0.2442). Since all cross-sectional variation in liquidity measures is captured by the event fixed effects, we can conclude that stocks appear more liquid *when* Schedule 13D filers trade.

In a robustness check we restricted the sample to the $(fday - 60, fday)$ period. The idea of this exercise it to verify that results are not driven by changes in liquidity in the post-filing period. The evidence in Panel C suggests that results are almost unaffected by changing the sample period.[17]

To summarize, the evidence constitutes a major challenge to the idea that empirical measures of stock price liquidity, and, in particular, of adverse selection, reveal the

[17]Untabulated robustness check suggests that the coefficient of *itrade* in equation (15) does not change significantly when the ten-day period before the filing date is concerned. Specifically, we estimate the following specification: $liq_{it} = \alpha + \gamma_1 itrade_{it} * tenday_{it} + \gamma_2 itrade_{it} + \gamma_3 tenday_{it} + \eta_i + \epsilon_{it}$, where *tenday* indicates the ten-day period before the filing date. The evidence suggests that γ_1 is insignificant for all liquidity measures, except *rspread*. When *rspread* is concerned, γ_1 is positive and significant at 10% level while the sum of γ_1 and γ_2 is negative and statistically insignificant.

presence of informed trading. Instead, we find that measures of stock liquidity appear better (i.e., measured adverse selection is smaller) when informed investors trade more aggressively. Importantly, the results are similar when either high- or low-frequency measures of stock liquidity are considered.

6. Aggregate Return and Liquidity

To shed more light on the selection mechanism that drives the results, we study the effect of exogenous variation in stock liquidity on trading strategies of Schedule 13D filers.[18] Collin-Dufresne and Fos (2012) present at theoretical model where insiders trade more aggressively when uninformed order-flow volatility is high. The authors find that when uninformed order-flow volatility is allowed to vary stochastically over time in Kyle's model, then the sign of the correlation between measures of price impact, such as Kyle's lambda, and the amount of informed trading is undetermined. In fact, if noise trader volatility is predictable, then the correlation can become negative, as trading (i.e., slippage) costs to uninformed investors are lower in high abnormal volume states, which is precisely when informed investors choose to trade more (and therefore more private information is incorporated into prices). Consistently with this intuition, Figure 7 suggests that Schedule 13D filers trade more aggressively when *uninformed* trading activity is high.[19]

[Insert Figure 7 here]

We next show how variation in market-wide conditions, such aggregate volume and market return, affects the trading strategies of Schedule 13D filers. Specifically, we

[18]Note that our regression regression results above say nothing about causality. It could be that insiders select to trade when stocks happen to be more liquid. Or it could be that stocks appear more liquid because insiders trade more and somehow affect stock liquidity. The latter is, in a way, the argument put forth by Cornell and Sirri (1992) who argue that there are 'falsely informed' noise traders who are attracted by informed trading and therefore offer better liquidity to the insiders (see page 1054). Below we offer some support that, if at all correct, this is not the whole story, since insiders do seem to condition on market wide liquidity, which is unlikely to be caused by their own trading.

[19]We separate to total trading volume for every trading day into two components: informed (initiated by Schedule 13D filers) and uninformed (not initiated by Schedule 13D filers).

estimate the following regression:

$$itrade_{it} = \alpha + \gamma_1 pdvol_t + \gamma_2 mktrf_t + \gamma_3 liq_{it} + \epsilon_{it}, \tag{16}$$

where *pdvol* is the percentage deviation of CRSP volume from its previous year average and $mktrf$ is the value-weight market return in excess of the risk-free rate. The analysis is based on daily observations from 60 days before the filing day to the filing day.

Panel A in Table 10 reports the results. The evidence suggests that Schedule 13D filers are more likely to trade when aggregate market activity is high (high CRSP volume), when the market performs poorly (low market return), and when measured liquidity is high. For robustness, we augment equation (16) with event fixed effects, which control for any event-specific unobservables. Panel B reports estimates and suggests that the results are not driven by unobservable event-specific factors.

[Insert Table 10 here]

7. Conclusion

In this paper we exploit a hand-collected data set on stock transactions by Schedule 13D filers. We find substantial evidence that trades by Schedule 13D filers contain valuable information: both announcement returns and profits realized by the filers are substantial. Moveover, we show that when Schedule 13D filers trade, prices do move up. We therefore feel warranted classifying pre-filing trades by Schedule 13D filers as informed trades.

The data set allows us to test whether stock price liquidity measures, proposed in the literature, reveal the presence of informed traders. The evidence suggests that neither high-frequency nor low-frequency measures of stock liquidity indicate the presence of informed traders. Instead, stocks exhibit higher stock liquidity when informed market participants trade, and even more so when they trade more aggressively. Importantly, measures that have been used as direct proxies for adverse selection, suggest that the

adverse selection is lower when informed trading takes place. The evidence is consistent with informed traders being more aggressive in regimes with higher stock 'liquidity.'

The main implication of the paper is that we cannot use standard liquidity measures as proxies for information asymmetry. The main problem seems to be that these measures are not robust to the informed trader's ability to select when and how much to trade. We show that along with liquidity measures, Schedule 13D filers use market volume and market return to condition their timing and size of trades.

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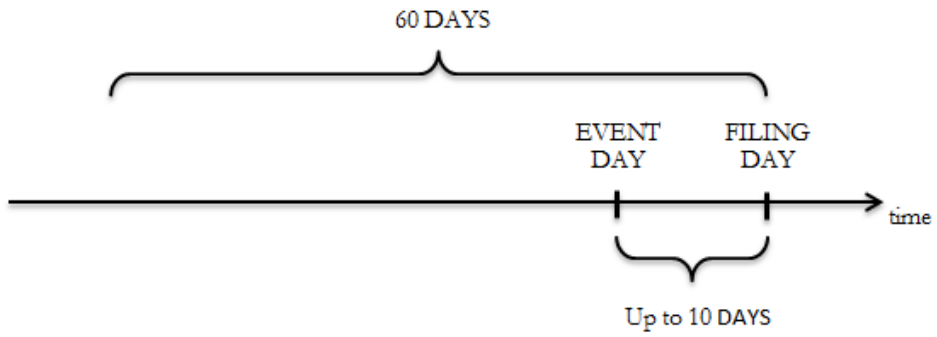


Figure 1: **The Schedule 13D Time Line** This figure summarizes the time line of a Schedule filing. The event day is the day on which Schedule 13D filer's ownership crosses the 5% threshold. Within ten days after the event day the filer files with the SEC and the filing day is determined. The filing includes information on trades during the sixty-day period that precedes the filing day ("sixty-day disclosure period").

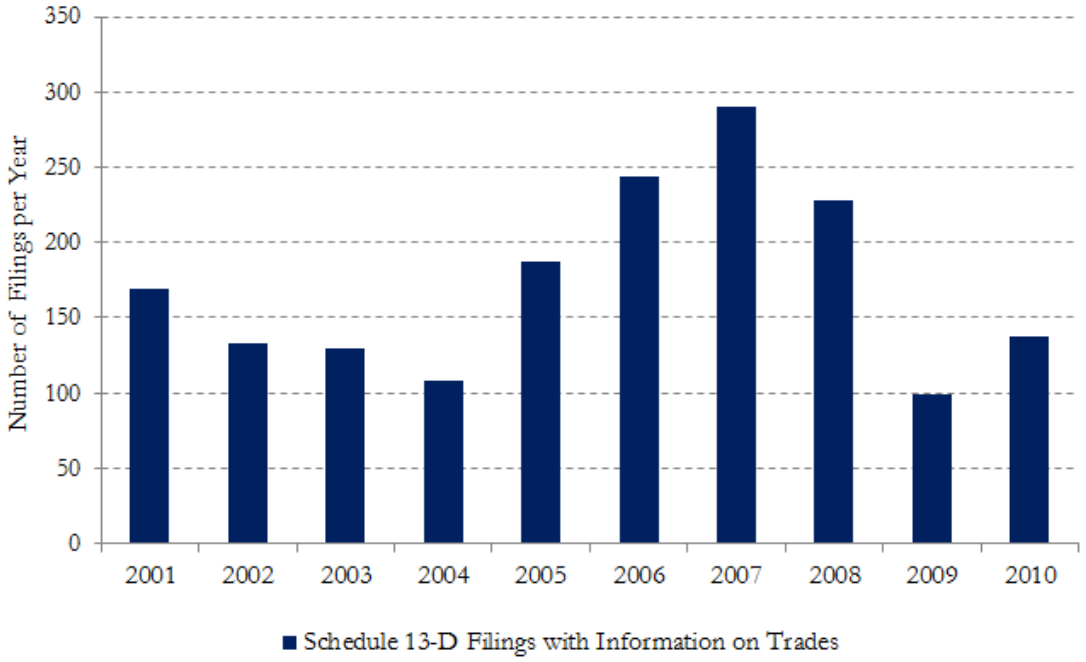


Figure 2: **Time Distribution of Schedule 13D Filings with Information on Trades.** The dark bars represent the number of Schedule 13D filings that satisfy the criteria listed in Section 2.1. The total number of Schedule 13D filings that satisfy the these criteria is 1,725 during 2001-2010.

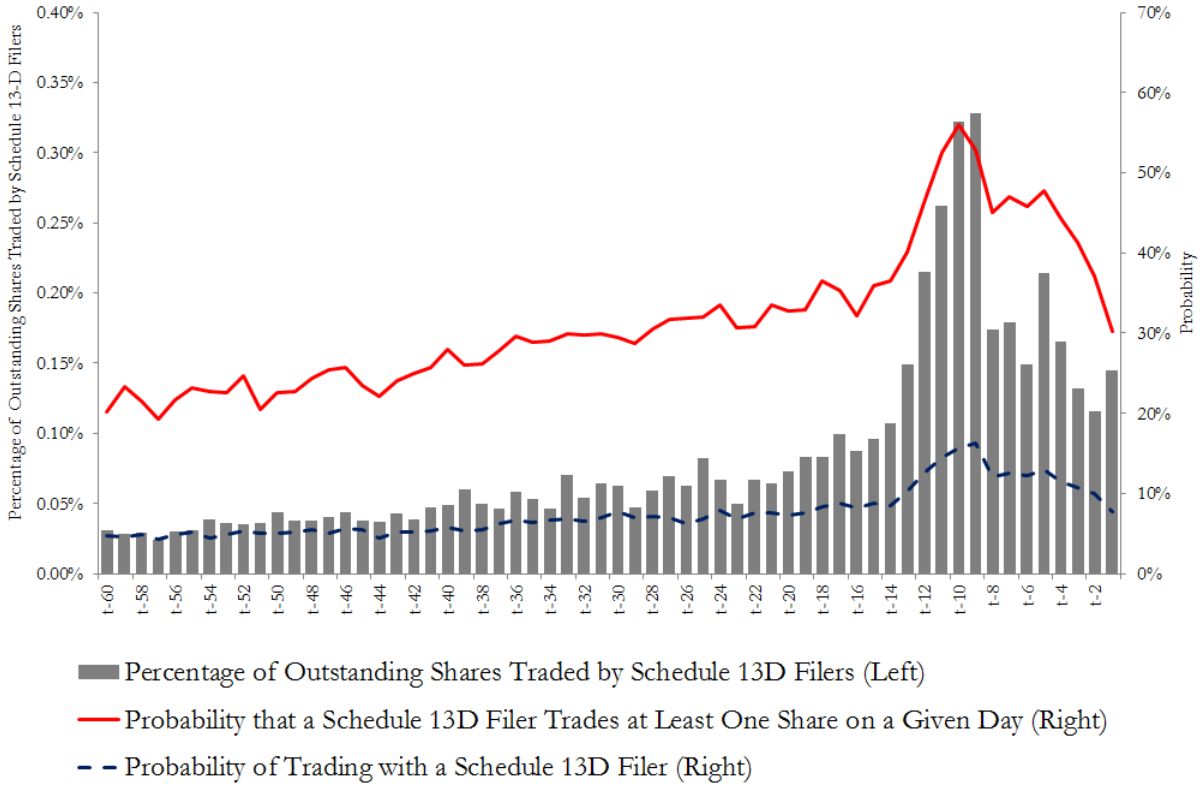


Figure 3: **Trading Strategy of Schedule 13D Filers before the Filing Day.** The solid line (right axis) plots the probability that a Schedule 13D filer trades at least one share on a given day. For every distance to the filing day, $t - \tau$, the probability that a Schedule 13D filer trades at least one share is the number of filings with a non-zero trade by the filer divided by the total number of Schedule 13D filings in the sample. We define the distance to the filing day as the number of days between a trading day, τ, and the filing day, t. The filing day corresponds to the day of filing with the SEC. The dark bars (left axis) represent the percentage of outstanding shares traded by Schedule 13D filers, from 60 days prior to the filing day. For every Schedule 13D filing and distance to the filing day, $t - \tau$, we calculate the percentage of outstanding shares traded by the filer as the ratio between the number of shares traded by the filer and the number of shares outstanding. If no trade is reported on a given day by the filer, the percentage of outstanding shares traded by the filer is set to zero. Then, for every distance to the filing day, $t - \tau$, the percentage of outstanding shares traded by Schedule 13D filers is the average of the percentage of outstanding shares traded among all filings. The dashed line (right axis) plots the probability of trading with a Schedule 13D filer. For every distance to the filing day, $t - \tau$, the probability of trading with a Schedule 13D filer is the average of the number of shares traded by the filer divided by security's volume from CRSP.

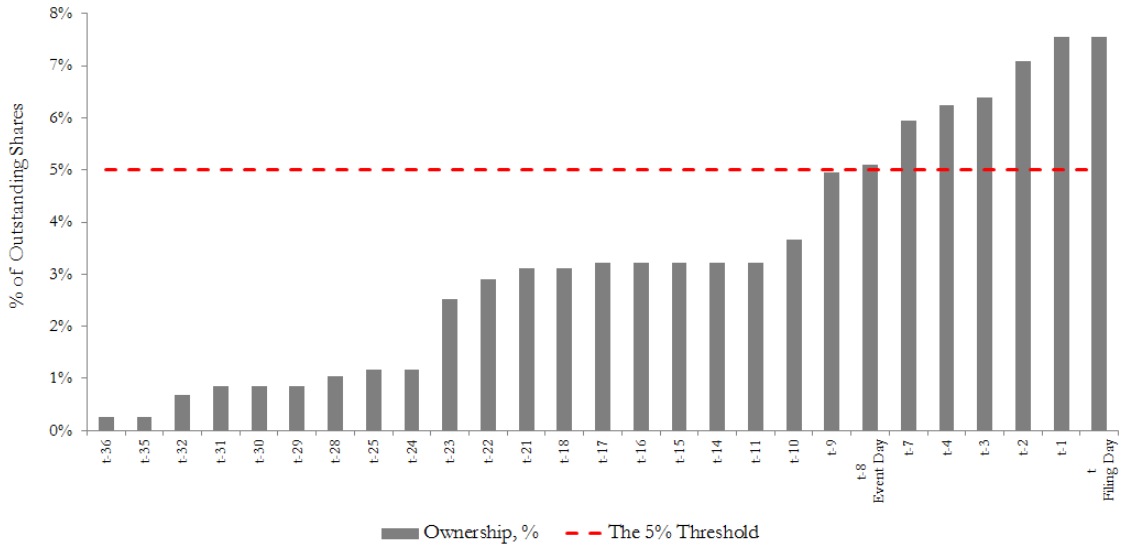
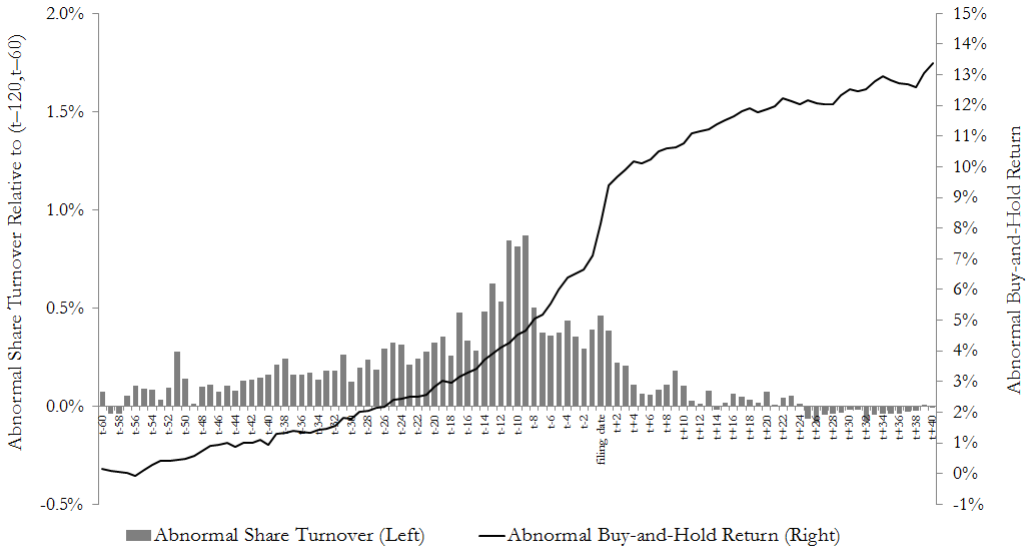
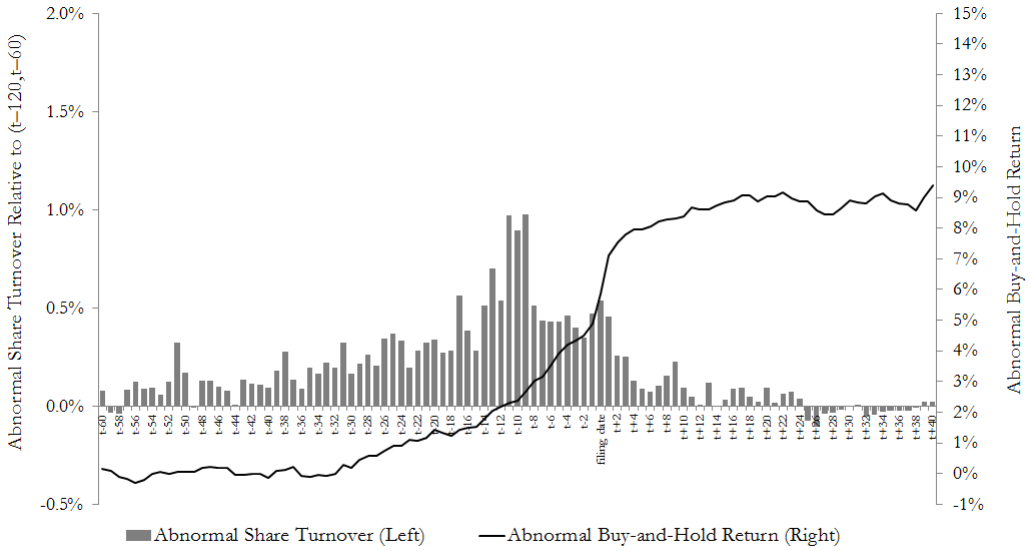


Figure 4: **Icahn Capital LP and Chesapeake Energy Corporation.** The event day is the day on which filer's ownership exceeds the 5% threshold. The filing day corresponds to the day of filing with the SEC. The dark bars plot the percentage of outstanding shares owned by the filer. The dashed line plots the 5% threshold. Since during the (t-60,t-37) period the filer did not trade stocks of Chesapeake Energy Corporation, this period is not plotted in this figure.

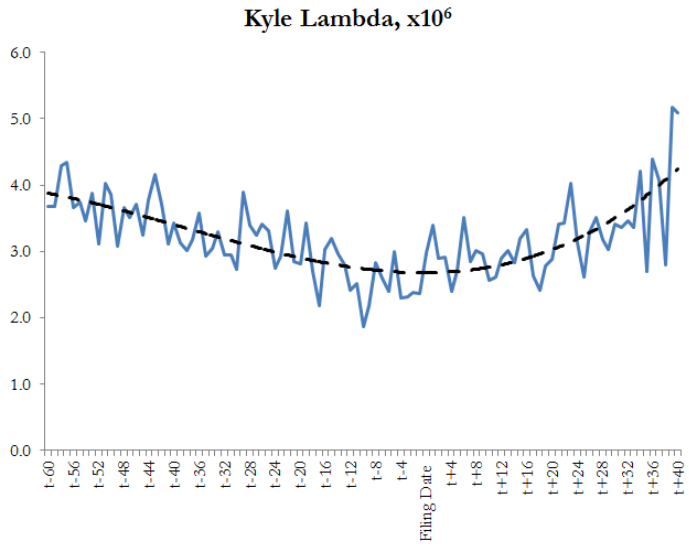


(a) Panel A: 2001-2010 Sample Period

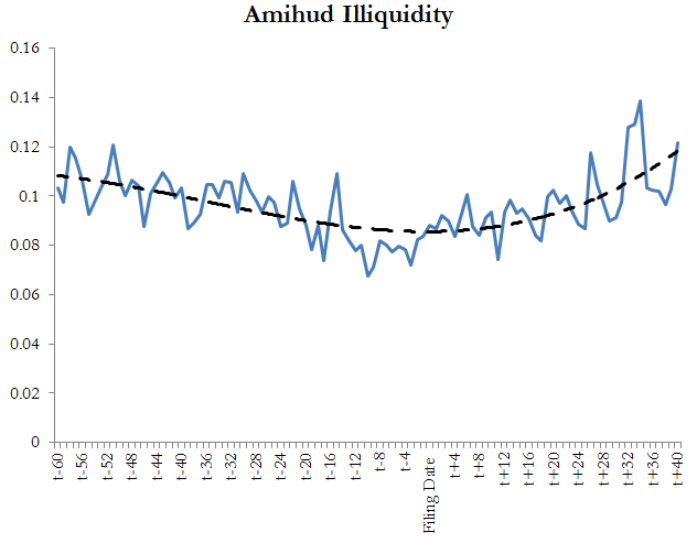


(b) Panel B: 2003-2010 Sample Period

Figure 5: **Buy-and-Hold Abnormal Return around the Filing Date.** The solid line (right axis) plots the average buy-and-hold return around the filing date in excess of the buy-and-hold return of the value-weight market from 60 days prior the filing day to 40 days afterwards. The filing day is the day on which the Schedule 13D filing is submitted to the SEC. The dark bars (left axis) plot the increase (in percentage points) in the share turnover during the same time window compared to the average turnover rate during the preceding (t-120, t-60) event window.



(a) Panel A



(b) Panel B

Figure 6: **Liquidity Measures around the Filing Date.** The solid line plots the Kyle Lambda (Panel A) and the Amihud Illiquidity measure (Panel B) from 60 days prior the filing day to 40 days afterwards. The dashed lines plots the third-order polynomial that fits the liquidity measure. Liquidity measures are defined in Section 4.

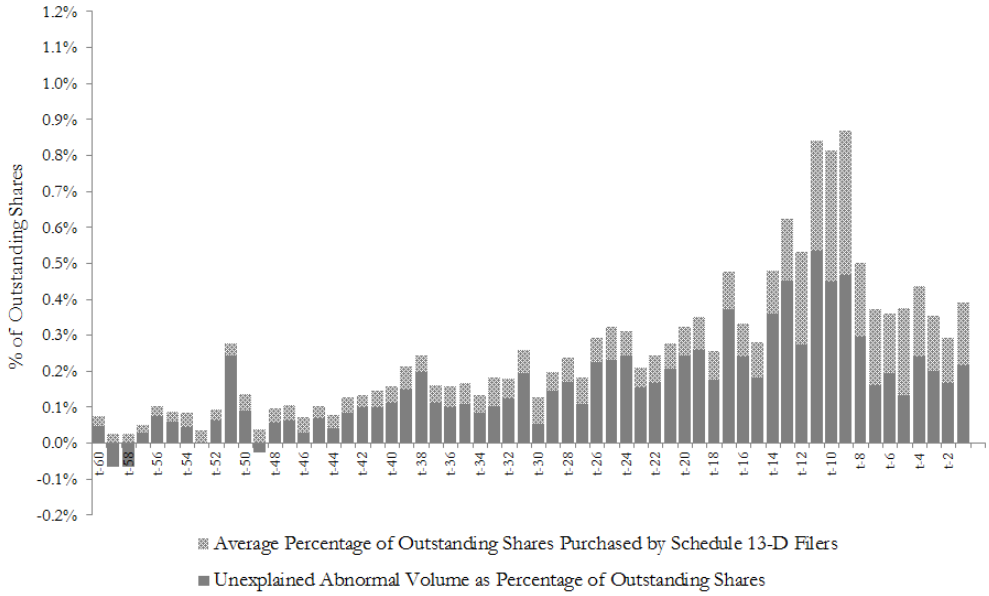


Figure 7: **Decomposition of Abnormal Share Turnover.** The bars plot the abnormal volume as percentage of outstanding shares from 60 days prior to the filing day to the filing day. The dashed part of each bar plots the average percentage of outstanding shares purchased by Schedule 13-F filers. The dark part of each bar plots the remaining part of abnormal volume that does not come from Schedule 13D filers.

Table 1: **Trading Strategy of Schedule 13D Filers.** This table presents descriptive statistics of Schedule 13D filers' trading strategies. Columns (1)-(3) report cross-event means of characteristics and columns (4)-(6) report cross-event medians of characteristics. Columns (1) and (4) report descriptive statistics from the full sample, which covers all days with informed trades during the sixty-day period before the filing day. The filing day is the day on which the Schedule 13D filing is submitted to the SEC. Columns (2) and (5) report descriptive statistics from days with informed trades during the pre-event day period ('Before'). The event day is the day on which filer's ownership exceeds the 5% threshold. Columns (3) and (6) report descriptive statistics from days with informed trades during the post-event day period ('After'). 'Informed trade' is a trade executed by a Schedule 13D filer. Stock ownership on the filing date is the total beneficial ownership of the Schedule 13D filer on the filing date. Number of trading days is the number of days with informed trades during the corresponding period. % of trading days with informed trades is the ratio of days with informed trades to the number of trading days. Informed volume (per trading day) is the total number of shares traded by a Schedule 13D filer (per trading day) on days with informed trades. Dollar informed volume (per trading day) is the total dollar amount traded by a Schedule 13D filer (per trading day) on days with informed trades. Change in ownership (per trading day) is the increase in stock ownership (per trading day), as percentage of number of shares outstanding, on days with informed trades. Informed turnover is the percentage of daily turnover that corresponds to the trades executed by Schedule 13D filers.

	Mean			Median		
	Full Sample	Before	After	Full Sample	Before	After
	(1)	(2)	(3)	(4)	(5)	(6)
Stock ownership on the filing date	7.68%			6.20%		
Number of trading days	15.1	13.1	3.7	13	11	3
% of trading days with informed trades	34.8%	34.7%	57.1%	30.0%	29.4%	57.2%
Informed volume	1,304,126	948,175	535,561	393,387	252,201	144,038
Informed volume per trading day	132,194	102,165	195,784	30,191	21,667	45,102
Informed volume (m$)	25.6	17.9	11.3	3.3	2.2	1.3
Informed volume per trading day (m$)	3.2	2.6	4.6	0.3	0.2	0.5
Change in stock ownership	3.8%	2.5%	1.8%	2.8%	1.8%	0.9%
Change in ownership per trading day	0.5%	0.3%	0.8%	0.2%	0.1%	0.3%
Informed turnover (%)	29.9%	26.1%	36.2%	22.6%	19.4%	27.8%

Table 2: **Profits from Informed Trades.** This table presents summary statistics of three measures of profits. *Trading Profit* is defined as $\mathbf{q}'(p_{post} - \mathbf{p})$, where $\mathbf{q}$ is the vector of trades (purchases are positive and sales are negative), p_{post} is the post-announcement price, and $\mathbf{p}$ is the vector of transaction prices. The post-announcement price is the average price during the week that follows the filing date. *Total Profit* is defined as $Trading\ Profit + (p_{post} - p_0)w_0$, where p_0 is the price of the first transaction disclosed in the Schedule 13D filing and w_0 is the initial ownership, established prior to the first transaction disclosed in the Schedule 13D filing. $Value\ Created$ is defined as $(p_{post} - p_0)SHOUT$, where $SHOUT$ is the number of shares outstanding. Market CAP is market capitalization of the targeted company.

Market CAP ($)		Trading Profit ($)		Total Profit ($)		Value Created ($)	
Quantile	Median	Mean	Median	Mean	Median	Mean	Median
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Q1 - low	23,659,879	50,877	9,810	100,295	52,559	1,270,457	844,707
Q2	63,368,069	90,877	26,025	197,147	59,418	1,819,414	1,828,604
Q3	151,542,849	308,514	65,642	369,945	291,283	6,626,805	5,969,746
Q4	404,095,821	568,519	124,864	1,133,935	307,943	19,634,771	8,424,417
Q5 - high	1,818,551,960	1,434,720	586,761	2,982,360	1,501,983	46,216,662	28,635,234

Table 3: **Performance of Trading Strategies Based on Schedule 13D Filers' Transactions.** This table presents evidence on performance of portfolios that replicate trades by Schedule 13D filers. Panel A reports performance of an equal-weighted portfolio return, which is constructed as follows. For every trading day, we calculate the equal-weighted average of returns on stocks held by Schedule 13D filers. We report results for three investment horizons: from 90 days before filing to 30 days after filing, from 60 days before filing to 30 days after filing, and from 30 days before filing to 30 days after filing. Panel B reports the performance of a portfolio-weighted return, which is constructed as follows. For every trading day, we calculate the dollar investment of Schedule 13D filers in the underlying security. Then we calculate the average return on stocks held by Schedule 13D filers for every trading date, where the weights are proportional to the dollar investment in each security. The trading strategy starts with the first disclosed transaction. We assume that Schedule 13D filers do not change their position during 30 days that follow the filing date. Table reports estimates of daily alpha (α) and the corresponding t-statistics. Standard errors are clustered by calendar date.

Investment Horizon	One-Factor Model		Three-Factor Model		Four-Factor Model	
	α	$t(\alpha)$	α	$t(\alpha)$	α	$t(\alpha)$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Equal-Weighted Returns						
$(fday-90, fday+30)$	0.14%	8.04	0.13%	7.66	0.13%	7.79
$(fday-60, fday+30)$	0.17%	8.58	0.15%	8.21	0.15%	8.30
$(fday-30, fday+30)$	0.21%	8.99	0.20%	8.61	0.20%	8.71
Panel B: Portfolio-Weighted Returns						
$(transactions, fday+30)$	0.10%	3.31	0.09%	3.00	0.09%	3.04

Table 4: **Summary Statistics of Liquidity Measures.** This table reports the summary statistics of liquidity measures on daily data. All liquidity measures are defined in Section 4. The sample covers $(fday - 60 - year,\ fday - 1 - year)$ period, where $fday$ is the Schedule 13D filing day. First, for every Schedule 13D filing we calculate the average level of a liquidity measure during the $(fday - 60 - year,\ fday - 1 - year)$ period. Then, we calculate summary statistic of liquidity measure among all events. The data set combines TAQ, CRSP, and the hand-collected sample of Schedule 13D filings (see Section 2).

Liquidity Measure	Description	Min	Percentile					Max	Mean	Std Dev
			5th	25th	Median	75th	95th			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: High-Frequency Measures										
$\lambda * 10^6$	the slope coefficient of $ret_{itn} = \delta_{it} + \lambda_{it} S_{itn} + \varepsilon_{itn}$	-201.7220	0.4600	1.7943	6.2807	20.6310	78.3130	414.5880	19.0390	36.5350
espread	dollar-weighted effective spread	0.0003	0.0011	0.0031	0.0082	0.0180	0.0480	0.4285	0.0149	0.0236
rspread	dollar-weighted realized spread	-0.0765	-0.0001	0.0004	0.0020	0.0077	0.0278	0.1404	0.0064	0.0118
pimpact	dollar-weighted price impact	-0.0104	0.0006	0.0017	0.0038	0.0081	0.0247	0.4662	0.0084	0.0210
Panel B: Low-Frequency Measures										
illiquidity	Amihud's illiquidity	0.0033	0.0177	0.0543	0.1859	0.5411	2.1057	7.3556	0.4858	0.8111
liquidity	Amivest liquidity	0.1151	0.5838	2.5321	7.4699	24.3899	73.8651	457.2598	18.9964	30.8862
baspread	Closing bid-ask spread	-0.0002	0.0007	0.0019	0.0063	0.0178	0.0596	0.1851	0.0150	0.0228
pin	the probability of informed trade	0.0000	0.1306	0.2912	0.4616	0.7175	0.9328	0.9988	0.4998	0.2563
psgamma	reversal measure	-0.7516	-0.0443	-0.0017	0.0000	0.0013	0.0433	0.6015	-0.0016	0.0656
zero	% of days with zero returns	0.0000	0.0000	0.0000	0.0250	0.0769	0.2703	0.7333	0.0665	0.0983
*zero*2	% of positive-volume days with zero returns	0.0000	0.0000	0.0000	0.0250	0.0745	0.2000	0.4762	0.0557	0.0713

Table 5: **Market-Adjusted Returns and Daily Turnover.** This table compares market-adjusted returns and daily turnover during periods with trades by Schedule 13D filers. The data set combines TAQ, CRSP, and the hand-collected sample of Schedule 13D filings (see Section 2). Market-adjusted return (*eret*) is the stock return in excess of the CRSP value-weighted return. Daily turnover (*to*) is daily volume divided by the number of shares outstanding. Panel A compares level of market-adjusted returns and daily turnover during the sixty-day disclosure period, $(fday-60, fday-1)$, and the corresponding sixty-day period of the year before the Schedule 13D filing, $(fday-420, fday-361)$. First, for every Schedule 13D filing we calculate the average level of market-adjusted returns and daily turnover during the sixty-day disclosure period, $(fday-60, fday-1)$. Then, we calculate the average level of market-adjusted returns and daily turnover among all events. Column (1) reports the average level of market-adjusted returns and daily turnover during the sixty-day disclosure period among all events. Similarly, Column (2) reports the average level of market-adjusted returns and daily turnover during the corresponding sixty-day period of the year before the Schedule 13D filing, $(fday-420, fday-361)$. Column (3) reports the differences between columns (1) and (2). Column (4) reports the t-statistic of the difference. Panel B compares level of market-adjusted returns and daily turnover during on days when Schedule 13D filers trade and on days when Schedule 13D filers do not trade. The sample covers the sixty-day disclosure period only. First, for every Schedule 13D filing we calculate the average level of market-adjusted returns and daily turnover during the sixty-day disclosure period on days with trades by the Schedule 13D filer. Column (1) reports the average level of market-adjusted returns and daily turnover on days with trades by Schedule 13D filers among all events. Column (2) reports the average level of market-adjusted returns and daily turnover on days with no trades by Schedule 13D filers during the sixty-day disclosure period. Column (3) reports the differences between columns (1) and (2). Column (4) reports the t-statistic of the difference. Panel C .. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

Panel A

	(fday-60,fday-1)	(fday-420,fday-361)	difference	t-stat
	(1)	(2)	(3)	(4)
eret	0.0011	0.0002	0.0009***	4.08
to	0.0103	0.0072	0.0030***	9.06

Panel B

	days with informed trading	days with no informed trading	difference	t-stat
	(1)	(2)	(3)	(4)
eret	0.0062	-0.0004	0.0067***	4.92
to	0.0218	0.0085	0.0132***	12.36

Table 6: **Market-Adjusted Returns and Daily Turnover – Continued.** This table compares market-adjusted returns and daily turnover during periods with trades by Schedule 13D filers. The data set combines TAQ, CRSP, and the hand-collected sample of Schedule 13D filings (see Section 2). Market-adjusted return (*eret*) is the stock return in excess of the CRSP value-weighted return. Daily turnover (*to*) is daily volume divided by the number of shares outstanding. We regress market-adjusted returns (columns (1)-(3)) and daily turnover (columns (4)-(6)) on indicator of informed trading, using the following specification: $y_{it} = \alpha + \gamma itrade_{it} + \epsilon_{it}$, where y_{it} is either market-adjusted return or daily turnover for company i on day t, and *itrade* indicates days on which Schedule 13D filers trade. Columns (1) and (4) reports results based on daily observations from 120 days before the filing day to 40 days after the filing day, where the filing day is the day on which the Schedule 13D filing is submitted to the SEC. Columns (2) and (5) report estimates of a specification augmented by event fixed effects: $y_{it} = \alpha + \gamma itrade_{it} + \eta_i + \epsilon_{it}$, where η_i are event fixed effects. Columns (3) and (6) report results with events fixed effects based of daily observations from 60 days before the filing day to the filing day. In each column, we report estimated coefficients and their t-statistics, calculated using heteroscedasticity robust standard errors. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

Dependent Variable	*eret* (1)	*eret* (2)	*eret* (3)	*to* (4)	*to* (5)	*to* (6)
itrade	0.0032***	0.0034***	0.0053***	0.0068***	0.0072***	0.0090***
	[8.46]	[8.14]	[9.21]	[26.50]	[15.30]	[16.24]
Constant	0.0006***	0.0005***	-0.0007***	0.0089***	0.0089***	0.0083***
	[4.66]	[9.10]	[-3.32]	[165.52]	[131.19]	[42.30]
Event FE	No	Yes	Yes	No	Yes	Yes
Observations	106,897	106,897	39,783	106,897	106,897	39,783
R-squared	0.001	0.001	0.003	0.015	0.021	0.034

Table 7: **Liquidity Measures during the Sixty-Day Disclosure Period.** This table reports the summary statistics of liquidity measures during the sixty-day disclosure period and the corresponding sixty-day period during the year before the Schedule 13D filing. The data set combines TAQ, CRSP, and the hand-collected sample of Schedule 13D filings (see Section 2). All liquidity measures are defined in Section 4 and are 99.9% winsorized. Market-adjusted return ($eret$) is the stock return in excess of the CRSP value-weighted return. Daily turnover (to) is daily volume divided by the number of shares outstanding. For every Schedule 13D filing we calculate the average level of a liquidity measure during the sixty-day disclosure period, $(fday-60, fday-1)$. Column (1) reports the average level of liquidity measures during the sixty-day disclosure period among all events. Similarly, Column (2) reports the average level of liquidity measures during the corresponding sixty-day period of the year before the Schedule 13D filing, $(fday-420, fday-361)$. Column (3) reports the differences between columns (1) and (2). Column (4) reports the t-statistic of the difference. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

	(fday-60,fday-1) (1)	(fday-420,fday-361) (2)	difference (3)	t-stat (4)
Low Frequency Measures				
illiquidity	0.4438	0.4794	-0.0357**	-2.29
liquidity	26.7813	19.1090	7.6723**	7.99
baspread	0.0132	0.0149	-0.0017***	-3.13
pin	0.4298	0.5000	-0.0703***	-10.85
psgamma	-0.0025	-0.0012	-0.0013	-0.54
zero	0.0671	0.0659	0.0012	0.51
zero2	0.0590	0.0553	0.0037*	1.83
High Frequency Measures				
$\lambda * 10^6$	16.3110	18.0540	-1.7430*	-1.68
espread	0.0133	0.0148	-0.0015**	-2.48
rspread	0.0057	0.0064	-0.0008***	-2.77
pimpact	0.0077	0.0083	-0.0006	-1.03

Table 8: **Liquidity Measures on Days when Schedule 13D Filers Trade.** This table reports the summary statistics of liquidity measures on days when Schedule 13D filers trade. The sample covers the sixty-day disclosure period only. The data set combines TAQ, CRSP, and the hand-collected sample of Schedule 13D filings (see Section 2). All liquidity measures are defined in Section 4 and are 99.9% winsorized. Market-adjusted return (*eret*) is the stock return in excess of the CRSP value-weighted return. Daily turnover (*to*) is daily volume divided by the number of shares outstanding. For every Schedule 13D filing we calculate the average level of a liquidity measure during the sixty-day disclosure period on days with trades by the Schedule 13D filer. Column (1) reports the average level of liquidity measures on days with trades by Schedule 13D filers among all events. Similarly, Column (2) reports the average level of liquidity measures on days with no trades by Schedule 13D filers during the sixty-day disclosure period. Column (3) reports the differences between columns (1) and (2). Column (4) reports the t-statistic of the difference. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

	days with informed trading (1)	days with no informed trading (2)	difference (3)	t-stat (4)
Low Frequency Measures				
illiquidity	0.2575	0.4808	-0.2233***	-11.42
liquidity	36.6643	24.8088	11.8555***	8.59
baspread	0.0109	0.0126	-0.0017***	-5.89
zero	0.0637	0.0632	0.0005	0.14
*zero*2	0.0635	0.0552	0.0083**	2.26
High Frequency Measures				
$\lambda * 10^6$	12.3510	16.8494	-4.4985***	-5.36
espread	0.0109	0.0125	-0.0016***	-2.89
rspread	0.0046	0.0054	-0.0007**	-2.62
pimpact	0.0062	0.0072	-0.0011*	-1.94

Table 9: **Informed Trading and Liquidity Measures.** This table shows the impact of informed trading on liquidity measures. In Panel A we regress each of liquidity measures described in Section 4 on indicator of informed trading, using the following specification: $liq_{it} = \alpha + \gamma itrade_{it} + \epsilon_{it}$, where liq_{it} is a measure of liquidity for company i on day t, and *itrade* indicates days on which Schedule 13D filers trade. The analysis is based on daily observations from 120 days before the filing day to 40 days after the filing day, where the filing day is the day on which the Schedule 13D filing is submitted to the SEC. In Panel B we estimate the specification from Panel A, while adding event fixed effects: $liq_{it} = \alpha + \gamma itrade_{it} + \eta_i + \epsilon_{it}$, where η_i are event fixed effects. In Panel C we estimate the specification from Panel B, while restricting the sample to daily observations from 60 days before the filing day to the filing day. In each column, we report estimated coefficients and their t-statistics, calculated using heteroscedasticity robust standard errors. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

	HIGH FREQUENCY MEASURES				LOW FREQUENCY MEASURES				
Dependent Variable	$\lambda * 10^6$	*espread*	*rspread*	*pimpact*	*illiquidity*	*liquidity*	*baspread*	*zero*	*zero*2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A									
itrade	-2.4077***	-0.0023***	-0.0011***	-0.0012***	-0.1352***	14.5902***	-0.0023***	0.0104***	0.0104***
	[-10.13]	[-12.62]	[-10.95]	[-8.42]	[-33.41]	[21.65]	[-14.86]	[5.09]	[5.09]
Constant	11.3420***	0.0112***	0.0048***	0.0062***	0.3447***	25.6913***	0.0107***	0.0498***	0.0498***
	[102.65]	[134.18]	[101.12]	[90.18]	[143.81]	[151.18]	[157.60]	[69.24]	[69.24]
Observations	79,801	106,897	106,897	106,897	106,895	101,416	105,727	106,895	106,895
Panel B									
itrade	-2.1531***	-0.0010***	-0.0005***	-0.0005***	-0.0947***	12.2101***	-0.0009***	0.0126***	0.0126***
	[-7.31]	[-4.69]	[-4.02]	[-3.06]	[-13.51]	[8.88]	[-5.11]	[5.14]	[5.14]
Constant	11.3028***	0.0110***	0.0047***	0.0061***	0.3389***	26.0301***	0.0105***	0.0495***	0.0495***
	[249.41]	[364.26]	[247.06]	[251.02]	[336.44]	[132.93]	[393.20]	[140.75]	[140.75]
Observations	79,801	106,897	106,897	106,897	106,895	101,416	105,727	106,895	106,895
Panel C									
itrade	-2.7457***	-0.0009***	-0.0007***	-0.0005**	-0.1173***	13.3584***	-0.0012***	0.0117***	0.0117***
	[-8.77]	[-3.57]	[-4.63]	[-2.04]	[-13.97]	[8.50]	[-5.45]	[3.96]	[3.96]
Constant	11.5867***	0.0108***	0.0047***	0.0062***	0.3520***	26.2981***	0.0103***	0.0488***	0.0488***
	[97.16]	[120.76]	[85.56]	[78.93]	[118.89]	[47.77]	[138.28]	[46.82]	[46.82]
Observations	29,884	39,783	39,783	39,783	39,783	37,678	39,357	39,783	39,783

Table 10: **Uninformed Volume, Market Return, and Trading Strategy of Schedule 13D Filers.** This table shows the impact of uninformed volume and market return on trading strategy on Schedule 13D filers. In Panel A we estimate the following specification: $itrade_{it} = \alpha + \gamma_1 pdvol_t + \gamma_2 mktrf_t + \gamma_3 liq_{it} + \epsilon_{it}$, where *itrade* indicates days on which Schedule 13D filers trade, *pdvol* is the percentage deviation of CRSP volume from its annual average level, *mktrf* is market return in excess of the risk-free rate, and liq_{it} is a measure of liquidity for company i on day t. The analysis is based on daily observations from 60 days before the filing day to the filing day, where the filing day is the day on which the Schedule 13D filing is submitted to the SEC. In Panel B we estimate the specification from Panel A, while adding event fixed effects: $itrade_{it} = \alpha + \gamma_1 pdvol_t + \gamma_2 mktrf_t + \gamma_3 liq_{it} + \eta_i + \epsilon_{it}$, where η_i are event fixed effects. In each column, we report estimated coefficients and their t-statistics, calculated using heteroscedasticity robust standard errors. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels.

	HIGH FREQUENCY MEASURES				LOW FREQUENCY MEASURES				
Liquidity Measure	$\lambda * 10^6$	*espread*	*rspread*	*pimpact*	*illiquidity*	*liquidity*	*baspread*	*zero*	*zero2*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A									
pdvol	0.0424***	0.0387***	0.0386***	0.0384***	0.0366***	0.0425***	0.0406***	0.0387***	0.0387***
	[3.27]	[3.49]	[3.48]	[3.45]	[3.33]	[3.77]	[3.64]	[3.48]	[3.48]
mktrf	-0.4180**	-0.3895**	-0.3757**	-0.3804**	-0.3993**	-0.4303**	-0.4182**	-0.3678**	-0.3678**
	[-2.06]	[-2.30]	[-2.22]	[-2.25]	[-2.38]	[-2.49]	[-2.46]	[-2.17]	[-2.17]
liq	-0.0010***	-1.1277***	-2.0175***	-0.8974***	-0.0903***	0.0010***	-1.8980***	0.0487***	0.0487***
	[-11.37]	[-11.53]	[-12.12]	[-8.68]	[-25.08]	[24.10]	[-16.19]	[4.45]	[4.45]
Constant	0.3917***	0.3645***	0.3615***	0.3580***	0.3807***	0.3200***	0.3712***	0.3500***	0.3500***
	[130.55]	[138.48]	[142.56]	[143.71]	[140.36]	[118.70]	[136.37]	[142.47]	[142.47]
Observations	29,884	39,783	39,783	39,783	39,783	37,678	39,357	39,783	39,783
Panel B									
pdvol	0.0785***	0.0636***	0.0630***	0.0636***	0.0621***	0.0650***	0.0654***	0.0638***	0.0638***
	[3.40]	[3.33]	[3.30]	[3.33]	[3.26]	[3.46]	[3.41]	[3.34]	[3.34]
mktrf	-0.4895**	-0.3312**	-0.3305**	-0.3271**	-0.3624**	-0.3569**	-0.3635**	-0.3247**	-0.3247**
	[-2.46]	[-2.08]	[-2.08]	[-2.05]	[-2.28]	[-2.17]	[-2.26]	[-2.04]	[-2.04]
liq	-0.0016***	-0.4222***	-1.0739***	-0.2438**	-0.0936***	0.0014***	-1.3199***	0.0444***	0.0444***
	[-8.24]	[-3.38]	[-4.60]	[-2.07]	[-10.27]	[10.90]	[-5.71]	[4.02]	[4.02]
Constant	0.3976***	0.3570***	0.3573***	0.3540***	0.3816***	0.3066***	0.3654***	0.3502***	0.3502***
	[192.88]	[271.24]	[346.11]	[497.26]	[134.70]	[77.17]	[160.01]	[597.62]	[597.62]
Observations	29,884	39,783	39,783	39,783	39,783	37,678	39,357	39,783	39,783